NAME : NIMMAGADDA NAGA VENKATA SAI KUMAR
UNIVERSITY : SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY
EMAIL : NAVSAIKUMAR@GMAIL.COM
MOBILE : 7569943524

RED WINE QUALITY PREDICTION

TASK :

Build a model to predict the quality of wine based on different input variables like fixed acidity of the wine, volatile acidity, citric acid, residual sugar, chlorides, free sulfur dioxide, total sulfur dioxide, density, sulphates, alcohol, quality etc. quality is dependent

Data Description : Use machine learning to determine which physiochemical properties make a wine 'good'!

STEPS

(1) Importing packages (2) Loading Dataset (3) Plotting Graphs (4) Pre-processing dataset (5) creating ML Model (6) Tuning

IMPORTING REQUIRED PACKAGES

Import pandas as pd import numpy as np import matplotlib.pyplot as plt import seaborn as sns

from sklearn.model_selection import train_test_split, GridSearchCV,cross_val_score from sklearn.preprocessing import StandardScaler from sklearn.ensemble import RandomForestClassifier from sklearn.svm import SVC from sklearn.metrics import confusion_matrix

LOADING DATASET

```
In [1]: /*setting dataset*/
wf.getfile("C:\\Users\\srikanthlakshmanpuram\\Desktop\\winequality-red.csv")
wf.getfile("winequality-red.csv")
```

Out[1]:

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	5
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.68	9.8	5
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.65	9.8	5
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.58	9.8	6
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.56	9.4	5

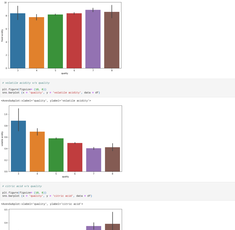
```
In [2]: df.info()
```

```
output: <class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 12 columns):
fixed acidity           1599 non-null float64
volatile acidity        1599 non-null float64
citric acid             1599 non-null float64
residual sugar          1599 non-null float64
chlorides               1599 non-null float64
free sulfur dioxide     1599 non-null float64
total sulfur dioxide    1599 non-null float64
density                 1599 non-null float64
pH                      1599 non-null float64
sulphates               1599 non-null float64
alcohol                 1599 non-null float64
quality                 1599 non-null int64
dtypes: float64(11), int64(1)
memory usage: 150.0 KB
```

PLOTING GRAPHS FOR BETTER INSIGHTS TO DATA DESTRIBUTION

```
In [3]: # fixed acidity vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'fixed acidity', data = df)
```

Out[3]:




```
In [4]: # volatile acidity vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'volatile acidity', data = df)
```

Out[4]:



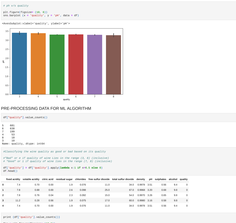

```
In [5]: # citric acid vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'citric acid', data = df)
```

Out[5]:



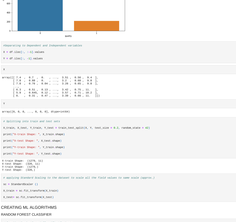

```
In [6]: # residual sugar vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'residual sugar', data = df)
```

Out[6]:




```
In [7]: # chlorides vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'chlorides', data = df)
```

Out[7]:




```
In [8]: # free sulfur dioxide vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'free sulfur dioxide', data = df)
```

Out[8]:




```
In [9]: # total sulfur dioxide vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'total sulfur dioxide', data = df)
```

Out[9]:

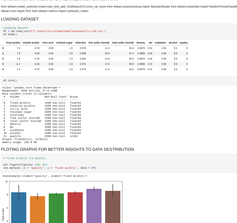



```
In [10]: # sulphates vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'sulphates', data = df)
```

Out[10]:


```
In [11]: # alcohol vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'alcohol', data = df)
```

Out[11]:




```
In [12]: # pH vs quality
plt.figure(figsize=(20, 8))
sns.barplot(x = 'quality', y = 'pH', data = df)
```

Out[12]:

PRE-PROCESSING DATA FOR ML ALGORITHM

```
In [13]: df['quality'].value_counts()
```

```
Out[13]: 5    681
         6    638
         7    199
         4     53
         8     18
         3     10
         Name: quality, dtype: int64
```

```
In [14]: # Understanding the wine quality as good or bad based on its quality

#"bad" if 0 quality of wine lie in the range of 0 (inclusive)
#"good" if 1 quality of wine lie in the range of 1 (inclusive)

df['quality'] = df['quality'].apply(lambda x: 'bad' if x<6 else 'good')
```

Out[14]:

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

```
In [15]: df['quality'].value_counts()
```

```
Out[15]: bad     1382
         good     217
         Name: quality, dtype: int64
```

```
In [16]: from sklearn.preprocessing import LabelEncoder
label = LabelEncoder()
df['quality'] = label.fit_transform(df['quality'])
```

```
In [17]: df['quality'].value_counts()
```

```
Out[17]: 0    1382
         1     217
         Name: quality, dtype: int64
```

```
In [18]: sns.countplot(df['quality'])
```

Out[18]:


```
In [19]: #Separating the dataset as response variable and feature variable
X = df.drop('quality', axis=1)
y = df['quality']
```

```
In [20]: X
```

```
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
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 [21]: y
```

```
Out[21]: 0       0
         1       0
         2       0
         3       0
         4       0
         5       0
         6       0
         7       0
         8       0
         9       0
         10      0
         11      0
         12      0
         13      0
         14      0
         15      0
         16      0
         17      0
         18      0
         19      0
         20      0
         21      0
         22      0
         23      0
         24      0
         25      0
         26      0
         27      0
         28      0
         29      0
         30      0
         31      0
         32      0
         33      0
         34      0
         35      0
         36      0
         37      0
         38      0
         39      0
         40      0
         41      0
         42      0
         43      0
         44      0
         45      0
         46      0
         47      0
         48      0
         49      0
         50      0
         51      0
         52      0
         53      0
         54      0
         55      0
         56      0
         57      0
         58      0
         59      0
         60      0
         61      0
         62      0
         63      0
         64      0
         65      0
         66      0
         67      0
         68      0
         69      0
         70      0
         71      0
         72      0
         73      0
         74      0
         75      0
         76      0
         77      0
         78      0
         79      0
         80      0
         81      0
         82      0
         83      0
         84      0
         85      0
         86      0
         87      0
         88      0
         89      0
         90      0
         91      0
         92      0
         93      0
         94      0
         95      0
         96      0
         97      0
         98      0
         99      0
         100     0
         101     0
         102     0
         103     0
         104     0
         105     0
         106     0
         107     0
         108     0
         109     0
         110     0
         111     0
         112     0
         113     0
         114     0
         115     0
         116     0
         117     0
         118     0
         119     0
         120     0
         121     0
         122     0
         123     0
         124     0
         125     0
         126     0
         127     0
         128     0
         129     0
         130     0
         131     0
         132     0
         133     0
         134     0
         135     0
         136     0
         137     0
         138     0
         139     0
         140     0
         141     0
         142     0
         143     0
         144     0
         145     0
         146     0
         147     0
         148     0
         149     0
         150     0
         151     0
         152     0
         153     0
         154     0
         155     0
         156     0
         157     0
         158     0
         159     0
         160     0
         161     0
         162     0
         163     0
         164     0
         165     0
         166     0
         167     0
         168     0
         169     0
         170     0
         171     0
         172     0
         173     0
         174     0
         175     0
         176     0
         177     0
         178     0
         179     0
         180     0
         181     0
         182     0
         183     0
         184     0
         185     0
         186     0
         187     0
         188     0
         189     0
         190     0
         191     0
         192     0
         193     0
         194     0
         195     0
         196     0
         197     0
         198     0
         199     0
         200     0
         201     0
         202     0
         203     0
         204     0
         205     0
         206     0
         207     0
         208     0
         209     0
         210     0
         211     0
         212     0
         213     0
         214     0
         215     0
         216     0
         217     0
         218     0
         219     0
         220     0
         221     0
         222     0
         223     0
         224     0
         225     0
         226     0
         227     0
         228     0
         229     0
         230     0
         231     0
         232     0
         233     0
         234     0
         235     0
         236     0
         237     0
         238     0
         239     0
         240     0
         241     0
         242     0
         243     0
         244     0
         245     0
         246     0
         247     0
         248     0
         249     0
         250     0
         251     0
         252     0
         253     0
         254     0
         255     0
         256     0
         257     0
         258     0
         259     0
         260     0
         261     0
         262     0
         263     0
         264     0
         265     0
         266     0
         267     0
         268     0
         269     0
         270     0
         271     0
         272     0
         273     0
         274     0
         275     0
         276     0
         277     0
         278     0
         279     0
         280     0
         281     0
         282     0
         283     0
         284     0
         285     0
         286     0
         287     0
         288     0
         289     0
         290     0
         291     0
         292     0
         293     0
         294     0
         295     0
         296     0
         297     0
         298     0
         299     0
         300     0
         301     0
         302     0
         303     0
         304     0
         305     0
         306     0
         307     0
         308     0
         309     0
         310     0
         311     0
         312     0
         313     0
         314     0
         315     0
         316     0
         317     0
         318     0
         319     0
         320     0
         321     0
         322     0
         323     0
         324     0
         325     0
         326     0
         327     0
         328     0
         329     0
         330     0
         331     0
         332     0
         333     0
         334     0
         335     0
         336     0
         337     0
         338     0
         339     0
         340     0
         341     0
         342     0
         343     0
         344     0
         345     0
         346     0
         347     0
         348     0
         349     0
         350     0
         351     0
         352     0
         353     0
         354     0
         355     0
         356     0
         357     0
         358     0
         359     0
         360     0
         361     0
         362     0
         363     0
         364     0
         365     0
         366     0
         367     0
         368     0
         369     0
         370     0
         371     0
         372     0
         373     0
         374     0
         375     0
         376     0
         377     0
         378     0
         379     0
         380     0
         381     0
         382     0
         383     0
         384     0
         385     0
         386     0
         387     0
         388     0
         389     0
         390     0
         391     0
         392     0
         393     0
         394     0
         395     0
         396     0
         397     0
         398     0
         399     0
         400     0
         401     0
         402     0
         403     0
         404     0
         405     0
         406     0
         407     0
         408     0
         409     0
         410     0
         411     0
         412     0
         413     0
         414     0
         415     0
         416     0
         417     0
         418     0
         419     0
         420     0
         421     0
         422     0
         423     0
         424     0
         425     0
         426     0
         427     0
         428     0
         429     0
         430     0
         431     0
         432     0
         433     0
         434     0
         435     0
         436     0
         437     0
         438     0
         439     0
         440     0
         441     0
         442     0
         443     0
         444     0
         445     0
         446     0
         447     0
         448     0
         449     0
         450     0
         451     0
         452     0
         453     0
         454     0
         455     0
         456     0
         457     0
         458     0
         459     0
         460     0
         461     0
         462     0
         463     0
         464     0
         465     0
         466     0
         467     0
         468     0
         469     0
         470     0
         471     0
         472     0
         473     0
         474     0
         475     0
         476     0
         477     0
         478     0
         479     0
         480     0
         481     0
         482     0
         483     0
         484     0
         485     0
         486     0
         487     0
         488     0
         489     0
         490     0
         491     0
         492     0
         493     0
         494     0
         495     0
         496     0
         497     0
         498     0
         499     0
         500     0
         501     0
         502     0
         503     0
         504     0
         505     0
         506     0
         507     0
         508     0
         509     0
         510     0
         511     0
         512     0
         513     0
         514     0
         515     0
         516     0
         517     0
         518     0
         519     0
         520     0
         521     0
         522     0
         523     0
         524     0
         525     0
         526     0
         527     0
         528     0
         529     0
         530     0
         531     0
         532     0
         533     0
         534     0
         535     0
         536     0
         537     0
         538     0
         539     0
         540     0
         541     0
         542     0
         543     0
         544     0
         545     0
         546     0
         547     0
         548     0
         549     0
         550     0
         551     0
         552     0
         553     0
         554     0
         555     0
         556     0
         557     0
         558     0
         559     0
         560     0
         561     0
         562     0
         563     0
         564     0
         565     0
         566     0
         567     0
         568     0
         569     0
         570     0
         571     0
         572     0
         573     0
         574     0
         575     0
         576     0
         577     0
         578     0
         579     0
         580     0
         581     0
         582     0
         583     0
         584     0
         585     0
         586     0
         587     0
         588     0
         589     0
         590     0
         591     0
         592     0
         593     0
         594     0
         595     0
         596     0
         597     0
         598     0
         599     0
         600     0
         601     0
         602     0
         603     0
         604     0
         605     0
         606     0
         607     0
         608     0
         609     0
         610     0
         611     0
         612     0
         613     0
         614     0
         615     0
         616     0
         617     0
         618     0
         619     0
         620     0
         621     0
         622     0
         623     0
         624     0
         625     0
         626     0
         627     0
         628     0
         629     0
         630     0
         631     0
         632     0
         633     0
         634     0
         635     0
         636     0
         637     0
         638     0
         639     0
         640     0
         641     0
         642     0
         643     0
         644     0
         645     0
         646     0
         647     0
         648     0
         649     0
         650     0
         651     0
         652     0
         653     0
         654     0
         655     0
         656     0
         657     0
         658     0
         659     0
         660     0
         661     0
         662     0
         663     0
         664     0
         665     0
         666     0
         667     0
         668     0
         669     0
         670     0
         671     0
         672     0
         673     0
         674     0
         675     0
         676     0
         677     0
         678     0
         679     0
         680     0
         681     0
         682     0
         683     0
         684     0
         685     0
         686     0
         687     0
         688     0
         689     0
         690     0
         691     0
         692     0
         693     0
         694     0
         695     0
         696     0
         697     0
         698     0
         699     0
         700     0
         701     0
         702     0
         703     0
         704     0
         705     0
         706     0
         707     0
         708     0
         709     0
         710     0
         711     0
         712     0
         713     0
         714     0
         715     0
         716     0
         717     0
         718     0
         719     0
         720     0
         721     0
         722     0
         723     0
         724     0
         725     0
         726     0
         727     0
         728     0
         729     0
         730     0
         731     0
         732     0
         733     0
         734     0
         735     0
         736     0
         737     0
         738     0
         739     0
         740     0
         741     0
         742     0
         743     0
         744     0
         745     0
         746     0
         747     0
         748     0
         749     0
         750     0
         751     0
         752     0
         753     0
         754     0
         755     0
         756     0
         757     0
         758     0
         759     0
         760     0
         761     0
         762     0
         763     0
         764     0
         765     0
         766     0
         767     0
         768     0
         769     0
         770     0
         771     0
         772     0
         773     0
         774     0
         775     0
         776     0
         777     0
         778     0
         779     0
         780     0
         781     0
         782     0
         783     0
         784     0
         785     0
         786     0
         787     0
         788     0
         789     0
         790     0
         791     0
         792     0
         793     0
         794     0
         795     0
         796     0
         797     0
         798     0
         799     0
         800     0
         801     0
         802     0
         803     0
         804     0
         805     0
         806     0
         807     0
         808     0
         809     0
         810     0
         811     0
         812     0
         813     0
         814     0
         815     0
         816     0
         817     0
         818     0
         819     0
         820     0
         821     0
         822     0
         823     0
         824     0
         825     0
         826     0
         827     0
         828     0
         829     0
         830     0
         831     0
         832     0
         833     0
         834     0
         835     0
         836     0
         837     0
         838     0
         839     0
         840     0
         841     0
         842     0
         843     0
         844     0
         845     0
         846     0
         847     0
         848     0
         849     0
         850     0
         851     0
         852     0
         853     0
         854     0
         855     0
         856     0
         857     0
         858     0
         859     0
         860     0
         861     0
         862     0
         863     0
         864     0
         865     0
         866     0
         867     0
         868     0
         869     0
         870     0
         871     0
         872     0
         873     0
         874     0
         875     0
         876     0
         877     0
         878     0
         879     0
         880     0
         881     0
         882     0
         883     0
         884     0
         885     0
         886     0
         887     0
         888     0
         889     0
         890     0
         891     0
         892     0
         893     0
         894     0
         895     0
         896     0
         897     0
         898     0
         899     0
         900     0
         901     0
         902     0
         903     0
         904     0
         905     0
         906     0
         907     0
         908     0
         909     0
         910     0
         911     0
         912     0
         913     0
         914     0
         915     0
         916     0
         917     0
         918     0
         919     0
         920     0
         921     0
         922     0
         923     0
         924     0
         925     0
         926     0
         927     0
         928     0
         929     0
         930     0
         931     0
         932     0
         933     0
         934     0
         935     0
         936     0
         937     0
         938     0
         939     0
         940     0
         941     0
         942     0
         943     0
         944     0
         945     0
         946     0
         947     0
         948     0
         949     0
         950     0
         951     0
         952     0
         953     0
         954     0
         955     0
         956     0
         957     0
         958     0
         959     0
         960     0
         961     0
         962     0
         963     0
         964     0
         965     0
         966     0
         967     0
         968     0
         969     0
         970     0
         971     0
         972     0
         973     0
         974     0
         975     0
         976     0
         977     0
         978     0
         979     0
         980     0
         981     0
         982     0
         983     0
         984     0
         985     0
         986     0
         987     0
         988     0
         989     0
         990     0
         991     0
         992     0
         993     0
         994     0
         995     0
         996     0
         997     0
         998     0
         999     0
         1000    0
         1001    0
         1002    0
         1003    0
         1004    0
         1005    0
         1006    0
         1007    0
         1008    0
         1009    0
         1010    0
         1011    0
         1012    0
         1013    0
         1014    0
         1015    0
         1016    0
         1017    0
         1018    0
         1019    0
         1020    0
         1021    0
         1022    0
         1023    0
         1024    0
         1025    0
         1026    0
         1027    0
         1028    0
         1029    0
         1030    0
         1031    0
         1032    0
         1033    0
         1034    0
         1035    0
         1036    0
         1037    0
         1038    0
         1039    0
         1040    0
         1041    0
         1042    0
         1043    0
         1044    0
         1045    0
         1046    0
         1047    0
         1048    0
         1049    0
         1050    0
         1051    0
         1052    0
         1053    0
         1054    0
         1055    0
         1056    0
         1057    0
         1058    0
         1059    0
         1060    0
         1061    0
         1062    0
         1063    0
         1064    0
         1065    0
         1066    0
         1067    0
         1068    0
         1069    0
         1070    0
         1071    0
         1072    0
         1073    0
         1074    0
         1075    0
         1076    0
         1077    0
         1078    0
         1079    0
         1080    0
         1081    0
         1082    0
         1083    0
         1084    0
         1085    0
         1086    0
         1087    0
         1088    0
         1089    0
         1090    0
         1091    0
         1092    0
         1093    0
         1094    0
         1095    0
         1096    0
         1097    0
         1098    0
         1099    0
         1100    0
         1101    0
         1102    0
         1103    0
         1104    0
         1105    0
         1106    0
         1107    0
         1108    0
         1109    0
         1110    0
         1111    0
         1112    0
         1113    0
         1114    0
         1115    0
         1116    0
         1117    0
         1118    0
         1119    0
         1120    0
         1121    0
         1122    0
         1123    0
         1124    0
         1125    0
         1126    0
         1127    0
         1128    0
         1129    0
         1130    0
         1131    0
         1132    0
         1133    0
         1134    0
         1135    0
         1136    0
         1137    0
         1138    0
         1139    0
         1140    0
         1141    0
         1142    0
         1143    0
         1144    0
         1145    0
         1146    0
         1147    0
         1148    0
         1149    0
         1150    0
         1151    0
         1152    0
         1153    0
         1154    0
         1155    0
         1156    0
         1157    0
         1158    0
         1159    0
         1160    0
         1161    0
         1162    0
         1163    0
         1164    0
         1165    0
         1166    0
         1167    0
         1168    0
         1169    0
         1170    0
         1171    0
         1172    0
         1173    0
         1174    0
         1175    0
         1176    0
         1177    0
         1178    0
         1179    0
         1180    0
         1181    0
         1182    0
         1183    0
         1184    0
         1185    0
         1186    0
         1187    0
         1188    0
         1189    0
         1190    0
         1191    0
         1192    0
         1193    0
         1194    0
         1195    0
         1196    0
         1197    0
         1198    0
         1199    0
         1200    0
         1201    0
         1202    0
         1203    0
         1204    0
         1205    0
         1206    0
         1207    0
         1208    0
         1209    0
         1210    0
         1211    0
         1212    0
         1213    0
         1214    0
         1215    0
         1216    0
         1217    0
         1218    0
         1219    0
         1220    0
         1221    0
         1222    0
         1223    0
         1224    0
         1225    0
         1226    0
         1227    0
         1228    0
         1229    0
         1230    0
         1231    0
         1232    0
         1233    0
         1234    0
         1235    0
         1236    0
         1237    0
         1238    0
         1239    0
         1240    0
         1241    0
         1242    0
         1243    0
         1244    0
         1245    0
         1246    0
         1247    0
         1248    0
         1249    0
         1250    0
         1251    0
         1252    0
         1253    0
         1254    0
         1255    0
         1256    0
         1257    0
         1258    0
         1259    0
         1260    0
         1261    0
         1262    0
         1263    0
         1264    0
         1265    0
         1266    0
         1267    0
         1268    0
         1269    0
         1270    0
         1271    0
         1272    0
         1273    0
         1274    0
         1275    0
         1276    0
         1277    0
         1278    0
         1279    0
         1280    0
         1281    0
         1282    0
         1283    0
         1284    0
         1285    0
         1286    0
         1287    0
         1288    0
         1289    0
         1290    0
         1291    0
         1292    0
         1293    0
         1294    0
         1295    0
         1296    0
         1297    0
         1298    0
         1299    0
         1300    0
         1301    0
         1302    0
         1303    0
         1304    0
         1305    0
         1306    0
         1307    0
         1308    0
         1309    0
         1310    0
         1311    0
         1312    0
         1313    0
         1314    0
         1315    0
         1316    0
         1317    0
         1318    0
         1319    0
         1320    0
         1321    0
         1322    0
         1323    0
         1324    0
         1325    0
         1326    0
         1327    0
         1328    0
         1329    0
         1330    0
         1331    0
         1332    0
         1333    0
         1334    0
         1335    0
         1336    0
         1337    0
         1338    0
         1339    0
         1340    0
         1341    0
         1342    0
         1343    0
         1344    0
         1345    0
         1346    0
         1347    0
         1348    0
         1349    0
         1350    0
         1351    0
         1352    0
         1353    0
         1354    0
         1355    0
         1356    0
         1357    0
         1358    0
         1359    0
         1360    0
         1361    0
         1362    0
         1363    0
         1364    0
         1365    0
         1366    0
         1367    0
         1368    0
         1369    0
         1370    0
         1371    0
         1372    0
         1373    0
         1374    0
         1375    0
         1376    0
         1377    0
         1378    0
         1379    0
         1380    0
         1381    0
         1382    0
         1383    0
         1384    0
         1385    0
         1386    0
         1387    0
         1388    0
         1389    0
         1390    0
         1391    0
         1392    0
         1393    0
         1394    0
         1395    0
         1396    0
         1397    0
         1398    0
         1399    0
         1400    0
         1401    0
         1402    0
         1403    0
         1404    0
         1405    0
         1406    0
         1407    0
         1408    0
         1409    0
         1410    0
         1411    0
         1412    0
         1413    0
         1414    0
         1415    0
         1416    0
         1417    0
         1418    0
         1419    0
         1420    0
         1421    0
         1422    0
         1423    0
         1424    0
         1425    0
         1426    0
         1427    0
         1428    0
         1429    0
         1430    0
         1431    0
         1432    0
         1433    0
         1434    0
         1435    0
         1436    0
         1437    0
         1438    0
         1439    0
         1440    0
         1441    0
         1442    0
         1443    0
         1444    0
         1445    0
         1446    0
         1447    0
         1448    0
         1449    0
         1450    0
         1451    0
         1452    0
         1453    0
         1454    0
         1455    0
         1456    0
         1457    0
         1458    0
         1459    0
         1460    0
         1461    0
         1462    0
         1463    0
         1464    0
         1465    0
         1466    0
         1467    0
         1468    0
         1469    0
         1470    0
         1471    0
         1472    0
         1473    0
         1474    0
         1475    0
         1476    0
         1477    0
         1478    0
         1479    0
         1480    0
         1481    0
         1482    0
         1483    0
         1484    0
         1485    0
         1486    0
         1487    0
         1488    0
         1489    0
         1490    0
         1491    0
         1492    0
         1493    0
         1494    0
         1495    0
         1496    0
         1497    0
         1498    0
         1499    0
         Name: quality, Length: 1599, dtype: int32
```

```
In [22]: #Splitting the data into train and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_state = 42)
```

```
In [23]: print("X_train shape: ", X_train.shape)
print("X_test shape: ", X_test.shape)
print("y_train shape: ", y_train.shape)
print("y_test shape: ", y_test.shape)
```

```
output: X_train shape:  (1279, 11)
        X_test shape:  (320, 11)
        y_train shape:  (1279,)
        y_test shape:  (320,)
```

```
In [24]: # applying Standard Scaling to the dataset to scale all the field values to same scale (mean )

sc = StandardScaler()

X_train = sc.fit_transform(X_train)
X_test = sc.fit_transform(X_test)
```

CREATING ML ALGORITHM

RANDOM FOREST CLASSIFIER

```
In [25]: # Creating Random Forest Classifier Instance

rf_regressor = RandomForestClassifier(n_estimators=200)
rf_regressor.fit(X_train, y_train)

# Predicting using Classifier
rf_pred = rf_regressor.predict(X_test)

# Confusion Matrix using the Random Forest Classifier

cm = confusion_matrix(y_test, rf_pred)

print(cm)

#Function for Confusion Matrix of Random Forest Classifier

fig= plt.figure(figsize=(10,6))

sns.heatmap(cm, cmap = plt.cm.Greens, interpolation = 'nearest')

plt.title('Confusion Matrix - Random Forest Classifier\n')

plt.colorbar()

plt.xlabel('Predicted Labels')

plt.ylabel('Actual Labels')

plt.show()
```

```
output: [[295  11]
         [ 10   4]]
```

Confusion Matrix - Random Forest Classifier


```
In [26]: print("Total Predictions : ", len(y_pred))
print("Accuracy Score : ", accuracy_score(y_test, rf_pred))
print("Precision : ", precision_score(y_test, rf_pred))
print("Recall : ", recall_score(y_test, rf_pred))
```

```
output: Total Predictions :  320
        Accuracy Score :  0.9375
        Precision :  0.2857142857142857
        Recall :  0.2857142857142857
```

SUPPORT VECTOR CLASSIFIER(SVC)

```
In [27]: svc_regressor = SVC()
svc_regressor.fit(X_train, y_train)
svc_pred = svc_regressor.predict(X_test)

cm = confusion_matrix(y_test, svc_pred)

print(cm)

fig= plt.figure(figsize=(10,6))

sns.heatmap(cm, cmap = plt.cm.Greens, interpolation = 'nearest')

plt.title('Confusion Matrix - Support Vector Classifier\n')

plt.colorbar()

plt.xlabel('Predicted Labels')

plt.ylabel('Actual Labels')

plt.show()
```

```
output: [[306   0]
         [ 14   0]]
```

Confusion Matrix - Support Vector Classifier


```
In [28]: print("Total Predictions : ", len(y_pred))
print("Accuracy Score : ", accuracy_score(y_test, svc_pred))
print("Precision : ", precision_score(y_test, svc_pred))
print("Recall : ", recall_score(y_test, svc_pred))
```

```
output: Total Predictions :  320
        Accuracy Score :  0.95625
        Precision :  0.0
        Recall :  0.0
```

TUNING ML ALGORITHM

SVC

```
In [29]: #Finding parameters for SVC models

param = {
    'C': [0.1, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4],
    'kernel': ['linear', 'rbf'],
    'gamma' :[0.1, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4]
}
```

```
In [30]: grid_svc = GridSearchCV(svc_regressor, param_grid = param, scoring = 'accuracy', cv = 10)
```

```
In [31]: grid_svc.fit(X_train, y_train)
```

```
Out[31]: GridSearchCV(cv=10, error_score='raise-deprecating',
             estimator=SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
               decision_function_shape='ovr', degree=3, gamma='auto_deprecated',
               kernel='rbf', max_iter=-1, probability=False, random_state=None,
               shrinking=True, tol=0.001, verbose=False),
             fit_params=None, iid='warn', n_jobs=None,
             param_grid={'C': [0.1, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4], 'kernel': ['linear', 'rbf'], 'gamma': [0.1, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4]},
             pre_dispatch='2*n_jobs', refit=True, return_train_score=False,
             scoring='accuracy', verbose=0)
```

```
In [32]: svc_regressor2 = SVC(C= 1.1, gamma= 0.9, kernel= 'rbf')

svc_regressor2.fit(X_train, y_train)

svc_pred2 = svc_regressor2.predict(X_test)

cm = confusion_matrix(y_test, svc_pred2)

print(cm)

fig= plt.figure(figsize=(10,6))

sns.heatmap(cm, cmap = plt.cm.Greens, interpolation = 'nearest')

plt.title('Confusion Matrix - Support Vector Classifier (Improved)\n')

plt.colorbar()

plt.xlabel('Predicted Labels')

plt.ylabel('Actual Labels')

plt.show()
```

```
output: [[306   0]
         [ 14   0]]
```

Confusion Matrix - Support Vector Classifier (Improved)


```
In [33]: print("Total Predictions : ", len(y_pred))
print("Accuracy Score : ", accuracy_score(y_test, svc_pred2))
print("Precision : ", precision_score(y_test, svc_pred2))
print("Recall : ", recall_score(y_test, svc_pred2))
```

```
output: Total Predictions :  320
        Accuracy Score :  0.95625
        Precision :  0.0
        Recall :  0.0
```

```
In [34]: rf_pred = grid_svc.predict(X_test.iloc[:,0:11].values)
cm = confusion_matrix(y_test, rf_pred)
```

```
In [35]: # PREDICTIONS
```

RESULT

(1) We created ML classifier for classifying wine as good or bad.

(2) The dataset contained 1599 records and 12 fields.

(3) Random Forest Classifier Classifier with an accuracy of 95.0%(approx) , and 90%(approx) after tunings

(4) SVC classifier with an accuracy of 90%(approx), and 90%(approx) after tuning.