OMKAR BANDU SHINDE

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

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

In [2]:
```
df = pd.read_csv("DataSets/mobile_data.csv")
df.head().T
```

Out[2]:

	0	1	2	3	4
battery_power	842.0	1021.0	563.0	615.0	1821.0
blue	0.0	1.0	1.0	1.0	1.0
clock_speed	2.2	0.5	0.5	2.5	1.2
dual_sim	0.0	1.0	1.0	0.0	0.0
fc	1.0	0.0	2.0	0.0	13.0
four_g	0.0	1.0	1.0	0.0	1.0
int_memory	7.0	53.0	41.0	10.0	44.0
m_dep	0.6	0.7	0.9	0.8	0.6
mobile_wt	188.0	136.0	145.0	131.0	141.0
n_cores	2.0	3.0	5.0	6.0	2.0
pc	2.0	6.0	6.0	9.0	14.0
px_height	20.0	905.0	1263.0	1216.0	1208.0
px_width	756.0	1988.0	1716.0	1786.0	1212.0
ram	2549.0	2631.0	2603.0	2769.0	1411.0
sc_h	9.0	17.0	11.0	16.0	8.0
sc_w	7.0	3.0	2.0	8.0	2.0
talk_time	19.0	7.0	9.0	11.0	15.0
three_g	0.0	1.0	1.0	1.0	1.0
touch_screen	0.0	1.0	1.0	0.0	1.0
wifi	1.0	0.0	0.0	0.0	0.0
price_range	1.0	2.0	2.0	2.0	1.0

In [3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2000 entries, 0 to 1999
Data columns (total 21 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   battery_power  2000 non-null   int64  
 1   blue           2000 non-null   int64  
 2   clock_speed    2000 non-null   float64
 3   dual_sim       2000 non-null   int64  
 4   fc             2000 non-null   int64  
 5   four_g         2000 non-null   int64  
 6   int_memory     2000 non-null   int64  
 7   m_dep          2000 non-null   float64
 8   mobile_wt      2000 non-null   int64  
 9   n_cores        2000 non-null   int64  
 10  pc             2000 non-null   int64  
 11  px_height      2000 non-null   int64  
 12  px_width       2000 non-null   int64  
 13  ram            2000 non-null   int64  
 14  sc_h           2000 non-null   int64  
 15  sc_w           2000 non-null   int64  
 16  talk_time      2000 non-null   int64  
 17  three_g        2000 non-null   int64  
 18  touch_screen   2000 non-null   int64  
 19  wifi           2000 non-null   int64  
 20  price_range    2000 non-null   int64  
dtypes: float64(2), int64(19)
memory usage: 328.2 KB
```

- No null values

In [4]:
```
df.describe().T
```

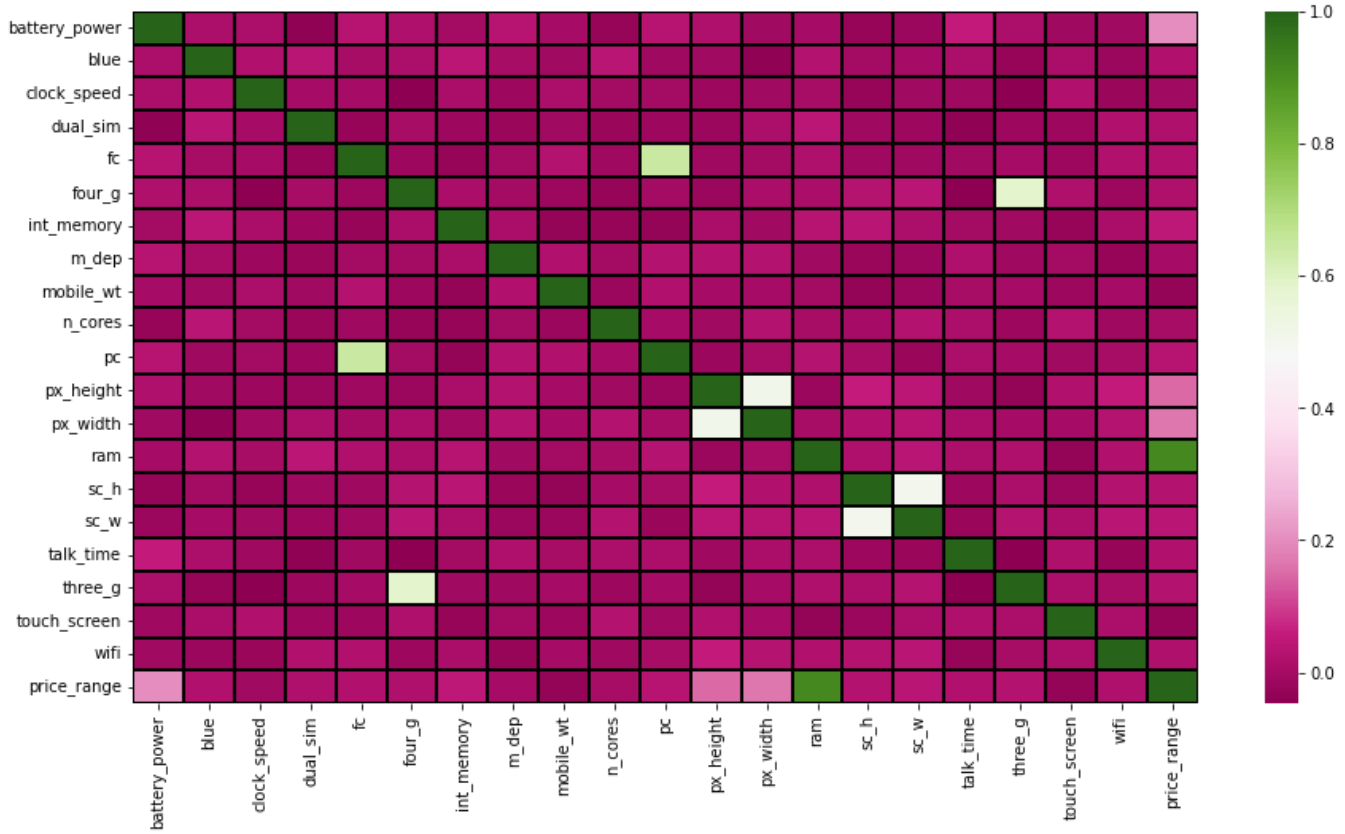
Out[4]:

	count	mean	std	min	25%	50%	75%	max
battery_power	2000.0	1238.51850	439.418206	501.0	851.75	1226.0	1615.25	1998.0
blue	2000.0	0.49500	0.500100	0.0	0.00	0.0	1.00	1.0
clock_speed	2000.0	1.52225	0.816004	0.5	0.70	1.5	2.20	3.0
dual_sim	2000.0	0.50950	0.500035	0.0	0.00	1.0	1.00	1.0
fc	2000.0	4.30950	4.341444	0.0	1.00	3.0	7.00	19.0
four_g	2000.0	0.52150	0.499662	0.0	0.00	1.0	1.00	1.0
int_memory	2000.0	32.04650	18.145715	2.0	16.00	32.0	48.00	64.0
m_dep	2000.0	0.50175	0.288416	0.1	0.20	0.5	0.80	1.0
mobile_wt	2000.0	140.24900	35.399655	80.0	109.00	141.0	170.00	200.0
n_cores	2000.0	4.52050	2.287837	1.0	3.00	4.0	7.00	8.0
pc	2000.0	9.91650	6.064315	0.0	5.00	10.0	15.00	20.0
px_height	2000.0	645.10800	443.780811	0.0	282.75	564.0	947.25	1960.0
px_width	2000.0	1251.51550	432.199447	500.0	874.75	1247.0	1633.00	1998.0
ram	2000.0	2124.21300	1084.732044	256.0	1207.50	2146.5	3064.50	3998.0
sc_h	2000.0	12.30650	4.213245	5.0	9.00	12.0	16.00	19.0
sc_w	2000.0	5.76700	4.356398	0.0	2.00	5.0	9.00	18.0
talk_time	2000.0	11.01100	5.463955	2.0	6.00	11.0	16.00	20.0
three_g	2000.0	0.76150	0.426273	0.0	1.00	1.0	1.00	1.0
touch_screen	2000.0	0.50300	0.500116	0.0	0.00	1.0	1.00	1.0
wifi	2000.0	0.50700	0.500076	0.0	0.00	1.0	1.00	1.0
price_range	2000.0	1.50000	1.118314	0.0	0.75	1.5	2.25	3.0

EDA

1 Correlation

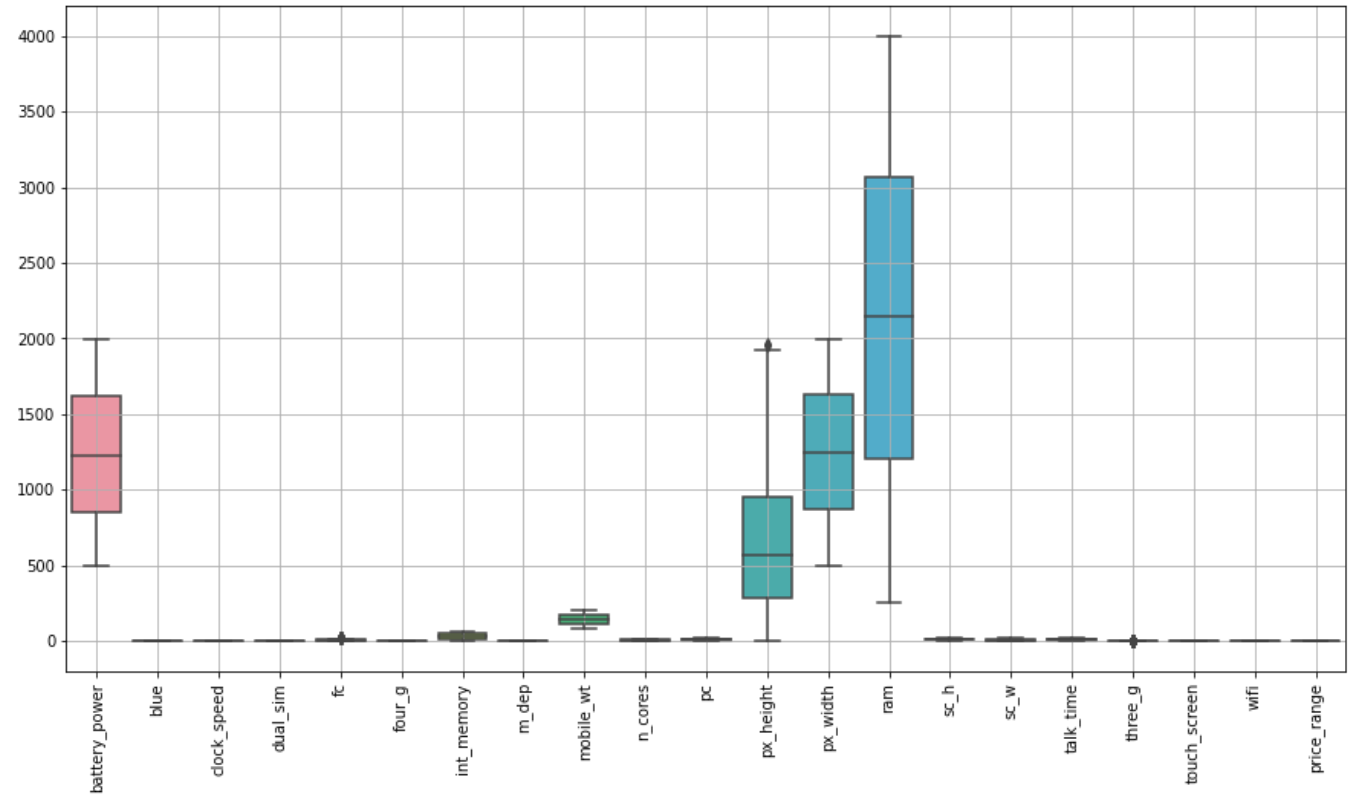
In [5]:
```
# Heatmap for corelation
plt.figure(figsize=(15,8))
sns.heatmap(df.corr(),annot=False,cmap="PiYG",linewidths=2,linecolor="black")
plt.show()
```



- Ram & Price are Highly correlated with each other (Ram↑ == Price↑) OR (Ram↓ == Price↓)
- PC & FC are nearly (60% - 80%) correlated with each other (PC↑ == FC↑) OR (PC↓ == FC↓)
- four_g & three_G are slightly correlated with each other

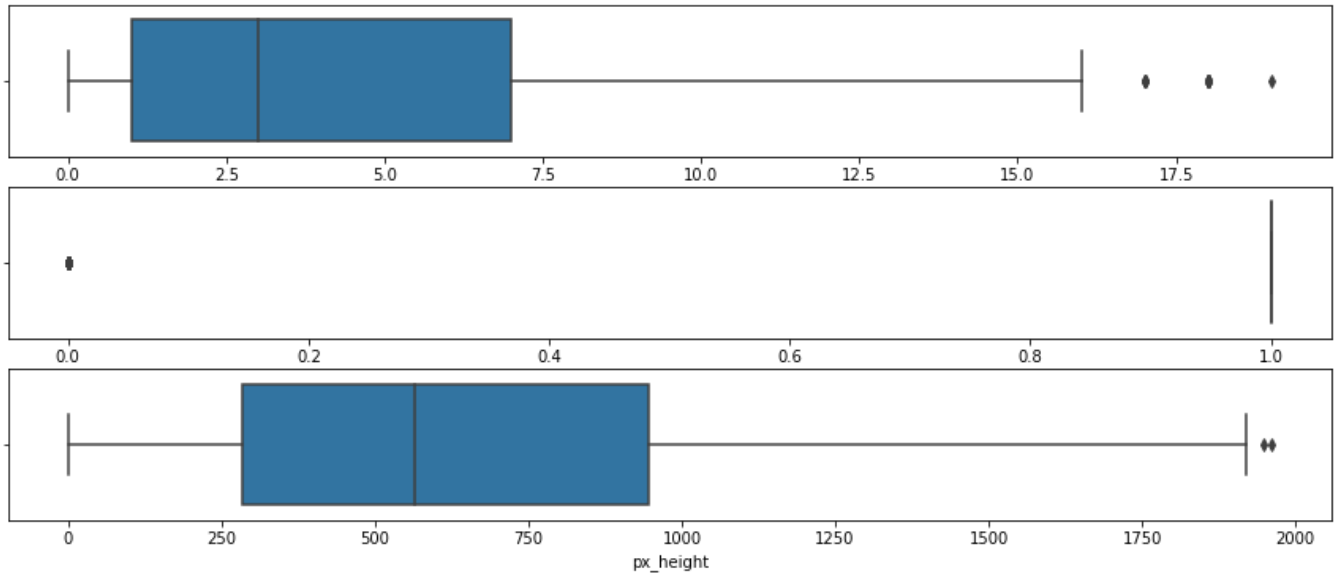
2 Outliers

In [6]:
```
# Searching for any outliers
plt.figure(figsize=(15,8))
sns.boxplot(data=df)
plt.grid()
plt.xticks(rotation=90)
plt.show()
```



- By seeing the Boxplot i can see there are some outliers in fc , px_height , three_g
- Plotting Individual Boxplot for each and displaying the outling records for the respective columns

In [7]:
```
plt.figure(figsize=(15,6))
plt.subplot(3,1,1)
sns.boxplot(df.fc)

plt.subplot(3,1,2)
sns.boxplot(df.three_g)

plt.subplot(3,1,3)
sns.boxplot(df.px_height)

plt.show()
```



In [8]:
```
df[df.fc > 17]
```

Out[8]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_cores	...
95	1137	1	1.0	0	18	0	7	1.0	196	3	...
226	1708	1	2.4	1	18	1	49	0.1	109	1	...
305	1348	0	2.0	0	18	0	52	0.3	98	3	...
1387	1533	1	1.1	1	18	1	17	0.3	160	4	...
1406	1731	1	2.3	1	18	0	60	0.5	171	4	...
1416	1448	0	0.5	1	18	0	2	0.2	100	5	...
1554	1957	0	1.2	1	18	1	36	0.8	151	2	...
1693	695	0	0.5	0	18	1	12	0.6	196	2	...
1705	1290	1	1.4	1	19	1	35	0.3	110	4	...
1880	1720	0	1.6	0	18	1	2	0.8	188	5	...
1882	591	0	2.1	1	18	1	16	0.5	196	7	...
1888	1544	0	2.4	0	18	1	12	0.1	186	7	...

12 rows × 21 columns

In [9]:
```
df[df.three_g == 0]
```

Out[9]:

	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	...
10	769	1	2.9	1	0	0	9	0.1	182	5	...
19	682	1	0.5	0	4	0	19	1.0	121	4	...
22	1949	0	2.6	1	4	0	47	0.3	199	4	...
30	1579	1	0.5	1	0	0	5	0.2	88	7	...
...	...	...	...	...	...	...	...	...	...	...	...
1981	1454	0	2.6	0	8	0	6	0.4	199	3	...
1982	1784	0	1.6	0	4	0	41	0.4	164	6	...
1983	1262	0	1.8	1	12	0	34	0.1	149	5	...
1988	1547	1	2.9	0	2	0	57	0.4	114	1	...
1989	586	0	2.8	0	2	0	15	0.2	83	3	...

477 rows × 21 columns

In [10]:
```
df[df.px_height > 1900]
```

Out[10]:

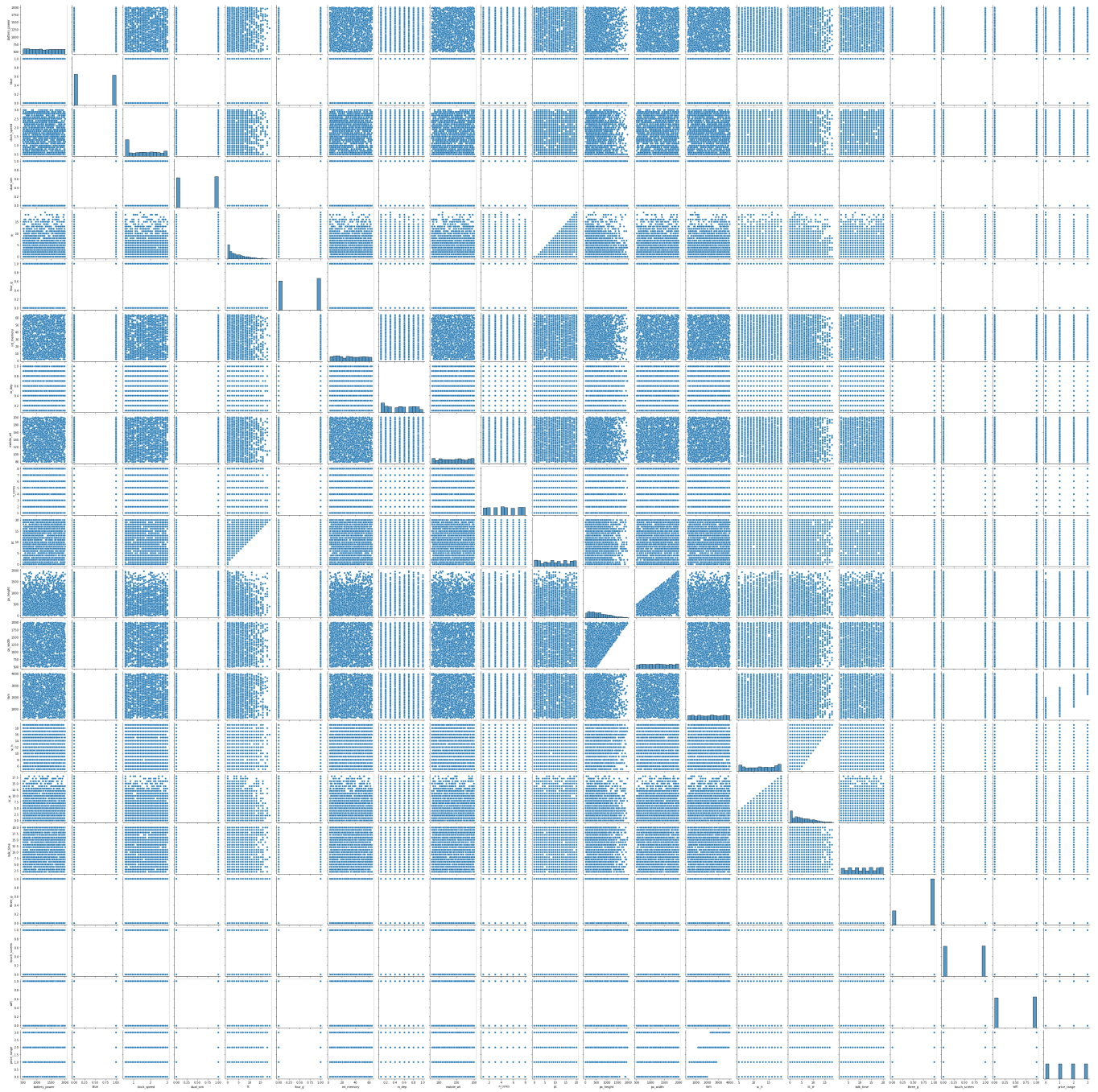
	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_cores	...
260	754	0	0.5	1	7	1	59	0.7	178	7	...
894	1497	1	0.7	0	5	0	32	0.7	92	3	...
988	1413	1	0.5	1	4	1	45	0.4	104	5	...
1163	1930	1	2.0	0	11	0	16	0.8	186	8	...
1771	1230	1	1.6	0	0	1	48	0.7	111	7	...

5 rows × 21 columns

3 Distribution of data

Price_Range data

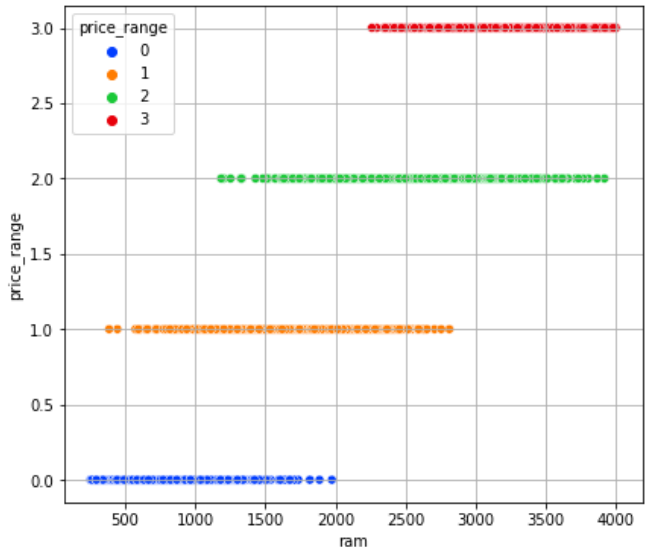
In [11]:
```
sns.pairplot(df)
plt.grid()
plt.show()
```

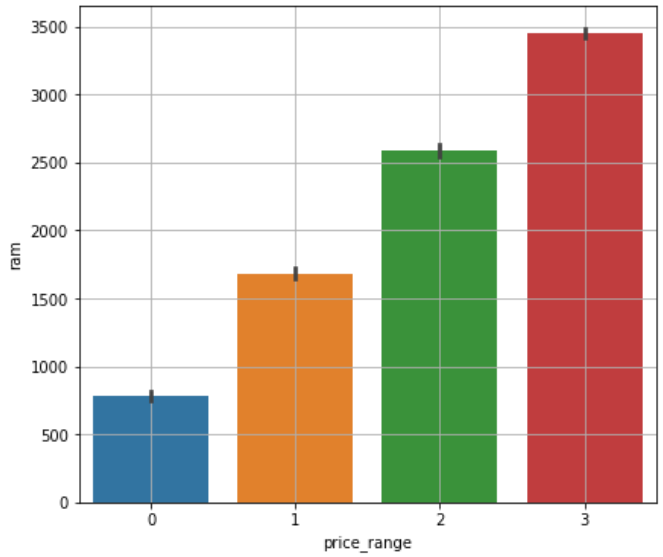


In [12]:
```
# Equally distributed data
plt.pie(df.price_range.value_counts(),autopct="%2f",labels=[0,1,2,3])
plt.show()
```

Ram vs Price

In [13]:
```
plt.figure(figsize = (15,6))

plt.subplot(1,2,1)
sns.scatterplot(x=df.ram,y=df.price_range,hue=df.price_range,palette="bright")
plt.grid()

plt.subplot(1,2,2)
sns.barplot(x = 'price_range', y = 'ram',data=df)
plt.grid()
plt.show()
```

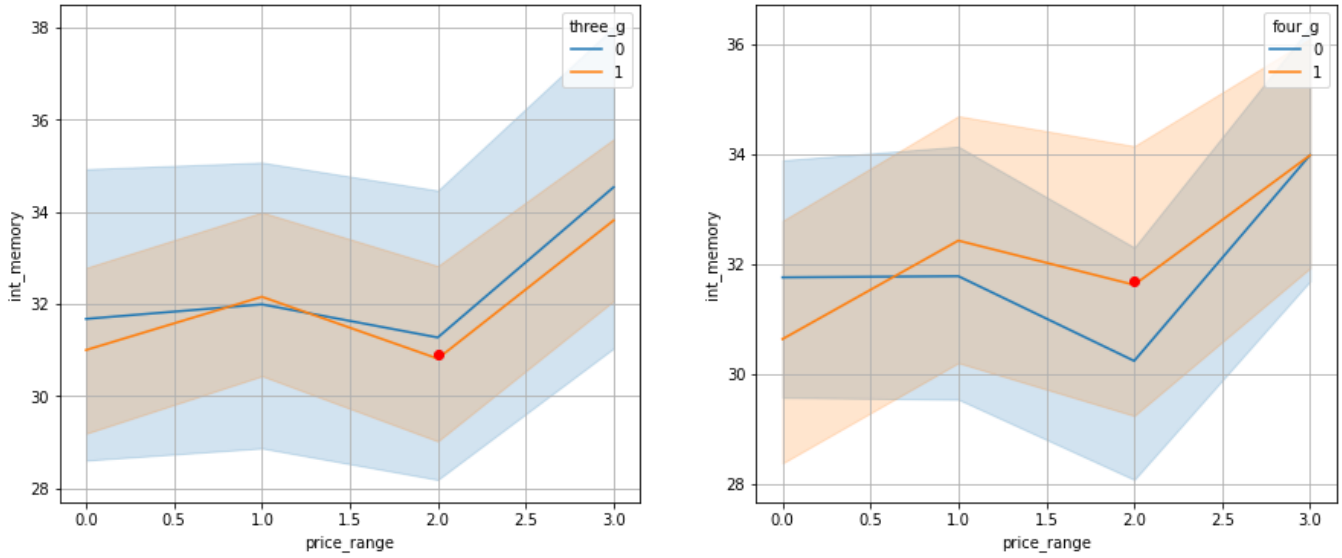




- 0 ==> (0 MB < ram_size < 2000 MB)
- 1 ==> (400 MB < ram_size < 3000 MB)
- 2 ==> (1200 MB < ram_size < 3900 MB)
- 3 ==> (2200 MB < ram_size < 4000 MB)

Internal_Memory vs Price W.R.T --- (3G / 4G)

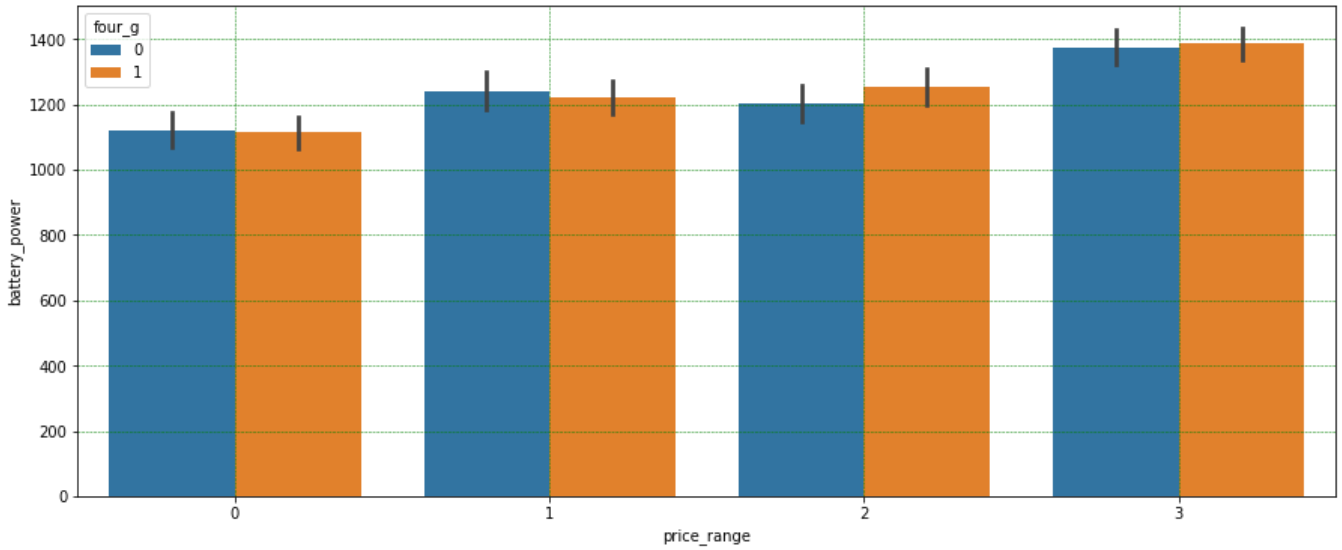
In [14]:
```
plt.figure(figsize = (15,6))

plt.subplot(1,2,1)
sns.lineplot(y=df.int_memory,x=df.price_range,hue=df.three_g)
plt.plot(2.0,30.9,marker="o",color="r")
plt.grid()

plt.subplot(1,2,2)
sns.lineplot(y=df.int_memory,x=df.price_range,hue=df.four_g)
plt.plot(2.0,31.7,marker="o",color="r")
plt.grid()
```



- 3G phone does have an high drop rate in internal_memory w.r.t to price_range
- 4G phone does not have an high drop rate in internal_memory w.r.t to price_range

Price_range vs battery_power

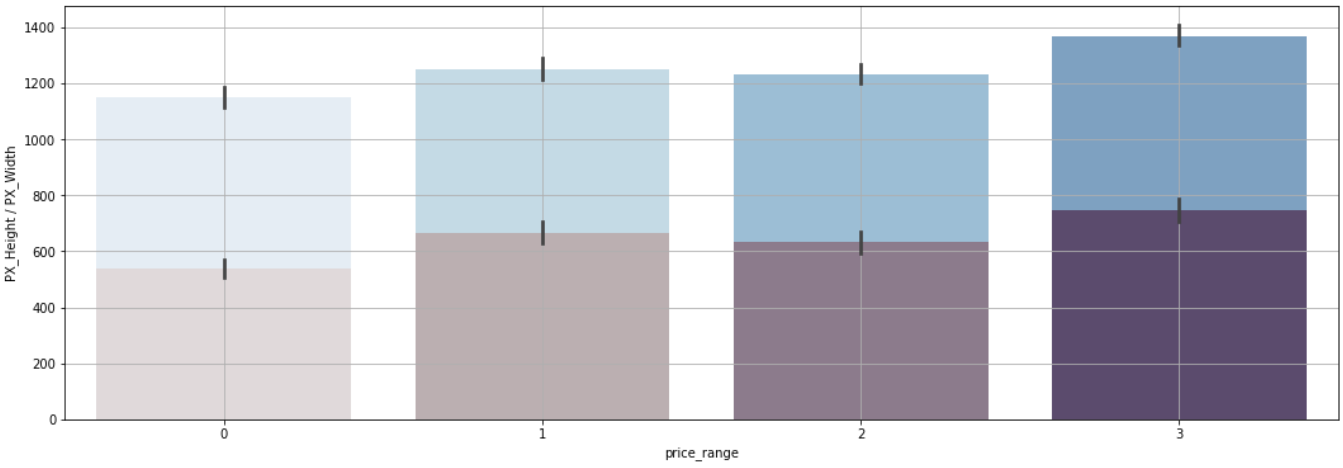
In [15]:
```
plt.figure(figsize = (15,6))
sns.barplot(x = 'price_range', y = 'battery_power', data=df,hue=df.four_g)
plt.grid(color = 'green', linestyle = '--', linewidth = 0.5)
plt.show()
```



- Costlier phones have higher battery capacity

(PX_Height / PX_Width) vs Price_Range

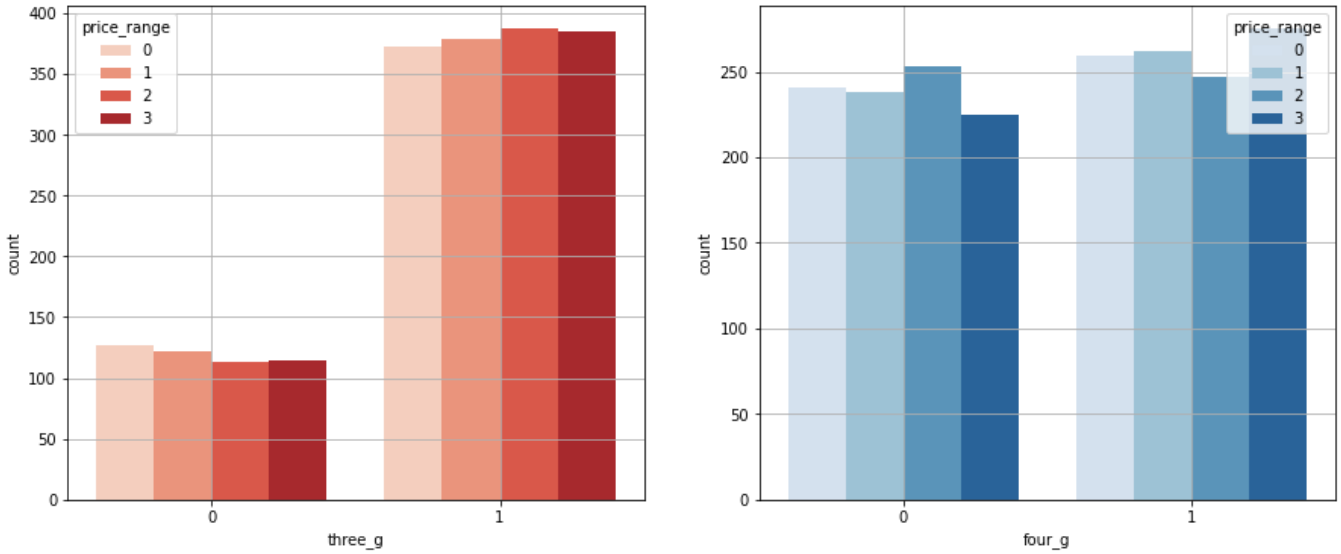
In [16]:
```
plt.figure(figsize = (18,6))

sns.barplot(x = 'price_range', y = 'px_height', data=df, palette = 'Reds')
sns.barplot(x = 'price_range', y = 'px_width', data=df , palette = 'Blues',alpha=0.6)
plt.ylabel("PX_Height / PX_Width")
plt.grid()

plt.show()
```



- 0 ==> Smaller Dimensions (H * W)
- 1 & 2 ==> Similar Dimensions (H * W)
- 3 ==> Larger Dimensions (H * W)

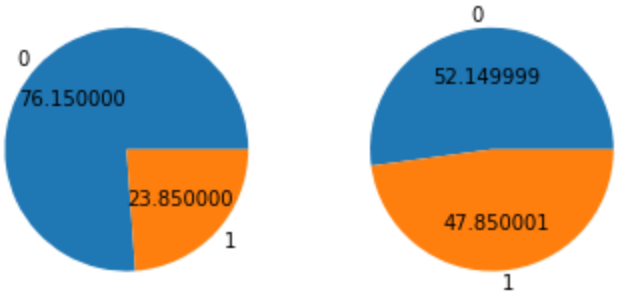
Price vs (3G / 4G)

In [17]:
```
plt.figure(figsize = (15,6))

plt.subplot(1,2,1)
sns.countplot(df['three_g'] , hue = df['price_range'] , palette = 'Reds')
plt.grid()

plt.subplot(1,2,2)
sns.countplot(df['four_g'] , hue = df['price_range'] , palette = 'Blues')
plt.grid()
plt.show()
```



In [18]:
```
plt.subplot(1,2,1)
plt.pie(df.three_g.value_counts(),autopct="%2f",labels=[0,1])
print(df.three_g.value_counts())
plt.subplot(1,2,2)
plt.pie(df.four_g.value_counts(),autopct="%2f",labels=[0,1])
print(df.four_g.value_counts())

plt.show()
```

```
1    1523
0     477
Name: three_g, dtype: int64
1    1043
0     957
Name: four_g, dtype: int64
```



- More no.of counts in 3G phones compared to 4G phones in Market
- 3G ==> Price_Range(2 > 3 > 1 > 0)
- 4G ==> Price_Range(3 > 1 > 0 > 2)

In [ ]:

In [ ]:

In [ ]:

Segregating , Scalling & Splitting

In [19]:
```
from sklearn.preprocessing import StandardScaler
SS = StandardScaler()

X = df.iloc[:,:-1]
# X = SS.fit_transform(X)
X
```

Out[19]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_cores	pc
0	842	0	2.2	0	1	0	7	0.6	188	2	2
1	1021	1	0.5	1	0	1	53	0.7	136	3	6
2	563	1	0.5	1	2	1	41	0.9	145	5	6
3	615	1	2.5	0	0	0	10	0.8	131	6	9
4	1821	1	1.2	0	13	1	44	0.6	141	2	14
...	...	...	...	...	...	...	...	...	...	...	...
1995	794	1	0.5	1	0	1	2	0.8	106	6	14
1996	1965	1	2.6	1	0	0	39	0.2	187	4	3
1997	1911	0	0.9	1	1	1	36	0.7	108	8	3
1998	1512	0	0.9	0	4	1	46	0.1	145	5	5
1999	510	1	2.0	1	5	1	45	0.9	168	6	16

2000 rows × 20 columns

In [20]:
```
Y = df.price_range
Y
```

Out[20]:
```
0       1
1       2
2       2
3       2
4       1
       ..
1995    0
1996    2
1997    3
1998    0
1999    3
Name: price_range, Length: 2000, dtype: int64
```

In [21]:
```
from sklearn.model_selection import train_test_split,GridSearchCV
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.2,random_state=1)
```

Modelling

In [22]:
```
from sklearn.metrics import classification_report,accuracy_score,roc_curve
from sklearn.neighbors import KNeighborsClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.svm import SVC

algo_performance_list = []

def MyModel(model,Name,Params):
    model.fit(X_train,Y_train)
    Y_pred = model.predict(X_test)
    print(classification_report(Y_test,Y_pred))
    algo_performance_list.append([Name,accuracy_score(Y_test,Y_pred),Params,model.score
(X_train,Y_train)])
```

KNN

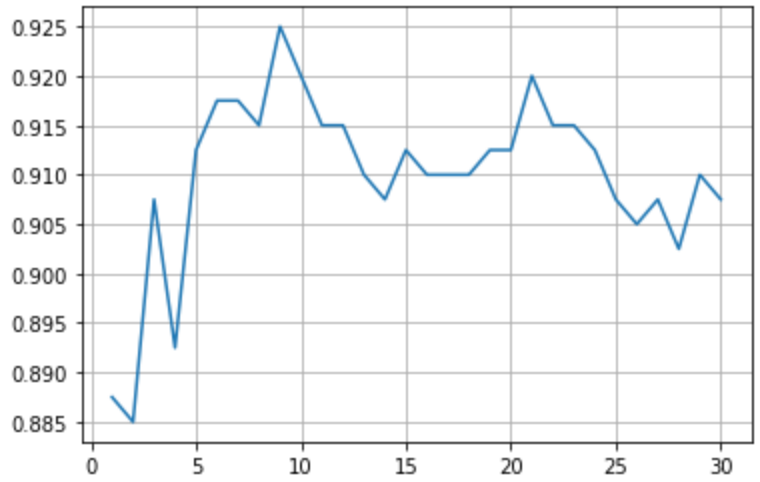
- 1) Default Model
- 2) Hypertuning
- 3) Final Model

In [23]:
```
# 1) Default Model
KNN = KNeighborsClassifier()
MyModel(KNN,"KNN","Default")
print(f"Training Score :- {KNN.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.98      0.97      0.97        92
           1       0.90      0.94      0.92        96
           2       0.83      0.90      0.86       106
           3       0.96      0.86      0.91       106

    accuracy                           0.91       400
   macro avg       0.92      0.91      0.92       400
weighted avg       0.92      0.91      0.91       400

Training Score :- 0.958125
```

In [24]:
```
# 2) Hypertuned KNN
KNN_list = []
for i in range(1,31):
    KNN = KNeighborsClassifier(n_neighbors=i)
    KNN.fit(X_train,Y_train)
    Y_pred = KNN.predict(X_test)
    KNN_list.append(accuracy_score(Y_test,Y_pred))
```

In [25]:
```
plt.plot(range(1,31),KNN_list)
plt.grid()
```



In [26]:
```
# 3) Final KNN
KNN = KNeighborsClassifier(n_neighbors=9)
MyModel(KNN,"H_KNN","n_neighbors = 9")
print(f"Training Score :- {KNN.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.97      0.97      0.97        92
           1       0.90      0.95      0.92        96
           2       0.87      0.91      0.89       106
           3       0.97      0.89      0.93       106

    accuracy                           0.93       400
   macro avg       0.93      0.93      0.93       400
weighted avg       0.93      0.93      0.93       400

Training Score :- 0.948125
```

Logistic Regression

- 1) Default Model
- 2) Hypertuning
- 3) Final Model

In [27]:
```
# 1) Default Model
LR = LogisticRegression()
MyModel(LR,"LR","Default")
print(f"Training Score :- {LR.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.82      0.77      0.79        92
           1       0.53      0.54      0.54        96
           2       0.45      0.42      0.43       106
           3       0.68      0.75      0.71       106

    accuracy                           0.61       400
   macro avg       0.62      0.62      0.62       400
weighted avg       0.61      0.61      0.61       400

Training Score :- 0.64125
```

In [28]:
```
# 2) Hypertuning Log_Reg
params = [ ['lbfgs','l2'],['lbfgs','none'],
           ['liblinear','l1'],['liblinear','l2'],
           ['newton-cg','l2'],['newton-cg','none'],
           ['sag','l2'],['sag','none'],
           ['saga','l1'],['saga','l2'],['saga','none']  ]

#  ['saga','elasticnet']  --->  Need to perform Scalling on the Data

all_combinations = []

for i in params:
    model = LogisticRegression(solver=i[0] , penalty=i[1])
    model.fit(X_train,Y_train)
    Y_pred = model.predict(X_test)

    acc = accuracy_score(Y_test,Y_pred)

    print(f"{i} ---> {acc} ")

    all_combinations.append([i[0],i[1],acc])
```

```
['lbfgs', 'l2'] ---> 0.615
['lbfgs', 'none'] ---> 0.61
['liblinear', 'l1'] ---> 0.86
['liblinear', 'l2'] ---> 0.7725
['newton-cg', 'l2'] ---> 0.955
['newton-cg', 'none'] ---> 0.9625
['sag', 'l2'] ---> 0.6225
['sag', 'none'] ---> 0.6225
['saga', 'l1'] ---> 0.5975
['saga', 'l2'] ---> 0.6025
['saga', 'none'] ---> 0.6
```

In [29]:
```
def Get_Best_combintion(Values_List):
    max_val = 0
    max_index = 0
    for i in Values_List:
        if max_val < i[2]:
            max_val = i[2]
            max_index = Values_List.index(i)
    return Values_List[max_index]

Get_Best_combintion(all_combinations)
```

Out[29]:
```
['newton-cg', 'none', 0.9625]
```

In [30]:
```
# 3) Final Log_Reg
H_Log_Reg = LogisticRegression(solver="newton-cg",penalty='none')
MyModel(H_Log_Reg,"H_Log_Reg","solver = newton-cg , penalty = none")
print(f"Training Score :- {H_Log_Reg.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.98      0.98      0.98        92
           1       0.96      0.96      0.96        96
           2       0.94      0.95      0.95       106
           3       0.97      0.96      0.97       106

    accuracy                           0.96       400
   macro avg       0.96      0.96      0.96       400
weighted avg       0.96      0.96      0.96       400

Training Score :- 0.974375
```

RandomForest Classifier

- 1) Default Model
- 2) Hypertuning
- 3) Final Model

In [31]:
```
# 1) Default Model
RFC = RandomForestClassifier()
MyModel(model = RFC , Name = "RFC" , Params = "Default" )
print(f"Training Score :- {RFC.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.90      0.92      0.91        92
           1       0.81      0.84      0.83        96
           2       0.83      0.85      0.84       106
           3       0.96      0.88      0.92       106

    accuracy                           0.87       400
   macro avg       0.87      0.87      0.87       400
weighted avg       0.88      0.87      0.87       400

Training Score :- 1.0
```

In [32]:
```
# 2) Hypertuning RFC
D_RFC = RandomForestClassifier()
hyperparameter_dict = {"criterion":['gini','entropy'],
                       "max_depth":range(5,10),
                       "min_samples_split":range(5,10),
                       "min_samples_leaf":range(5,10)}

GS_RFC = GridSearchCV(D_RFC , param_grid = hyperparameter_dict , verbose=3)
GS_RFC.fit(X_train,Y_train)
```

```
Fitting 5 folds for each of 250 candidates, totalling 1250 fits
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.869 total time=   0.1s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.825 total time=   0.1s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.853 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.863 total time=   0.1s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.831 total time=   0.1s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=6;, sco
re=0.863 total time=   0.1s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=6;, sco
re=0.822 total time=   0.1s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=6;, sco
re=0.838 total time=   0.1s
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re=0.844 total time=   0.1s
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re=0.841 total time=   0.0s
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re=0.809 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=8;, sco
re=0.853 total time=   0.1s
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re=0.847 total time=   0.1s
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re=0.819 total time=   0.1s
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[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=5;, sco
re=0.856 total time=   0.1s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=5;, sco
re=0.831 total time=   0.1s
```

```
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=6;, sco
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[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=7;, sco
re=0.853 total time=   0.1s
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re=0.850 total time=   0.1s
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re=0.816 total time=   0.1s
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re=0.866 total time=   0.1s
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re=0.844 total time=   0.1s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=6;, sco
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[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=7;, sco
re=0.850 total time=   0.1s
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re=0.819 total time=   0.1s
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re=0.841 total time=   0.1s
```

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[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=8;, sco
re=0.812 total time=   0.1s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=8;, sco
re=0.853 total time=   0.1s
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[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=9, min_samples_split=9;, sco
re=0.856 total time=   0.1s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=9, min_samples_split=9;, sco
re=0.834 total time=   0.1s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=9, min_samples_split=9;, sco
re=0.806 total time=   0.1s
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[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=9, min_samples_split=9;, sco
re=0.853 total time=   0.1s
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[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.859 total time=   0.1s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.866 total time=   0.1s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.897 total time=   0.1s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.847 total time=   0.1s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.875 total time=   0.1s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.856 total time=   0.1s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.869 total time=   0.1s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.878 total time=   0.1s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.844 total time=   0.1s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.894 total time=   0.1s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.841 total time=   0.1s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.847 total time=   0.1s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.875 total time=   0.1s
```

```
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.831 total time=   0.1s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.869 total time=   0.2s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.869 total time=   0.2s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.866 total time=   0.1s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.894 total time=   0.1s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.856 total time=   0.1s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.894 total time=   0.1s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.884 total time=   0.1s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.863 total time=   0.1s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.869 total time=   0.2s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.853 total time=   0.1s
```

Out[32]:
```
GridSearchCV(estimator=RandomForestClassifier(),
             param_grid={'criterion': ['gini', 'entropy'],
                         'max_depth': range(5, 10),
                         'min_samples_leaf': range(5, 10),
                         'min_samples_split': range(5, 10)},
             verbose=3)
```

In [33]:
```
GS_RFC.best_params_
```

Out[33]:
```
{'criterion': 'entropy',
 'max_depth': 8,
 'min_samples_leaf': 8,
 'min_samples_split': 6}
```

In [34]:
```
# 3) Final RFC
H_RFC = RandomForestClassifier( criterion = 'entropy', max_depth = 9 , min_samples_leaf
= 5, min_samples_split = 6 )
MyModel(H_RFC,"H_RFC","'criterion'='entropy','max_depth'= 9,'min_samples_leaf'= 5,'min_s
amples_split'= 6")
print(f"Training Score :- {H_RFC.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.91      0.95      0.93        92
           1       0.78      0.79      0.79        96
           2       0.79      0.80      0.80       106
           3       0.95      0.90      0.92       106

    accuracy                           0.86       400
   macro avg       0.86      0.86      0.86       400
weighted avg       0.86      0.86      0.86       400

Training Score :- 0.985625
```

DecisionTree Classifier

- 1) Default Model
- 2) Hypertuning
- 3) Final Model

In [35]:
```
# 1) Default Model
DTC = DecisionTreeClassifier()
MyModel(DTC,"DTC","Default")
print(f"Training Score :- {DTC.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.92      0.89      0.91        92
           1       0.76      0.85      0.80        96
           2       0.81      0.76      0.79       106
           3       0.91      0.89      0.90       106

    accuracy                           0.85       400
   macro avg       0.85      0.85      0.85       400
weighted avg       0.85      0.85      0.85       400

Training Score :- 1.0
```

In [36]:

```
# 2) Hypertuning DTC
D_DTC = DecisionTreeClassifier()
hyperparameter_dict = {"criterion":['gini','entropy'],
                       "max_depth":range(5,10),
                       "min_samples_split":range(5,10),
                       "min_samples_leaf":range(5,10)}

GS_DTC = GridSearchCV(D_DTC , param_grid = hyperparameter_dict , verbose=3)
GS_DTC.fit(X_train,Y_train)
```

```
Fitting 5 folds for each of 250 candidates, totalling 1250 fits
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.834 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.841 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.856 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=5;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=6;, sco
re=0.834 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=6;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=6;, sco
re=0.841 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=6;, sco
re=0.856 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=6;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=7;, sco
re=0.834 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=7;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=7;, sco
re=0.841 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=7;, sco
re=0.863 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=7;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=8;, sco
re=0.834 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=8;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=8;, sco
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[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=8;, sco
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[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=8;, sco
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[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=9;, sco
re=0.834 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=9;, sco
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[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=9;, sco
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[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=9;, sco
re=0.863 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=5, min_samples_split=9;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=5;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=5;, sco
re=0.778 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=5;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=5;, sco
re=0.856 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=5;, sco
re=0.812 total time=   0.0s
```

```
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=6;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=6;, sco
re=0.778 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=6;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=6;, sco
re=0.863 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=6;, sco
re=0.812 total time=   0.0s
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[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=7;, sco
re=0.778 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=7;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=7;, sco
re=0.863 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=7;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=8;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=8;, sco
re=0.778 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=8;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=8;, sco
re=0.856 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=8;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=9;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=9;, sco
re=0.778 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=6, min_samples_split=9;, sco
re=0.844 total time=   0.0s
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re=0.784 total time=   0.0s
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[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=5;, sco
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re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=6;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=6;, sco
re=0.859 total time=   0.0s
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re=0.806 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=7;, sco
re=0.831 total time=   0.0s
```

```
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=7;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=7;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=7;, sco
re=0.856 total time=   0.0s
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[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=8;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=8;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=8;, sco
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[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=8;, sco
re=0.859 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=8;, sco
re=0.806 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=9;, sco
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[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=9;, sco
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[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=9;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=9;, sco
re=0.856 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=7, min_samples_split=9;, sco
re=0.809 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=5;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=5;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=5;, sco
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[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=5;, sco
re=0.859 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=5;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=6;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=6;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=6;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=6;, sco
re=0.859 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=6;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=7;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=7;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=7;, sco
re=0.844 total time=   0.0s
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re=0.859 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=7;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=8;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=8;, sco
re=0.784 total time=   0.0s
```

```
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=8;, sco
re=0.844 total time=   0.0s
[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=8;, sco
re=0.859 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=8;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=9;, sco
re=0.831 total time=   0.0s
[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=9;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=9;, sco
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[CV 4/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=9;, sco
re=0.859 total time=   0.0s
[CV 5/5] END criterion=gini, max_depth=5, min_samples_leaf=8, min_samples_split=9;, sco
re=0.812 total time=   0.0s
[CV 1/5] END criterion=gini, max_depth=5, min_samples_leaf=9, min_samples_split=5;, sco
re=0.831 total time=   0.0s
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[CV 2/5] END criterion=gini, max_depth=5, min_samples_leaf=9, min_samples_split=7;, sco
re=0.784 total time=   0.0s
[CV 3/5] END criterion=gini, max_depth=5, min_samples_leaf=9, min_samples_split=7;, sco
re=0.844 total time=   0.0s
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score=0.872 total time=   0.0s
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score=0.872 total time=   0.0s
```

```
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=6;,
score=0.856 total time=   0.0s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=6;,
score=0.831 total time=   0.0s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=7;,
score=0.841 total time=   0.0s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=7;,
score=0.828 total time=   0.0s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=7;,
score=0.869 total time=   0.0s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=7;,
score=0.856 total time=   0.0s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=7;,
score=0.831 total time=   0.0s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=8;,
score=0.841 total time=   0.0s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=8;,
score=0.822 total time=   0.0s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=8;,
score=0.875 total time=   0.0s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=8;,
score=0.856 total time=   0.0s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=8;,
score=0.831 total time=   0.0s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=9;,
score=0.841 total time=   0.0s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=9;,
score=0.831 total time=   0.0s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=9;,
score=0.878 total time=   0.0s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=9;,
score=0.856 total time=   0.0s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=8, min_samples_split=9;,
score=0.831 total time=   0.0s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.844 total time=   0.0s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.838 total time=   0.0s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.875 total time=   0.0s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.856 total time=   0.0s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=5;,
score=0.838 total time=   0.0s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.844 total time=   0.0s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.844 total time=   0.0s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.875 total time=   0.0s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.856 total time=   0.0s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=6;,
score=0.828 total time=   0.0s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.844 total time=   0.0s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.844 total time=   0.0s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.881 total time=   0.0s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.856 total time=   0.0s
```

```
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=7;,
score=0.828 total time=   0.0s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.844 total time=   0.0s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.838 total time=   0.0s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.875 total time=   0.0s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.856 total time=   0.0s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=8;,
score=0.831 total time=   0.0s
[CV 1/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.844 total time=   0.0s
[CV 2/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.844 total time=   0.0s
[CV 3/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.875 total time=   0.0s
[CV 4/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.856 total time=   0.0s
[CV 5/5] END criterion=entropy, max_depth=9, min_samples_leaf=9, min_samples_split=9;,
score=0.838 total time=   0.0s
```

Out[36]:
```
GridSearchCV(estimator=DecisionTreeClassifier(),
             param_grid={'criterion': ['gini', 'entropy'],
                         'max_depth': range(5, 10),
                         'min_samples_leaf': range(5, 10),
                         'min_samples_split': range(5, 10)},
             verbose=3)
```

In [37]:
```
GS_DTC.best_params_
```

Out[37]:
```
{'criterion': 'gini',
 'max_depth': 8,
 'min_samples_leaf': 7,
 'min_samples_split': 5}
```

In [38]:
```
# 3) Final DTC
H_DTC = DecisionTreeClassifier( criterion = 'entropy', max_depth = 8 , min_samples_leaf
= 6, min_samples_split = 7 )
MyModel(H_DTC,"H_DTC","'criterion'='entropy','max_depth'= 8,'min_samples_leaf'= 6,'min_s
amples_split'= 7")
print(f"Training Score :- {H_DTC.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.90      0.87      0.88        92
           1       0.74      0.81      0.78        96
           2       0.80      0.76      0.78       106
           3       0.90      0.90      0.90       106

    accuracy                           0.83       400
   macro avg       0.84      0.84      0.84       400
weighted avg       0.84      0.83      0.84       400

Training Score :- 0.939375
```

SVC

- 1) Default Model
- 2) Hypertuning
- 3) Final Model

In [39]:
```
# 1) Default Model
D_SVC = SVC()
MyModel(D_SVC,"SVC","Default")
print(f"Training Score :- {D_SVC.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.97      0.99      0.98        92
           1       0.92      0.95      0.93        96
           2       0.91      0.91      0.91       106
           3       0.97      0.93      0.95       106

    accuracy                           0.94       400
   macro avg       0.94      0.94      0.94       400
weighted avg       0.94      0.94      0.94       400

Training Score :- 0.95375
```

In [40]:
```
# 2) Hypertuning SVC
SVC_Rbf = SVC()
hyperparameter_dict = {"kernel":['poly', 'rbf', 'sigmoid'],
                       "C":[0.1,0.01,0.001,0.0001],
                       "gamma":[0.1,0.01,0.001,0.0001]}

GS = GridSearchCV(SVC_Rbf , param_grid = hyperparameter_dict , verbose=3)
GS.fit(X_train,Y_train)
```

```
Fitting 5 folds for each of 48 candidates, totalling 240 fits
[CV 1/5] END .....C=0.1, gamma=0.1, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END .....C=0.1, gamma=0.1, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END .....C=0.1, gamma=0.1, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END .....C=0.1, gamma=0.1, kernel=poly;, score=0.966 total time=   0.1s
[CV 5/5] END .....C=0.1, gamma=0.1, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.2s
[CV 2/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.2s
[CV 3/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.253 total time=   0.2s
[CV 4/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.253 total time=   0.2s
[CV 5/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.2s
[CV 1/5] END ..C=0.1, gamma=0.1, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 2/5] END ..C=0.1, gamma=0.1, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 3/5] END ..C=0.1, gamma=0.1, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 4/5] END ..C=0.1, gamma=0.1, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END ..C=0.1, gamma=0.1, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END ....C=0.1, gamma=0.01, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END ....C=0.1, gamma=0.01, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END ....C=0.1, gamma=0.01, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ....C=0.1, gamma=0.01, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END ....C=0.1, gamma=0.01, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.256 total time=   0.1s
[CV 2/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.256 total time=   0.1s
[CV 3/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.253 total time=   0.1s
[CV 4/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.253 total time=   0.1s
[CV 5/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.256 total time=   0.1s
[CV 1/5] END .C=0.1, gamma=0.01, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 2/5] END .C=0.1, gamma=0.01, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 3/5] END .C=0.1, gamma=0.01, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 4/5] END .C=0.1, gamma=0.01, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END .C=0.1, gamma=0.01, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END ...C=0.1, gamma=0.001, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END ...C=0.1, gamma=0.001, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END ...C=0.1, gamma=0.001, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ...C=0.1, gamma=0.001, kernel=poly;, score=0.966 total time=   0.1s
[CV 5/5] END ...C=0.1, gamma=0.001, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.256 total time=   0.1s
[CV 2/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.256 total time=   0.1s
[CV 3/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.253 total time=   0.1s
[CV 4/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.253 total time=   0.1s
[CV 5/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.256 total time=   0.1s
[CV 1/5] END C=0.1, gamma=0.001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 2/5] END C=0.1, gamma=0.001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 3/5] END C=0.1, gamma=0.001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 4/5] END C=0.1, gamma=0.001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END C=0.1, gamma=0.001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END ..C=0.1, gamma=0.0001, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END ..C=0.1, gamma=0.0001, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END ..C=0.1, gamma=0.0001, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ..C=0.1, gamma=0.0001, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END ..C=0.1, gamma=0.0001, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.256 total time=   0.0s
[CV 2/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.256 total time=   0.0s
[CV 3/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.253 total time=   0.0s
[CV 4/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.253 total time=   0.0s
[CV 5/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.256 total time=   0.0s
[CV 1/5] END C=0.1, gamma=0.0001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 2/5] END C=0.1, gamma=0.0001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 3/5] END C=0.1, gamma=0.0001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 4/5] END C=0.1, gamma=0.0001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END C=0.1, gamma=0.0001, kernel=sigmoid;, score=0.256 total time=   0.0s
```

```
[CV 1/5] END ....C=0.01, gamma=0.1, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END ....C=0.01, gamma=0.1, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END ....C=0.01, gamma=0.1, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ....C=0.01, gamma=0.1, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END ....C=0.01, gamma=0.1, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END .....C=0.01, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.1s
[CV 2/5] END .....C=0.01, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.2s
[CV 3/5] END .....C=0.01, gamma=0.1, kernel=rbf;, score=0.253 total time=   0.1s
[CV 4/5] END .....C=0.01, gamma=0.1, kernel=rbf;, score=0.253 total time=   0.1s
[CV 5/5] END .....C=0.01, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.1s
[CV 1/5] END .C=0.01, gamma=0.1, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 2/5] END .C=0.01, gamma=0.1, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 3/5] END .C=0.01, gamma=0.1, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 4/5] END .C=0.01, gamma=0.1, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END .C=0.01, gamma=0.1, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END ...C=0.01, gamma=0.01, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END ...C=0.01, gamma=0.01, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END ...C=0.01, gamma=0.01, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ...C=0.01, gamma=0.01, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END ...C=0.01, gamma=0.01, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END ....C=0.01, gamma=0.01, kernel=rbf;, score=0.256 total time=   0.1s
[CV 2/5] END ....C=0.01, gamma=0.01, kernel=rbf;, score=0.256 total time=   0.1s
[CV 3/5] END ....C=0.01, gamma=0.01, kernel=rbf;, score=0.253 total time=   0.1s
[CV 4/5] END ....C=0.01, gamma=0.01, kernel=rbf;, score=0.253 total time=   0.1s
[CV 5/5] END ....C=0.01, gamma=0.01, kernel=rbf;, score=0.256 total time=   0.2s
[CV 1/5] END C=0.01, gamma=0.01, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 2/5] END C=0.01, gamma=0.01, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 3/5] END C=0.01, gamma=0.01, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 4/5] END C=0.01, gamma=0.01, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END C=0.01, gamma=0.01, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END ..C=0.01, gamma=0.001, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END ..C=0.01, gamma=0.001, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END ..C=0.01, gamma=0.001, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ..C=0.01, gamma=0.001, kernel=poly;, score=0.966 total time=   0.1s
[CV 5/5] END ..C=0.01, gamma=0.001, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END ...C=0.01, gamma=0.001, kernel=rbf;, score=0.256 total time=   0.1s
[CV 2/5] END ...C=0.01, gamma=0.001, kernel=rbf;, score=0.256 total time=   0.1s
[CV 3/5] END ...C=0.01, gamma=0.001, kernel=rbf;, score=0.253 total time=   0.1s
[CV 4/5] END ...C=0.01, gamma=0.001, kernel=rbf;, score=0.253 total time=   0.1s
[CV 5/5] END ...C=0.01, gamma=0.001, kernel=rbf;, score=0.256 total time=   0.1s
[CV 1/5] END C=0.01, gamma=0.001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 2/5] END C=0.01, gamma=0.001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 3/5] END C=0.01, gamma=0.001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 4/5] END C=0.01, gamma=0.001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END C=0.01, gamma=0.001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END .C=0.01, gamma=0.0001, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END .C=0.01, gamma=0.0001, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END .C=0.01, gamma=0.0001, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END .C=0.01, gamma=0.0001, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END .C=0.01, gamma=0.0001, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END ..C=0.01, gamma=0.0001, kernel=rbf;, score=0.256 total time=   0.0s
[CV 2/5] END ..C=0.01, gamma=0.0001, kernel=rbf;, score=0.256 total time=   0.0s
[CV 3/5] END ..C=0.01, gamma=0.0001, kernel=rbf;, score=0.253 total time=   0.1s
[CV 4/5] END ..C=0.01, gamma=0.0001, kernel=rbf;, score=0.253 total time=   0.0s
[CV 5/5] END ..C=0.01, gamma=0.0001, kernel=rbf;, score=0.256 total time=   0.0s
[CV 1/5] END C=0.01, gamma=0.0001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 2/5] END C=0.01, gamma=0.0001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 3/5] END C=0.01, gamma=0.0001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 4/5] END C=0.01, gamma=0.0001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END C=0.01, gamma=0.0001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END ...C=0.001, gamma=0.1, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END ...C=0.001, gamma=0.1, kernel=poly;, score=0.941 total time=   0.0s
```

```
[CV 3/5] END ...C=0.001, gamma=0.1, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ...C=0.001, gamma=0.1, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END ...C=0.001, gamma=0.1, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END ....C=0.001, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.1s
[CV 2/5] END ....C=0.001, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.1s
[CV 3/5] END ....C=0.001, gamma=0.1, kernel=rbf;, score=0.253 total time=   0.1s
[CV 4/5] END ....C=0.001, gamma=0.1, kernel=rbf;, score=0.253 total time=   0.1s
[CV 5/5] END ....C=0.001, gamma=0.1, kernel=rbf;, score=0.256 total time=   0.1s
[CV 1/5] END C=0.001, gamma=0.1, kernel=sigmoid;, score=0.256 total time=   0.0s
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[CV 1/5] END ..C=0.001, gamma=0.01, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END ..C=0.001, gamma=0.01, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END ..C=0.001, gamma=0.01, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ..C=0.001, gamma=0.01, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END ..C=0.001, gamma=0.01, kernel=poly;, score=0.950 total time=   0.0s
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[CV 4/5] END .C=0.001, gamma=0.001, kernel=poly;, score=0.966 total time=   0.1s
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[CV 4/5] END .C=0.001, gamma=0.0001, kernel=rbf;, score=0.253 total time=   0.0s
[CV 5/5] END .C=0.001, gamma=0.0001, kernel=rbf;, score=0.256 total time=   0.0s
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[CV 3/5] END ..C=0.0001, gamma=0.1, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END ..C=0.0001, gamma=0.1, kernel=poly;, score=0.966 total time=   0.0s
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```
[CV 5/5] END ..C=0.0001, gamma=0.1, kernel=poly;, score=0.950 total time=   0.0s
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[CV 1/5] END .C=0.0001, gamma=0.01, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END .C=0.0001, gamma=0.01, kernel=poly;, score=0.941 total time=   0.0s
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[CV 4/5] END .C=0.0001, gamma=0.01, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END .C=0.0001, gamma=0.01, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END ..C=0.0001, gamma=0.01, kernel=rbf;, score=0.256 total time=   0.1s
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[CV 5/5] END C=0.0001, gamma=0.01, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END C=0.0001, gamma=0.001, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END C=0.0001, gamma=0.001, kernel=poly;, score=0.941 total time=   0.0s
[CV 3/5] END C=0.0001, gamma=0.001, kernel=poly;, score=0.972 total time=   0.0s
[CV 4/5] END C=0.0001, gamma=0.001, kernel=poly;, score=0.966 total time=   0.1s
[CV 5/5] END C=0.0001, gamma=0.001, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END .C=0.0001, gamma=0.001, kernel=rbf;, score=0.256 total time=   0.1s
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[CV 4/5] END C=0.0001, gamma=0.001, kernel=sigmoid;, score=0.253 total time=   0.0s
[CV 5/5] END C=0.0001, gamma=0.001, kernel=sigmoid;, score=0.256 total time=   0.0s
[CV 1/5] END C=0.0001, gamma=0.0001, kernel=poly;, score=0.953 total time=   0.0s
[CV 2/5] END C=0.0001, gamma=0.0001, kernel=poly;, score=0.944 total time=   0.0s
[CV 3/5] END C=0.0001, gamma=0.0001, kernel=poly;, score=0.975 total time=   0.0s
[CV 4/5] END C=0.0001, gamma=0.0001, kernel=poly;, score=0.966 total time=   0.0s
[CV 5/5] END C=0.0001, gamma=0.0001, kernel=poly;, score=0.950 total time=   0.0s
[CV 1/5] END C=0.0001, gamma=0.0001, kernel=rbf;, score=0.256 total time=   0.0s
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[CV 5/5] END C=0.0001, gamma=0.0001, kernel=sigmoid;, score=0.256 total time=   0.0s
```

Out[40]:
```
GridSearchCV(estimator=SVC(),
             param_grid={'C': [0.1, 0.01, 0.001, 0.0001],
                         'gamma': [0.1, 0.01, 0.001, 0.0001],
                         'kernel': ['poly', 'rbf', 'sigmoid']},
             verbose=3)
```

In [41]:
```
GS.best_params_
```

Out[41]:
```
{'C': 0.0001, 'gamma': 0.0001, 'kernel': 'poly'}
```

In [42]:
```
# 3) Final SVC
H_SVC = SVC( kernel = "poly" , C = 0.0001 , gamma = 0.0001 )
MyModel(H_SVC,"H_SVC","'C': 0.0001, 'gamma': 0.0001, 'kernel': 'poly'")
print(f"Training Score :- {H_SVC.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.99      0.97      0.98        92
           1       0.95      0.98      0.96        96
           2       0.96      0.96      0.96       106
           3       0.98      0.97      0.98       106

    accuracy                           0.97       400
   macro avg       0.97      0.97      0.97       400
weighted avg       0.97      0.97      0.97       400

Training Score :- 0.998125
```

Conclusion

In [43]:
```
Algo_df = pd.DataFrame(algo_performance_list,columns=["ALgo",'Accuaracy','Params','Training Score'])
Algo_df
```

Out[43]:

	ALgo	Accuaracy	Params	Training Score
0	KNN	0.9125	Default	0.958125
1	H_KNN	0.9250	n_neighbors = 9	0.948125
2	LR	0.6150	Default	0.641250
3	H_Log_Reg	0.9625	solver = newton-cg , penalty = none	0.974375
4	RFC	0.8725	Default	1.000000
5	H_RFC	0.8575	'criterion'='entropy','max_depth'= 9,'min_samp...	0.985625
6	DTC	0.8475	Default	1.000000
7	H_DTC	0.8350	'criterion'='entropy','max_depth'= 8,'min_samp...	0.939375
8	SVC	0.9425	Default	0.953750
9	H_SVC	0.9700	'C': 0.0001, 'gamma': 0.0001, 'kernel': 'poly'	0.998125

Best Algo

In [44]:
```
Algo_df[Algo_df.Accuaracy == Algo_df.Accuaracy.max()]
```

Out[44]:

	ALgo	Accuaracy	Params	Training Score
9	H_SVC	0.97	'C': 0.0001, 'gamma': 0.0001, 'kernel': 'poly'	0.998125

Random Sample Testing

In [45]:
```
H_SVC = SVC( kernel = "poly" , C = 0.0001 , gamma = 0.0001 )
MyModel(H_SVC,"H_SVC","'C': 0.0001, 'gamma': 0.0001, 'kernel': 'poly'")
print(f"Training Score :- {H_SVC.score(X_train,Y_train)}")
```

```
              precision    recall  f1-score   support

           0       0.99      0.97      0.98        92
           1       0.95      0.98      0.96        96
           2       0.96      0.96      0.96       106
           3       0.98      0.97      0.98       106

    accuracy                           0.97       400
   macro avg       0.97      0.97      0.97       400
weighted avg       0.97      0.97      0.97       400

Training Score :- 0.998125
```

In [46]:
```
def predict_range(value):
    if value == 0:
      print("Price Is Low")

    elif value ==1:
      print('Price is Medium')

    elif value == 2:
      print('Price is High')

    else:
      print('Price is Very High')
```

In [47]:
```
# PR-0
s0 = np.array([df.loc[7].values[:-1]])
sa0 = H_SVC.predict(s0)
predict_range(sa0[0])
```

```
Price Is Low
```

In [48]:
```
# PR-1  (Testing on record present in Dataset)
s1 = np.array([df.loc[0].values[:-1]])
sa1 = H_SVC.predict(s1)
predict_range(sa1[0])
```

```
Price is Medium
```

In [49]:
```
# PR-2  (Testing on record present in Dataset)
s2 = np.array([df.loc[1].values[:-1]])
sa2 = H_SVC.predict(s2)
predict_range(sa2[0])
```

```
Price is High
```

In [50]:
```
# PR-3  (Testing on record present in Dataset)
s3 = np.array([df.loc[6].values[:-1]])
sa3 = H_SVC.predict(s3)
predict_range(sa3[0])
```

```
Price is Very High
```

In [ ]:
```

```

In [51]:
```
# (Testing on Random Values)
mobile=[842,0,2.2,0,1,0,7,0.6,188,2, 2,20,756,2549,9,7,19,0, 0, 1]
mobile = np.array([mobile])
value = H_SVC.predict(mobile)
predict_range(value)
```

```
Price is Medium
```

In [ ]:
```

```

In [ ]:
```

```