Feature Selection

VarianceThreshold

Step 1: Import Necessary Libraries

-

In [526…

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

Step 2: Create or Load the Dataset

-

In [529…

```
df = pd.read_csv(r"C:\Users\HP\Documents\Naresh IT\Data file\winequality_red.csv
df
```

Out[529…

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulph
0	7.4	0.700	0.00	1.9	0.076	11.0	34.0	0.99780	3.51	
1	7.8	0.880	0.00	2.6	0.098	25.0	67.0	0.99680	3.20	
2	7.8	0.760	0.04	2.3	0.092	15.0	54.0	0.99700	3.26	
3	11.2	0.280	0.56	1.9	0.075	17.0	60.0	0.99800	3.16	
4	7.4	0.700	0.00	1.9	0.076	11.0	34.0	0.99780	3.51	
...	...	...	...	...	...	...	...	...	...	
1594	6.2	0.600	0.08	2.0	0.090	32.0	44.0	0.99490	3.45	
1595	5.9	0.550	0.10	2.2	0.062	39.0	51.0	0.99512	3.52	
1596	6.3	0.510	0.13	2.3	0.076	29.0	40.0	0.99574	3.42	
1597	5.9	0.645	0.12	2.0	0.075	32.0	44.0	0.99547	3.57	
1598	6.0	0.310	0.47	3.6	0.067	18.0	42.0	0.99549	3.39	

1599 rows × 12 columns

Step 3: Splits X-y column

-

In [532…

```
X=df.drop('quality',axis=1)  # select the input columns
y=df['quality'] # select the output
df.shape,X.shape,y.shape
```

Out[532…

```
((1599, 12), (1599, 11), (1599,))
```

Apply Variance Threshold

-

In [535…

```
from sklearn.feature_selection import VarianceThreshold
vt=VarianceThreshold(threshold=0.3)
```

In [537…

```
vt.fit(X)
```

Out[537…

```
▾ VarianceThreshold
VarianceThreshold(threshold=0.3)
```

In [539…

```
vt.variances_
```

Out[539…

```
array([3.02952057e+00, 3.20423261e-02, 3.79237511e-02, 1.98665392e+00,
       2.21375732e-03, 1.09346457e+02, 1.08142564e+03, 3.55980179e-06,
       2.38202742e-02, 2.87146470e-02, 1.13493717e+00])
```

In [541…

```
vt.get_support()
```

Out[541…

```
array([ True, False, False,  True, False,  True,  True, False, False,
       False,  True])
```

Feature Selection-How To Drop Features Using Pearson Correlation

In [544…

```
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=

print(X_train.shape,X_test.shape,y_train.shape,y_test.shape)
```

```
(1279, 11) (320, 11) (1279,) (320,)
```

In [546…

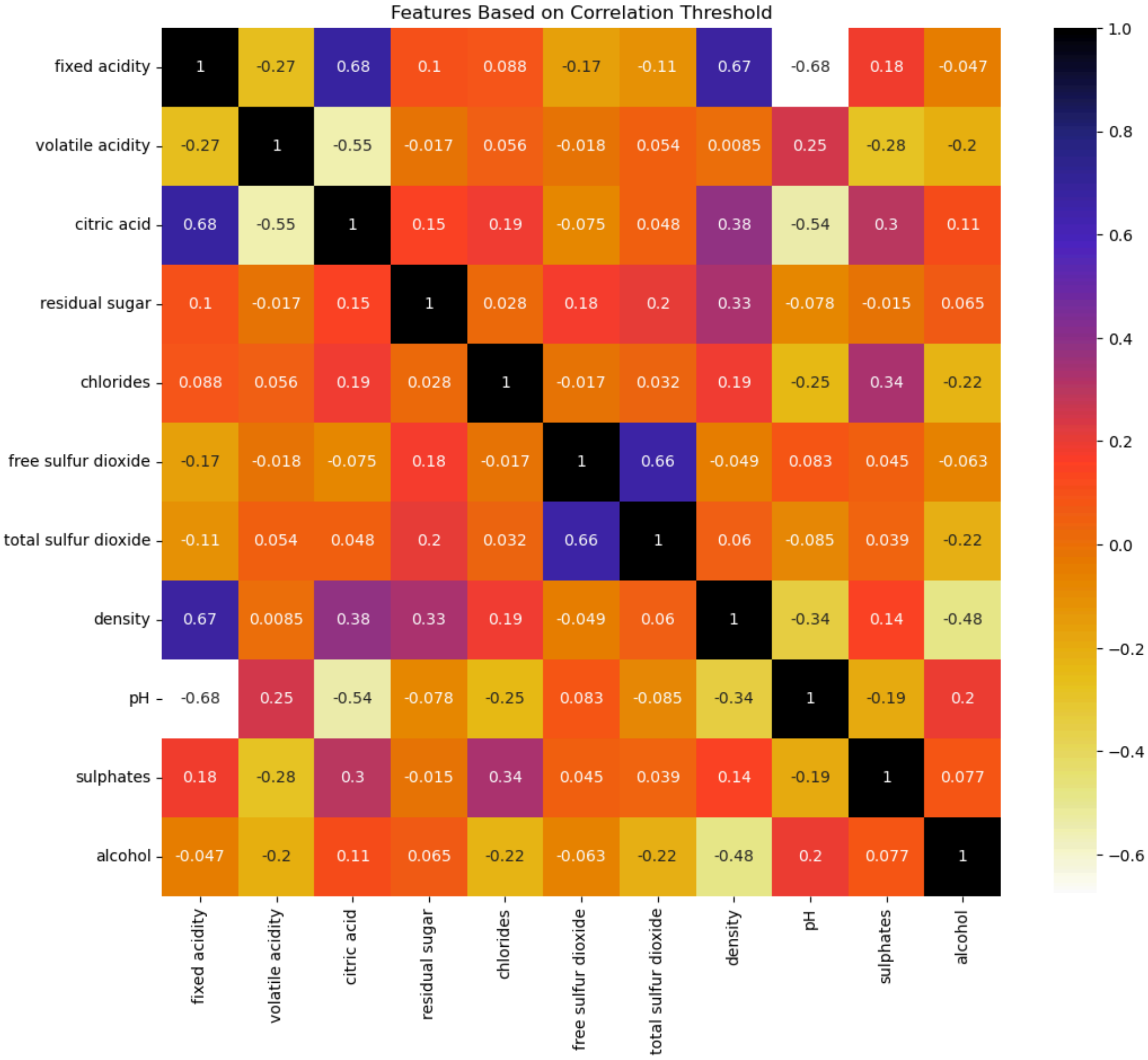
```
corr = X_train.corr()
corr
```

Out[546...

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	
fixed acidity	1.000000	-0.267924	0.679876	0.104657	0.087915	-0.168020	-0.108836	(
volatile acidity	-0.267924	1.000000	-0.550238	-0.017290	0.056300	-0.018207	0.054028	(
citric acid	0.679876	-0.550238	1.000000	0.148050	0.188716	-0.074663	0.047871	(
residual sugar	0.104657	-0.017290	0.148050	1.000000	0.027555	0.177538	0.201606	(
chlorides	0.087915	0.056300	0.188716	0.027555	1.000000	-0.016669	0.031555	(
free sulfur dioxide	-0.168020	-0.018207	-0.074663	0.177538	-0.016669	1.000000	0.661843	-(
total sulfur dioxide	-0.108836	0.054028	0.047871	0.201606	0.031555	0.661843	1.000000	(
density	0.669151	0.008512	0.378511	0.332520	0.190066	-0.049243	0.059614	1
pH	-0.680823	0.247491	-0.537238	-0.077903	-0.245936	0.082737	-0.084805	-(
sulphates	0.183105	-0.280754	0.300356	-0.014920	0.335765	0.045379	0.038650	(
alcohol	-0.046890	-0.202691	0.109209	0.065280	-0.223375	-0.062984	-0.216920	-(

In [548...

```
plt.figure(figsize=(12,10))
plt.title('Features Based on Correlation Threshold')
sns.heatmap(corr,annot=True, cmap=plt.cm.CMRmap_r)
plt.savefig('Features Based on Correlation Threshold.png')
plt.show()
```



In [550…

```python
def correlation(dataset, threshold):
    col_corr=set()
    corr_mateix = dataset.corr()
    for i in range(len(corr_mateix.columns)):
        for j in range(i):
            if abs(corr_matrix.iloc[i,j])>threshold:
                colname = corr_mateix.columns[i]
                col_corr.add(colname)
    return col_corr
```

In [552…

```python
corr_features = correlation(X_train,0.7)
len(set(corr_features))
corr_features
```

Out[552…

```
set()
```

In [554…

```python
X_train.drop(corr_features,axis=1)
X_test.drop(corr_features,axis=1)
```

Out[554…

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulph
688	7.7	0.660	0.04	1.6	0.039	4.0	9.0	0.99620	3.40	
961	7.1	0.560	0.14	1.6	0.078	7.0	18.0	0.99592	3.27	
726	8.1	0.720	0.09	2.8	0.084	18.0	49.0	0.99940	3.43	
537	8.1	0.825	0.24	2.1	0.084	5.0	13.0	0.99720	3.37	
1544	8.4	0.370	0.43	2.3	0.063	12.0	19.0	0.99550	3.17	
...	...	...	...	...	...	...	...	...	...	
351	9.1	0.795	0.00	2.6	0.096	11.0	26.0	0.99940	3.35	
415	8.6	0.725	0.24	6.6	0.117	31.0	134.0	1.00140	3.32	
564	13.0	0.470	0.49	4.3	0.085	6.0	47.0	1.00210	3.30	
1124	6.5	0.580	0.00	2.2	0.096	3.0	13.0	0.99557	3.62	
147	7.6	0.490	0.26	1.6	0.236	10.0	88.0	0.99680	3.11	

320 rows × 11 columns

Select Features Using Information Gain

-

it is a method of selecting the most relevent features for a model by meansuring how much each feature contributes to the target variable

In [558…

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

df = pd.read_csv(r"C:\Users\HP\Documents\Naresh IT\Data file\winequality_red.csv
df.head()
```

Out[558…

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphate
0	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.5
1	7.8	0.88	0.00	2.6	0.098	25.0	67.0	0.9968	3.20	0.6
2	7.8	0.76	0.04	2.3	0.092	15.0	54.0	0.9970	3.26	0.6
3	11.2	0.28	0.56	1.9	0.075	17.0	60.0	0.9980	3.16	0.5
4	7.4	0.70	0.00	1.9	0.076	11.0	34.0	0.9978	3.51	0.5

In [560…

```
df['fixed acidity'].unique()
```

Out[560... array([7.4, 7.8, 11.2, 7.9, 7.3, 7.5, 6.7, 5.6, 8.9, 8.5, 8.1,
                 7.6, 6.9, 6.3, 7.1, 8.3, 5.2, 5.7, 8.8, 6.8, 4.6, 7.7,
                 8.7, 6.4, 6.6, 8.6, 10.2, 7. , 7.2, 9.3, 8. , 9.7, 6.2,
                 5. , 4.7, 8.4, 10.1, 9.4, 9. , 8.2, 6.1, 5.8, 9.2, 11.5,
                 5.4, 9.6, 12.8, 11. , 11.6, 12. , 15. , 10.8, 11.1, 10. , 12.5,
                11.8, 10.9, 10.3, 11.4, 9.9, 10.4, 13.3, 10.6, 9.8, 13.4, 10.7,
                11.9, 12.4, 12.2, 13.8, 9.1, 13.5, 10.5, 12.6, 14. , 13.7, 9.5,
                12.7, 12.3, 15.6, 5.3, 11.3, 13. , 6.5, 12.9, 14.3, 15.5, 11.7,
                13.2, 15.9, 12.1, 5.1, 4.9, 5.9, 6. , 5.5])

In [562...
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 12 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   fixed acidity         1599 non-null   float64
 1   volatile acidity      1599 non-null   float64
 2   citric acid           1599 non-null   float64
 3   residual sugar        1599 non-null   float64
 4   chlorides             1599 non-null   float64
 5   free sulfur dioxide   1599 non-null   float64
 6   total sulfur dioxide  1599 non-null   float64
 7   density               1599 non-null   float64
 8   pH                    1599 non-null   float64
 9   sulphates             1599 non-null   float64
 10  alcohol               1599 non-null   float64
 11  quality               1599 non-null   int64  
dtypes: float64(11), int64(1)
memory usage: 150.0 KB
```

In [ ]:

In [ ]:

In [ ]:

In [567...
```
X=df.drop('quality',axis=1)  # select the input columns
y=df['quality'] # select the output
df.shape,X.shape,y.shape
```

Out[567... ((1599, 12), (1599, 11), (1599,))

In [569...
```
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=

print(X_train.shape,X_test.shape,y_train.shape,y_test.shape)
```

(1279, 11) (320, 11) (1279,) (320,)

In [571...
```
from sklearn.feature_selection import mutual_info_classif
mutual_info = mutual_info_classif(X_train,y_train)
mutual_info
```

Out[571... array([0.04846914, 0.14095619, 0.05092167, 0.03110906, 0.05635836,
       0.03748618, 0.07452345, 0.09033489, 0.01726703, 0.11533924,
       0.15444002])

In [573…

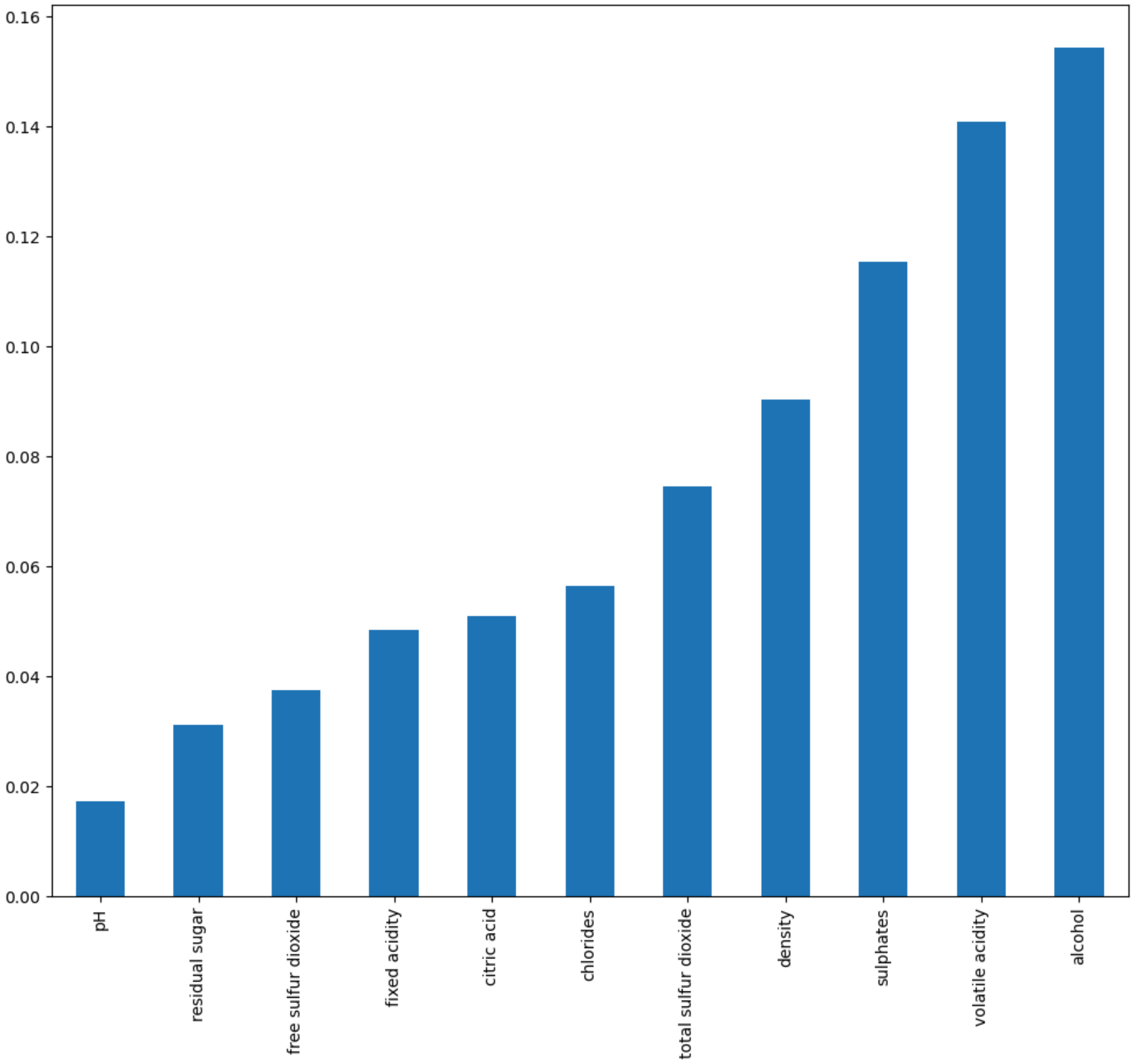
```
mutual_info = pd.Series(mutual_info)
mutual_info.index = X_train.columns
mutual_info.sort_values(ascending=False)
```

Out[573…

```
alcohol                 0.154440
volatile acidity        0.140956
sulphates               0.115339
density                 0.090335
total sulfur dioxide    0.074523
chlorides               0.056358
citric acid             0.050922
fixed acidity           0.048469
free sulfur dioxide     0.037486
residual sugar          0.031109
pH                      0.017267
dtype: float64
```

In [575…

```
mutual_info.sort_values(ascending=True).plot.bar(figsize=(12,10))
plt.savefig('Information Gain.png')
```



SelectKBest

-

In [578…

```
from sklearn.feature_selection import SelectKBest
```

In [580…

```
sel_five_cols = SelectKBest(mutual_info_classif, k = 5)
sel_five_cols.fit(X_train.fillna(0),y_train)
X_train.columns[sel_five_cols.get_support()]
```

Out[580…

```
Index(['volatile acidity', 'chlorides', 'density', 'sulphates', 'alcohol'], dty
pe='object')
```

Feature Selection-Perform Feature Selection Using Information Gain For Regression In ML

-

In [583…

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

df = pd.read_csv(r"C:\Users\HP\Documents\Naresh IT\Data file\winequality_red.csv
df.head()
```

Out[583…

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

In [585…

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599 entries, 0 to 1598
Data columns (total 12 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   fixed acidity         1599 non-null   float64
 1   volatile acidity      1599 non-null   float64
 2   citric acid           1599 non-null   float64
 3   residual sugar        1599 non-null   float64
 4   chlorides             1599 non-null   float64
 5   free sulfur dioxide   1599 non-null   float64
 6   total sulfur dioxide  1599 non-null   float64
 7   density               1599 non-null   float64
 8   pH                    1599 non-null   float64
 9   sulphates             1599 non-null   float64
 10  alcohol               1599 non-null   float64
 11  quality               1599 non-null   int64  
dtypes: float64(11), int64(1)
memory usage: 150.0 KB
```

In [587…

```
numeric_lst=list(df.select_dtypes(exclude='object').columns)
```

In [589…
```
numeric_lst
```
Out[589…
```
['fixed acidity',
 'volatile acidity',
 'citric acid',
 'residual sugar',
 'chlorides',
 'free sulfur dioxide',
 'total sulfur dioxide',
 'density',
 'pH',
 'sulphates',
 'alcohol',
 'quality']
```
In [591…
```
X=df.drop('quality',axis=1)  # select the input columns
y=df['quality'] # select the output
df.shape,X.shape,y.shape
```
Out[591…
```
((1599, 12), (1599, 11), (1599,))
```
In [593…
```
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=

print(X_train.shape,X_test.shape,y_train.shape,y_test.shape)
```
```
(1279, 11) (320, 11) (1279,) (320,)
```
In [595…
```
X_train
```
Out[595…

	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulph
441	11.9	0.40	0.65	2.15	0.068	7.0	27.0	0.99880	3.06	
227	9.0	0.82	0.14	2.60	0.089	9.0	23.0	0.99840	3.39	
1386	7.4	0.64	0.07	1.80	0.100	8.0	23.0	0.99610	3.30	
1245	7.4	0.55	0.19	1.80	0.082	15.0	34.0	0.99655	3.49	
60	8.8	0.40	0.40	2.20	0.079	19.0	52.0	0.99800	3.44	
...	...	...	...	...	...	...	...	...	...	
1228	5.1	0.42	0.00	1.80	0.044	18.0	88.0	0.99157	3.68	
1077	8.6	0.37	0.65	6.40	0.080	3.0	8.0	0.99817	3.27	
1318	7.5	0.63	0.27	2.00	0.083	17.0	91.0	0.99616	3.26	
723	7.1	0.31	0.30	2.20	0.053	36.0	127.0	0.99650	2.94	
815	10.8	0.45	0.33	2.50	0.099	20.0	38.0	0.99818	3.24	

1279 rows × 11 columns

In [597…
```
X_train.isnull().sum()
```

Out[597…

```
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
dtype: int64
```

In [599…

```
from sklearn.feature_selection import mutual_info_regression
mutual_regr = mutual_info_regression(X_train.fillna(0),y_train)
mutual_regr
```

Out[599…

```
array([0.0416753 , 0.1388615 , 0.05116235, 0.00617849, 0.05656146,
       0.0246472 , 0.08607223, 0.09446549, 0.05667224, 0.10660919,
       0.1670758 ])
```

In [601…

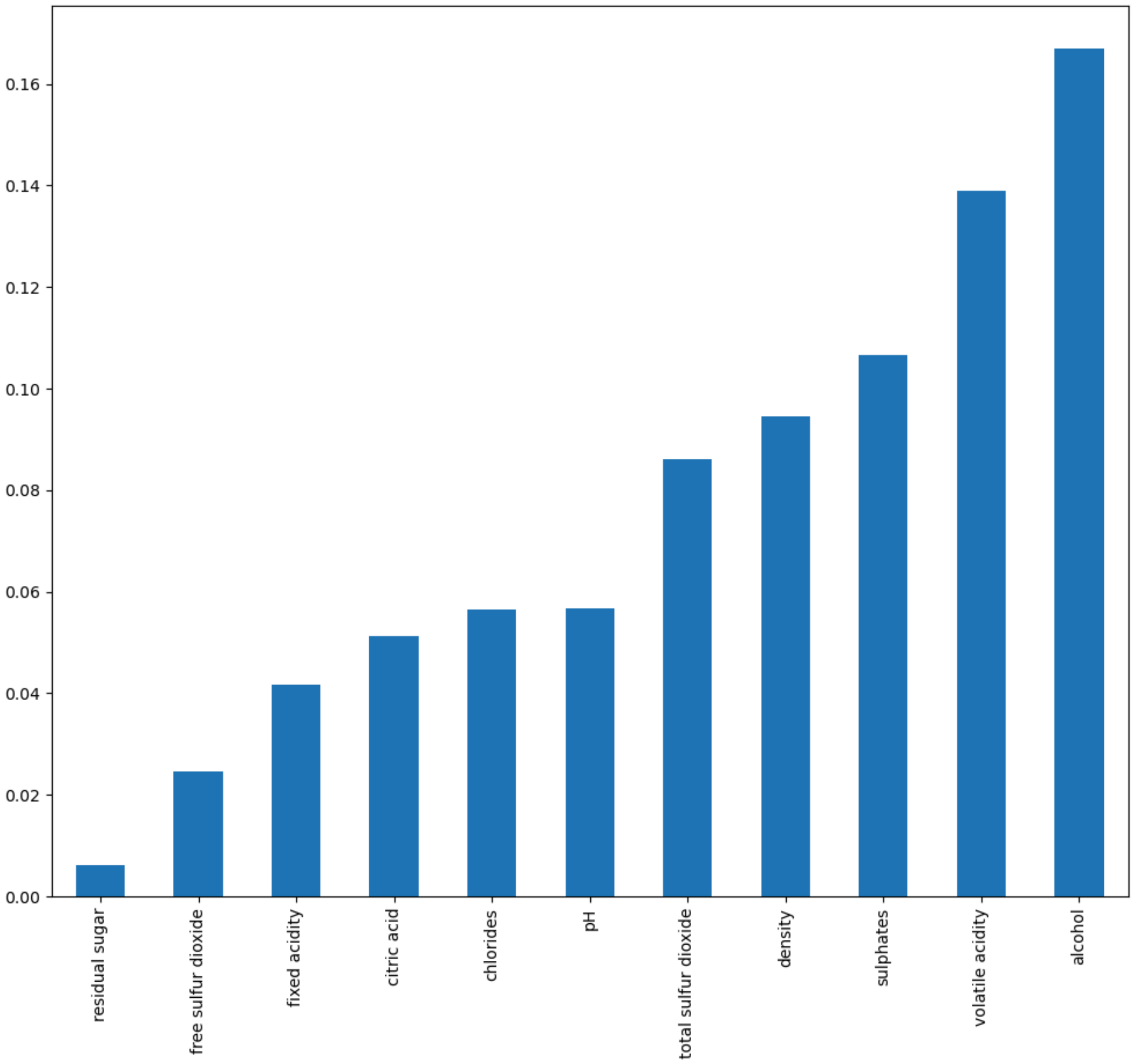
```
mutual_regr = pd.Series(mutual_regr)
mutual_regr.index = X_train.columns
mutual_regr.sort_values(ascending=False)
```

Out[601…

```
alcohol                 0.167076
volatile acidity        0.138861
sulphates               0.106609
density                 0.094465
total sulfur dioxide    0.086072
pH                      0.056672
chlorides               0.056561
citric acid             0.051162
fixed acidity           0.041675
free sulfur dioxide     0.024647
residual sugar          0.006178
dtype: float64
```

In [603…

```
mutual_regr.sort_values(ascending=True).plot.bar(figsize=(12,10))
plt.savefig('Information Gain For Regression.png')
```


0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
residual sugar
free sulfur dioxide
fixed acidity
citric acid
chlorides
pH
total sulfur dioxide
density
sulphates
volatile acidity
alcohol

In [ ]: