Machine Learning November Minor Project

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create a classification model to predict the price range of the mobile based on the certian specification.

importing all the required libraries:

In [82]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

import warnings
warnings.filterwarnings("ignore")
```

In [83]:
```
df = pd.read_excel('mobile_price_range_data.xlsx')
df.head()
```

Out[83]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_cores
0	842	0	2.2	0	1	0	7	0.6	188	2
1	1021	1	0.5	1	0	1	53	0.7	136	3
2	563	1	0.5	1	2	1	41	0.9	145	5
3	615	1	2.5	0	0	0	10	0.8	131	6
4	1821	1	1.2	0	13	1	44	0.6	141	2

5 rows × 21 columns

In [84]:
```
df.tail()
```

Out[84]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_co
1995	794	1	0.5	1	0	1	2	0.8	106	
1996	1965	1	2.6	1	0	0	39	0.2	187	
1997	1911	0	0.9	1	1	1	36	0.7	108	
1998	1512	0	0.9	0	4	1	46	0.1	145	
1999	510	1	2.0	1	5	1	45	0.9	168	

5 rows × 21 columns

In [85]:
```
df.shape
```

Out[85]:
```
(2000, 21)
```

Target variable

In [86]:
```
df['price_range'].value_counts()
```

Out[86]:
```
1    500
2    500
3    500
0    500
Name: price_range, dtype: int64
```

removing null values in the dataset.

In [87]:
```
df.isnull().sum()
```

Out[87]:
```
battery_power    0
blue             0
clock_speed      0
dual_sim         0
fc               0
four_g           0
int_memory       0
m_dep            0
mobile_wt        0
n_cores          0
pc               0
px_height        0
px_width         0
ram              0
sc_h             0
sc_w             0
talk_time        0
three_g          0
touch_screen     0
wifi             0
price_range      0
dtype: int64
```

handling dupilcate values in the given dataset:

In [88]:
```
df.duplicated().sum()
```

Out[88]:
```
0
```

In [89]:
```
df.drop_duplicates(inplace=True)
df.duplicated().sum()
```

Out[89]:
```
0
```

checking datatypes in the given dataset

In [90]:
```
df.dtypes
```

Out[90]:
```
battery_power      int64
blue               int64
clock_speed      float64
dual_sim           int64
fc                 int64
four_g             int64
int_memory         int64
m_dep            float64
mobile_wt          int64
n_cores            int64
pc                 int64
px_height          int64
px_width           int64
ram                int64
sc_h               int64
sc_w               int64
talk_time          int64
three_g            int64
touch_screen       int64
wifi               int64
price_range        int64
dtype: object
```

Selecting dependents(x) and independents(y) variables :

In [91]:
```
x = df.drop('price_range',axis=1)
y = df['price_range']
print(type(x))
print(type(y))
print(x.shape)
print(y.shape)
#x_train,y_train i.e x and y (train)
```

```
<class 'pandas.core.frame.DataFrame'>
<class 'pandas.core.series.Series'>
(2000, 20)
(2000,)
```

splitting data into training and test data

In [92]:
```
from sklearn.model_selection import train_test_split
```

In [93]:
```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.25,random_state=42)
print(x_train.shape)
print(y_train.shape)
print(x_test.shape)
print(y_test.shape)
```

```
(1500, 20)
(1500,)
(500, 20)
(500,)
```

confusion matrix

In [94]:
```
from sklearn.metrics import confusion_matrix,classification_report
```

In [95]:
```
def eval_model(y_test,ypred):
    cm=confusion_matrix(y_test,ypred)
    print("confusion matrix:")
    print(cm)
    print("\n\n")
    print("classification report:")
    print(classification_report(y_test,ypred))

def mscore(model):
    print('Training score',model.score(x_train,y_train))
    print('Testing score',model.score(x_test,y_test))
```

Applying all the following models on training dataset to generate the predicted value for the test dataset

a) Logistic Regression

In [96]:
```
from sklearn.linear_model import LogisticRegression
```

In [97]:
```
m1 = LogisticRegression(max_iter=10000,solver='liblinear')
m1.fit(x_train,y_train)
```

Out[97]:
```
LogisticRegression(max_iter=10000, solver='liblinear')
```

In [98]:
```
mscore(m1)
```

```
Training score 0.794
Testing score 0.786
```

In [99]:
```
ypred_m1=m1.predict(x_test)
eval_model(y_test,ypred_m1)
```

```
confusion matrix:
[[123   7   2   0]
 [ 13  72  33   0]
 [  0  24  72  24]
 [  0   0   4 126]]
```

```
classification report:
              precision    recall  f1-score   support

           0       0.90      0.93      0.92       132
           1       0.70      0.61      0.65       118
           2       0.65      0.60      0.62       120
           3       0.84      0.97      0.90       130

    accuracy                           0.79       500
   macro avg       0.77      0.78      0.77       500
weighted avg       0.78      0.79      0.78       500
```

b) KNN Classification:

In [105…
```
from sklearn.neighbors import KNeighborsClassifier
```

In [106…
```
m2 = KNeighborsClassifier(n_neighbors=23)
m2.fit(x_train,y_train)
```

Out[106]:
```
KNeighborsClassifier(n_neighbors=23)
```

In [107…
```
mscore(m2)
```

```
Training score 0.942
Testing score 0.94
```

In [108…
```
ypred_m2 = m2.predict(x_test)
eval_model(y_test,ypred_m2)
```

```
confusion matrix:
[[128   4   0   0]
 [  5 112   1   0]
 [  0   9 107   4]
 [  0   0   7 123]]
```

```
classification report:
              precision    recall  f1-score   support

           0       0.96      0.97      0.97       132
           1       0.90      0.95      0.92       118
           2       0.93      0.89      0.91       120
           3       0.97      0.95      0.96       130

    accuracy                           0.94       500
   macro avg       0.94      0.94      0.94       500
weighted avg       0.94      0.94      0.94       500
```

c) SVM Classifier with linear and rbf kernel

In [116…
```
from sklearn.svm import SVC
```

In [120…
```
m3 = SVC(kernel='linear',C=1)
m3.fit(x_train,y_train)
```

Out[120]:
```
SVC(C=1, kernel='linear')
```

In [121…
```
mscore(m3)
```

```
Training score 0.992
Testing score 0.97
```

In [122…
```
ypred_m3=m3.predict(x_test)
eval_model(y_test,ypred_m3)
```

```
confusion matrix:
[[127   5   0   0]
 [  1 117   0   0]
 [  0   3 112   5]
 [  0   0   1 129]]



classification report:
              precision    recall  f1-score   support

           0       0.99      0.96      0.98       132
           1       0.94      0.99      0.96       118
           2       0.99      0.93      0.96       120
           3       0.96      0.99      0.98       130

    accuracy                           0.97       500
   macro avg       0.97      0.97      0.97       500
weighted avg       0.97      0.97      0.97       500
```

d) Decision Tree Classifier:

In [100…
```
from sklearn.tree import DecisionTreeClassifier
```

In [101…
```
m4=DecisionTreeClassifier(criterion='entropy',max_depth=5)
m4.fit(x_train,y_train)
```

Out[101]:
```
DecisionTreeClassifier(criterion='entropy', max_depth=5)
```

In [102…
```
mscore(m4)
```

```
Training score 0.8793333333333333
Testing score 0.826
```

In [103…
```
ypred_m4=m4.predict(x_test)
eval_model(y_test,ypred_m4)
```

```
confusion matrix:
[[121  11   0   0]
 [ 11  97  10   0]
 [  0  19  82  19]
 [  0   0  17 113]]
```

```
classification report:
              precision    recall  f1-score   support

           0       0.92      0.92      0.92       132
           1       0.76      0.82      0.79       118
           2       0.75      0.68      0.72       120
           3       0.86      0.87      0.86       130

    accuracy                           0.83       500
   macro avg       0.82      0.82      0.82       500
weighted avg       0.83      0.83      0.83       500
```

e) Random Forest Classifier

In [109…
```
from sklearn.ensemble import RandomForestClassifier
```

In [112…
```
m5 = RandomForestClassifier(n_estimators=80,criterion='entropy',max_depth=7)
m5.fit(x_train,y_train)
```

Out[112]:
```
RandomForestClassifier(criterion='entropy', max_depth=7, n_estimators=80)
```

In [113…
```
mscore(m5)
```

```
Training score 0.9753333333333334
Testing score 0.86
```

In [115…
```
ypred_m5 = m5.predict(x_test)
eval_model(y_test,ypred_m5)
```

```
confusion matrix:
[[124   8   0   0]
 [ 10  96  12   0]
 [  0  17  88  15]
 [  0   0   8 122]]
```

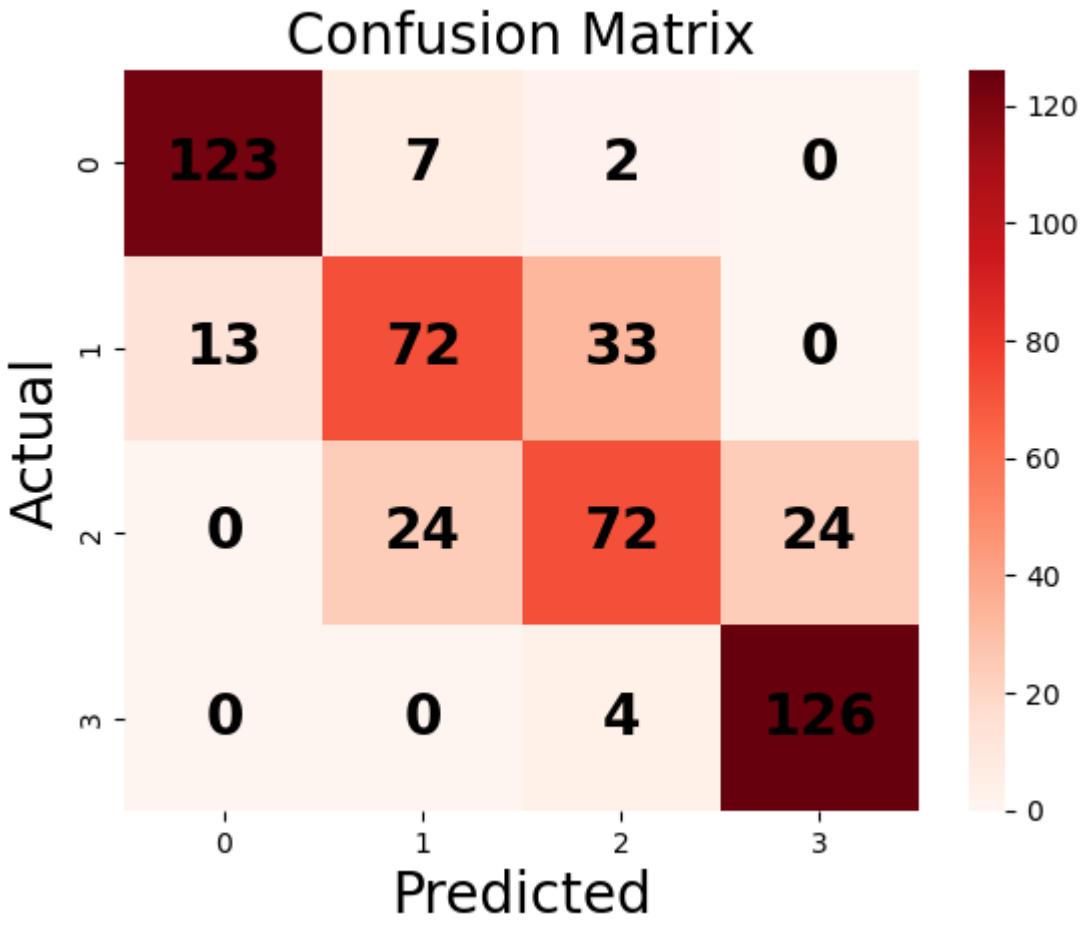
```
classification report:
              precision    recall  f1-score   support

           0       0.93      0.94      0.93       132
           1       0.79      0.81      0.80       118
           2       0.81      0.73      0.77       120
           3       0.89      0.94      0.91       130

    accuracy                           0.86       500
   macro avg       0.86      0.86      0.86       500
weighted avg       0.86      0.86      0.86       500
```

Data visualisatiion by seaborn graphs

a) logistic regression model confusion matrix:

In [130…
```
cm=confusion_matrix(y_test,ypred_m1)
sns.heatmap(cm, annot=True, cmap='Reds', fmt='d',annot_kws={"size": 20,'weight':'bold'
plt.title("Confusion Matrix", fontsize=20)
plt.xlabel("Predicted", fontsize=20)
plt.ylabel("Actual", fontsize=20)
```

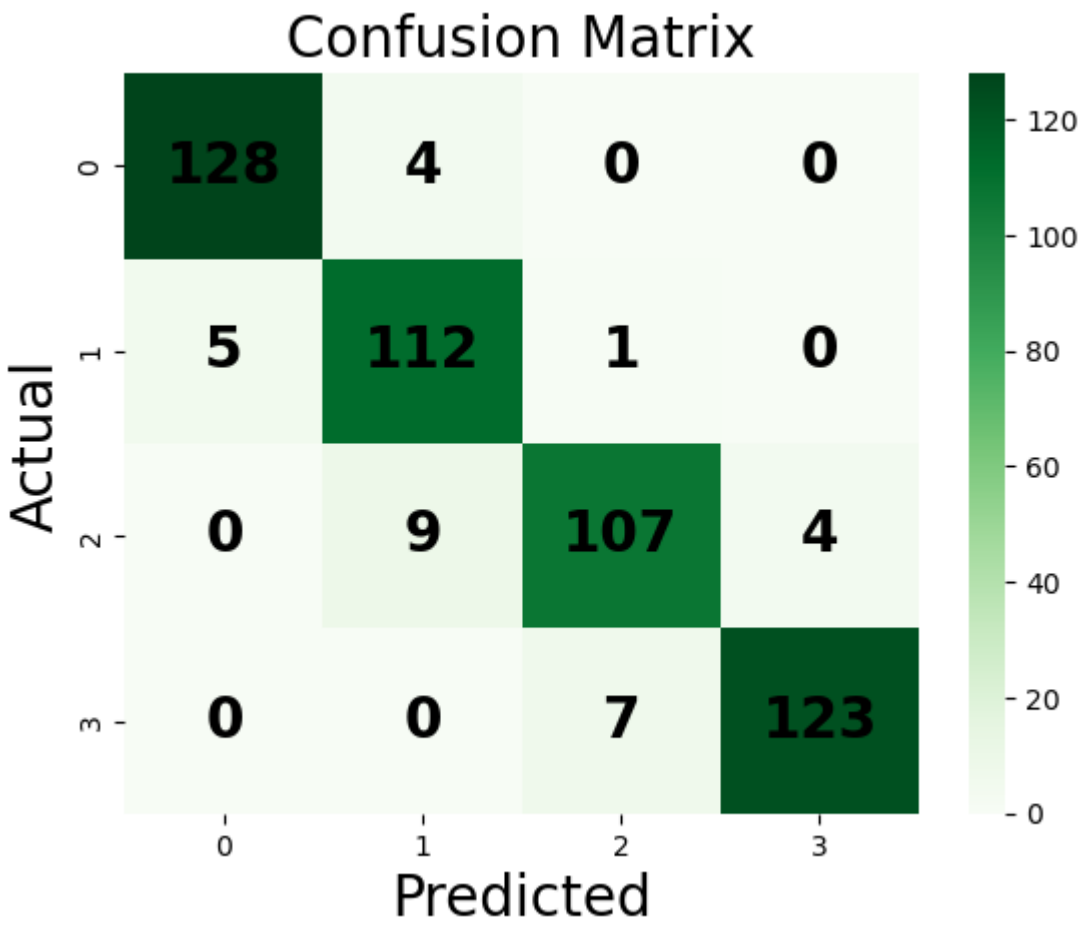
Out[130]:
```
Text(50.722222222222214, 0.5, 'Actual')
```



b) KNN classification confusion matrix:

In [147…
```
cm=confusion_matrix(y_test,ypred_m2)
sns.heatmap(cm, annot=True, cmap='Greens', fmt='d',annot_kws={"size": 20,'weight':'bol
plt.title("Confusion Matrix", fontsize=20)
plt.xlabel("Predicted", fontsize=20)
plt.ylabel("Actual", fontsize=20)
```

Out[147]:
```
Text(50.722222222222214, 0.5, 'Actual')
```



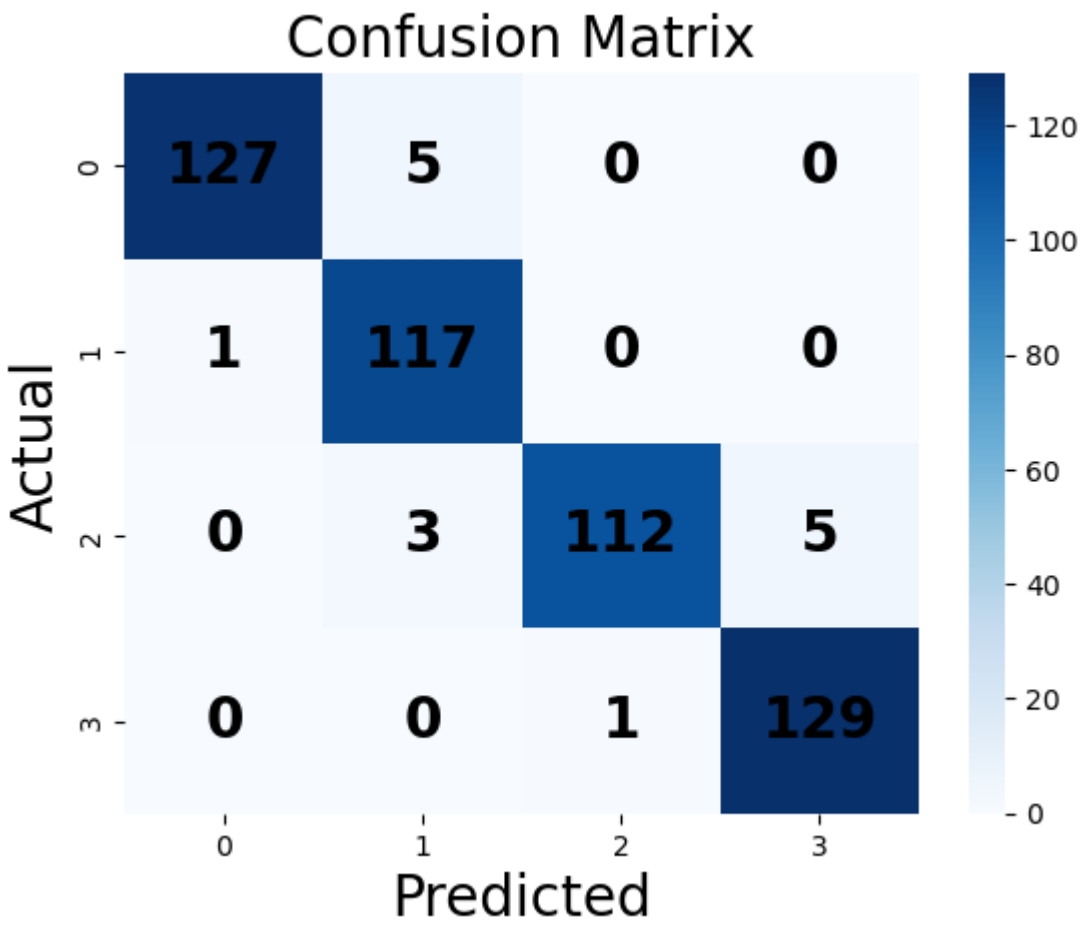
c) SVM classification confusion matrix:

In [131…

```
cm=confusion_matrix(y_test,ypred_m3)
sns.heatmap(cm, annot=True, cmap='Blues', fmt='d',annot_kws={"size": 20,'weight':'bold
plt.title("Confusion Matrix", fontsize=20)
plt.xlabel("Predicted", fontsize=20)
plt.ylabel("Actual", fontsize=20)
```

Out[131]:

```
Text(50.722222222222214, 0.5, 'Actual')
```



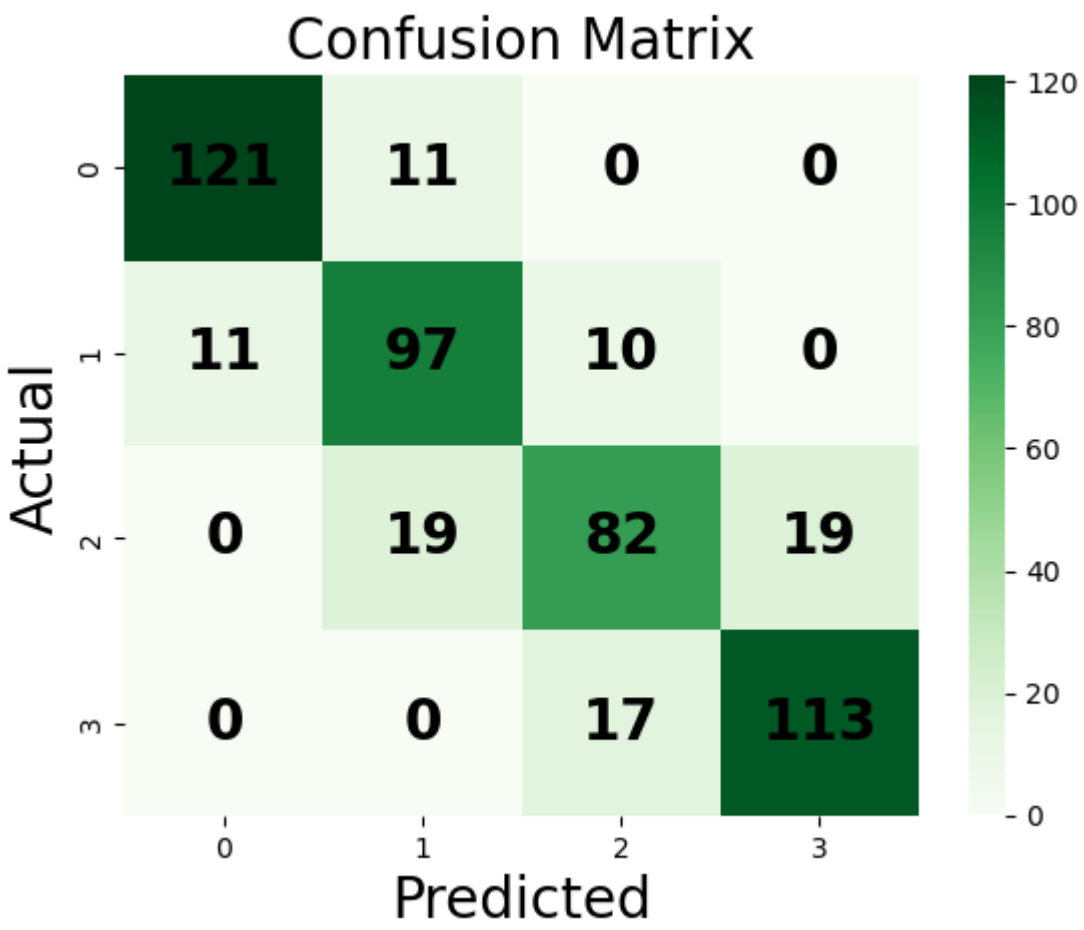
decision tree classifier confusion matrix:

In [136…

```
cm=confusion_matrix(y_test,ypred_m4)
sns.heatmap(cm, annot=True, cmap='Greens', fmt='d',annot_kws={"size": 20,'weight':'bol
plt.title("Confusion Matrix", fontsize=20)
plt.xlabel("Predicted", fontsize=20)
plt.ylabel("Actual", fontsize=20)
```

Out[136]:

```
Text(50.722222222222214, 0.5, 'Actual')
```



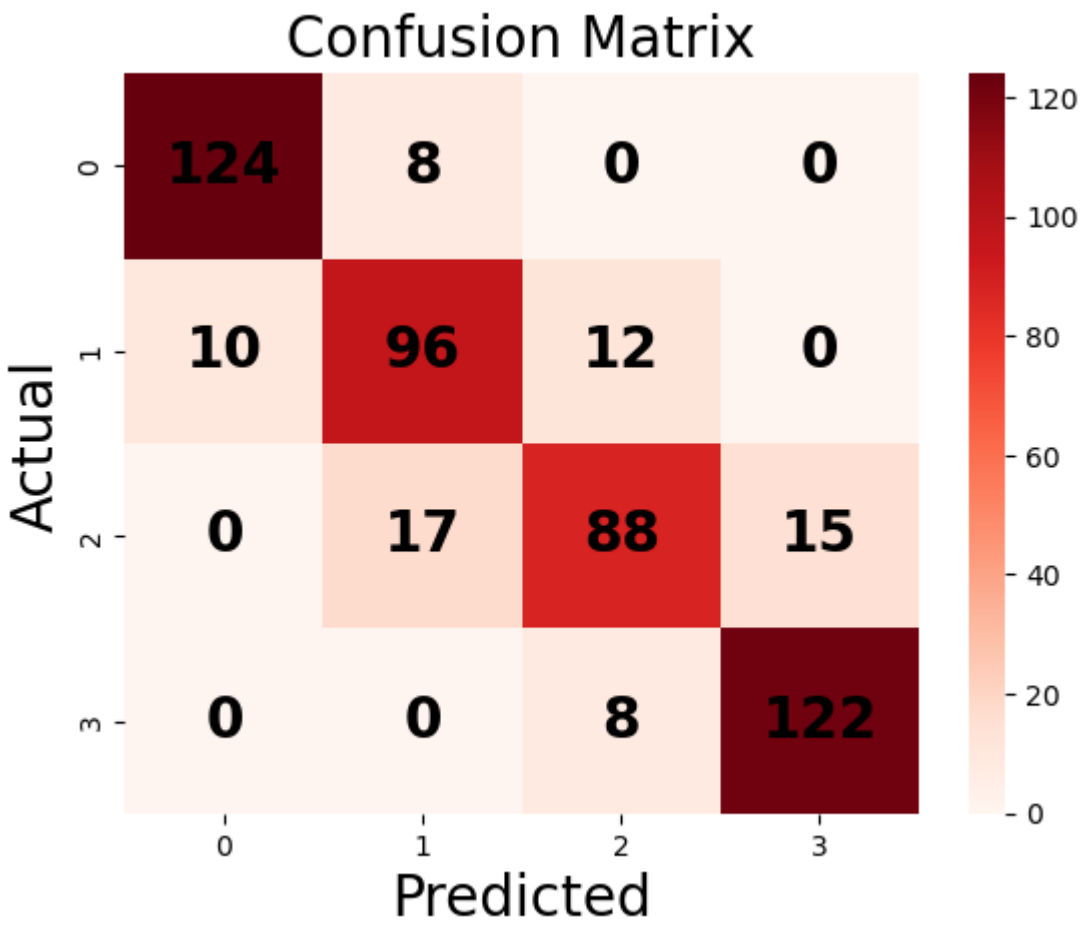
Random Forest Classifier connfusion matrix:

In [149…

```
cm=confusion_matrix(y_test,ypred_m5)
sns.heatmap(cm, annot=True, cmap='Reds', fmt='d',annot_kws={"size": 20,'weight':'bold'
plt.title("Confusion Matrix", fontsize=20)
plt.xlabel("Predicted", fontsize=20)
plt.ylabel("Actual", fontsize=20)
```

Out[149]:

```
Text(50.722222222222214, 0.5, 'Actual')
```



The Score of predicting the price range for the test data:

In [141…

```
print("logistic regression accuracy score:")
print(mscore(m1))
print("\n\n")
print("KNN predict score:")
print(mscore(m2))
print("\n\n")
print("Support vector machine (svm) score: ")
print(mscore(m3))
print("\n\n")
print("Decision Tree classifier score: ")
print(mscore(m4))
print("\n\n")
print("Random Forest score:")
print(mscore(m5))
```

```
logistic regression accuracy score:
Training score 0.794
Testing score 0.786
None



KNN predict score:
Training score 0.942
Testing score 0.94
None



Support vector machine (svm) score:
Training score 0.992
Testing score 0.97
None



Decision Tree classifier score:
Training score 0.8793333333333333
Testing score 0.826
None



Random Forest score:
Training score 0.9753333333333334
Testing score 0.86
None
```

Conclusion

From the above results we can tell that the SVM shows the best results among all the other classifers The order of their test scores goes like this:

1.Support Vector Machine (SVM)

2.KNN Classifier

3.Random Forest

4.Desision Tree

5.Logistic Regression