

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

```
In [4]: ▶ train_data=pd.read_csv(r"C:\Users\chinta pavani\Documents\Mobile_Price_Cla
train_data
```

Out[4]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_
0	842	0	2.2	0	1	0	7	0.6	1
1	1021	1	0.5	1	0	1	53	0.7	1
2	563	1	0.5	1	2	1	41	0.9	1
3	615	1	2.5	0	0	0	10	0.8	1
4	1821	1	1.2	0	13	1	44	0.6	1
...
1995	794	1	0.5	1	0	1	2	0.8	1
1996	1965	1	2.6	1	0	0	39	0.2	1
1997	1911	0	0.9	1	1	1	36	0.7	1
1998	1512	0	0.9	0	4	1	46	0.1	1
1999	510	1	2.0	1	5	1	45	0.9	1

2000 rows × 21 columns

```
In [5]: test_data=pd.read_csv(r"C:\Users\chinta pavani\Documents\Mobile_Price_Clas
test_data
```

Out[5]:

	id	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	m
0	1	1043	1	1.8	1	14	0	5	0.1	
1	2	841	1	0.5	1	4	1	61	0.8	
2	3	1807	1	2.8	0	1	0	27	0.9	
3	4	1546	0	0.5	1	18	1	25	0.5	
4	5	1434	0	1.4	0	11	1	49	0.5	
...
995	996	1700	1	1.9	0	0	1	54	0.5	
996	997	609	0	1.8	1	0	0	13	0.9	
997	998	1185	0	1.4	0	1	1	8	0.5	
998	999	1533	1	0.5	1	0	0	50	0.4	
999	1000	1270	1	0.5	0	4	1	35	0.1	

1000 rows × 21 columns

```
In [6]: train_data.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: 328.3 KB
```

```
In [7]: test_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 21 columns):
 #   Column              Non-Null Count  Dtype  
---  --
 0   id                  1000 non-null   int64  
 1   battery_power       1000 non-null   int64  
 2   blue                 1000 non-null   int64  
 3   clock_speed         1000 non-null   float64 
 4   dual_sim            1000 non-null   int64  
 5   fc                  1000 non-null   int64  
 6   four_g              1000 non-null   int64  
 7   int_memory          1000 non-null   int64  
 8   m_dep               1000 non-null   float64 
 9   mobile_wt           1000 non-null   int64  
10   n_cores              1000 non-null   int64  
11   pc                  1000 non-null   int64  
12   px_height            1000 non-null   int64  
13   px_width             1000 non-null   int64  
14   ram                  1000 non-null   int64  
15   sc_h                 1000 non-null   int64  
16   sc_w                 1000 non-null   int64  
17   talk_time            1000 non-null   int64  
18   three_g              1000 non-null   int64  
19   touch_screen         1000 non-null   int64  
20   wifi                 1000 non-null   int64  
dtypes: float64(2), int64(19)
memory usage: 164.2 KB
```

```
In [8]: x=train_data.drop('wifi',axis=1)
        y=train_data['wifi']
```

```
In [9]: x=test_data.drop('wifi',axis=1)
        y=test_data['wifi']
```

```
In [10]: train_data['dual_sim'].value_counts()
```

```
Out[10]: dual_sim
1      1019
0       981
Name: count, dtype: int64
```

```
In [11]: test_data['dual_sim'].value_counts()
```

```
Out[11]: dual_sim
1       517
0       483
Name: count, dtype: int64
```

```
In [12]: TG={"three_g":{"yes":1,"No":0}}
train_data=train_data.replace(TG)
print(train_data)
```

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory
0	842	0	2.2	0	1	0	7
\							
1	1021	1	0.5	1	0	1	53
2	563	1	0.5	1	2	1	41
3	615	1	2.5	0	0	0	10
4	1821	1	1.2	0	13	1	44
...
1995	794	1	0.5	1	0	1	2
1996	1965	1	2.6	1	0	0	39
1997	1911	0	0.9	1	1	1	36
1998	1512	0	0.9	0	4	1	46
1999	510	1	2.0	1	5	1	45

	m_dep	mobile_wt	n_cores	...	px_height	px_width	ram	sc_h	sc
_w									
0	0.6	188	2	...	20	756	2549	9	
7 \									
1	0.7	136	3	...	905	1988	2631	17	
3									
2	0.9	145	5	...	1263	1716	2603	11	
2									
3	0.8	131	6	...	1216	1786	2769	16	
8									
4	0.6	141	2	...	1208	1212	1411	8	
2									
...	
...									
1995	0.8	106	6	...	1222	1890	668	13	
4									
1996	0.2	187	4	...	915	1965	2032	11	
10									
1997	0.7	108	8	...	868	1632	3057	9	
1									
1998	0.1	145	5	...	336	670	869	18	
10									
1999	0.9	168	6	...	483	754	3919	19	
4									

	talk_time	three_g	touch_screen	wifi	price_range
0	19	0	0	1	1
1	7	1	1	0	2
2	9	1	1	0	2
3	11	1	0	0	2
4	15	1	1	0	1
...
1995	19	1	1	0	0
1996	16	1	1	1	2
1997	5	1	1	0	3
1998	19	1	1	1	0
1999	2	1	1	1	3

```
[2000 rows x 21 columns]
```

```
In [13]: ► TG={"three_g":{"yes":1,"No":0}}  
test_data=test_data.replace(TG)  
print(test_data)
```

	id	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_me
0	1	1043	1	1.8	1	14	0	
1	2	841	1	0.5	1	4	1	
2	3	1807	1	2.8	0	1	0	
3	4	1546	0	0.5	1	18	1	
4	5	1434	0	1.4	0	11	1	
...	
995	996	1700	1	1.9	0	0	1	
996	997	609	0	1.8	1	0	0	
997	998	1185	0	1.4	0	1	1	
998	999	1533	1	0.5	1	0	0	
999	1000	1270	1	0.5	0	4	1	

	m_dep	mobile_wt	...	pc	px_height	px_width	ram	sc_h	sc_w
0	0.1	193	...	16	226	1412	3476	12	7
1	0.8	191	...	12	746	857	3895	6	0
2	0.9	186	...	4	1270	1366	2396	17	10
3	0.5	96	...	20	295	1752	3893	10	0
4	0.5	108	...	18	749	810	1773	15	8
...
995	0.5	170	...	17	644	913	2121	14	8
996	0.9	186	...	2	1152	1632	1933	8	1
997	0.5	80	...	12	477	825	1223	5	0
998	0.4	171	...	12	38	832	2509	15	11
999	0.1	140	...	19	457	608	2828	9	2

	talk_time	three_g	touch_screen	wifi
0	2	0	1	0
1	7	1	0	0
2	10	0	1	1
3	7	1	1	0
4	7	1	0	1
...
995	15	1	1	0
996	19	0	1	1
997	14	1	0	0
998	6	0	1	0
999	3	1	0	1

[1000 rows x 21 columns]

```
In [14]: ▶ from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,train_size=0.7,random_s
x_train.shape,x_test.shape
```

Out[14]: ((700, 20), (300, 20))

```
In [15]: ▶ from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[15]:

▼ RandomForestClassifier
RandomForestClassifier()

```
In [16]: ▶ rf=RandomForestClassifier()
params={'max_depth':[2,3,5,10,20],
        'min_samples_leaf':[5,10,20,50,100,200],
        'n_estimators':[10,25,30,50,100,200]}
```



```
In [17]: from sklearn.model_selection import GridSearchCV
grid_search=GridSearchCV(estimator=rf,param_grid=params,cv=2,scoring='accu
grid_search.fit(x_train,y_train)
```

C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\model_selection_validation.py:378: FitFailedWarning:
60 fits failed out of a total of 300.
The score on these train-test partitions for these parameters will be set to nan.
If these failures are not expected, you can try to debug them by setting error_score='raise'.

Below are more details about the failures:

```
-----
-----
60 fits failed with the following error:
Traceback (most recent call last):
  File "C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\model_selection\_validation.py", line 686, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\ensemble\_forest.py", line 340, in fit
    self._validate_params()
  File "C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\base.py", line 600, in _validate_params
    validate_parameter_constraints(
  File "C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\utils\_param_validation.py", line 97, in validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'min_samples_leaf' parameter of RandomForestClassifier must be an int in the range [1, inf) or a float in the range (0.0, 1.0). Got 20.5 instead.
```

```
warnings.warn(some_fits_failed_message, FitFailedWarning)
C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\model_selection\_search.py:952: UserWarning: One or more of the test scores are non-finite: [0.51571429 0.52714286 0.52285714 0.52428571 0.52285714 0.51428571
0.50285714 0.54142857 0.49428571 0.50571429 0.49857143 0.51857143
nan nan nan nan nan nan
0.49857143 0.51428571 0.52428571 0.54428571 0.55428571 0.52285714
0.49857143 0.50142857 0.50142857 0.50142857 0.49857143 0.50142857
0.47571429 0.51857143 0.51142857 0.53142857 0.51857143 0.49857143
0.49428571 0.51714286 0.49428571 0.54285714 0.50571429 0.51857143
nan nan nan nan nan nan
0.52857143 0.55 0.50571429 0.52285714 0.54428571 0.53714286
0.50142857 0.50142857 0.49857143 0.50142857 0.49857143 0.50142857
0.48714286 0.52285714 0.50285714 0.50285714 0.51571429 0.50714286
0.49571429 0.5 0.51857143 0.50571429 0.52 0.49428571
nan nan nan nan nan nan
0.52428571 0.51857143 0.54428571 0.55 0.54428571 0.52571429
0.49857143 0.50142857 0.50142857 0.50142857 0.49857143 0.50142857
0.51142857 0.51714286 0.49428571 0.51285714 0.52857143 0.51571429
0.49571429 0.51714286 0.50428571 0.51714286 0.52857143 0.51142857
```

```

nan nan nan nan nan nan
0.53857143 0.54 0.53857143 0.53142857 0.54285714 0.54428571
0.49857143 0.49857143 0.49857143 0.49857143 0.50142857 0.49857143
0.48571429 0.51428571 0.49571429 0.52 0.52142857 0.50857143
0.51857143 0.51142857 0.52714286 0.50428571 0.51571429 0.51142857
nan nan nan nan nan nan
0.55 0.51428571 0.52571429 0.54571429 0.54571429 0.53142857
0.49857143 0.49857143 0.50142857 0.50142857 0.49857143 0.50142857]
warnings.warn(

```

Out[17]:

```

GridSearchCV
  estimator: RandomForestClassifier
    RandomForestClassifier

```

In [18]: `grid_search.best_score_`

Out[18]: 0.5542857142857143

In [19]: `grid_search.fit(x_train,y_train)`

```
C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\model_selection\_validation.py:378: FitFailedWarning:
60 fits failed out of a total of 300.
The score on these train-test partitions for these parameters will be set
to nan.
If these failures are not expected, you can try to debug them by setting
error_score='raise'.
```

Below are more details about the failures:

```
-----
-----
60 fits failed with the following error:
Traceback (most recent call last):
  File "C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\model_selection\_validation.py", line 686, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\ensemble\_forest.py", line 340, in fit
    self._validate_params()
  File "C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\base.py", line 600, in _validate_params
    validate_parameter_constraints(
  File "C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\utils\_param_validation.py", line 97, in validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The 'min_samples_leaf' parameter of RandomForestClassifier must be an int in the range [1, inf) or a float in the range (0.0, 1.0). Got 20.5 instead.
```

```
warnings.warn(some_fits_failed_message, FitFailedWarning)
C:\Users\chinta pavani\AppData\Local\Programs\Python\Python311\Lib\site-packages\sklearn\model_selection\_search.py:952: UserWarning: One or more
of the test scores are non-finite: [0.52428571 0.49428571 0.51      0.52
0.52      0.53571429
0.53142857 0.50857143 0.51      0.51571429 0.52571429 0.50571429
nan nan nan nan nan nan
0.51857143 0.52428571 0.53      0.54571429 0.52857143 0.53857143
0.50142857 0.49857143 0.49857143 0.49857143 0.49857143 0.50142857
0.51571429 0.52857143 0.50857143 0.52285714 0.50571429 0.51142857
0.53428571 0.52428571 0.52571429 0.50571429 0.52857143 0.50714286
nan nan nan nan nan nan
0.51857143 0.52142857 0.55285714 0.52714286 0.54      0.53428571
0.49857143 0.49857143 0.49857143 0.49857143 0.49857143 0.49857143
0.49428571 0.51285714 0.52428571 0.49      0.52      0.52
0.51428571 0.50857143 0.49428571 0.49714286 0.50142857 0.50571429
nan nan nan nan nan nan
0.52571429 0.51142857 0.52571429 0.52285714 0.54571429 0.54428571
0.49857143 0.49857143 0.50142857 0.50142857 0.50142857 0.50142857
0.50857143 0.51571429 0.49428571 0.48857143 0.51428571 0.49571429
0.53428571 0.50571429 0.51142857 0.52571429 0.51      0.5
nan nan nan nan nan nan
```

```

0.52714286 0.52428571 0.52428571 0.52571429 0.54142857 0.54285714
0.50142857 0.50142857 0.49857143 0.49857143 0.49857143 0.50142857
0.50714286 0.50285714 0.51857143 0.51142857 0.52714286 0.49
0.50714286 0.5          0.52428571 0.50714286 0.50142857 0.50857143
          nan          nan          nan          nan          nan          nan
0.52857143 0.55          0.53428571 0.52142857 0.55          0.53428571
0.50142857 0.49857143 0.49857143 0.50142857 0.50142857 0.50142857]

```

Out[19]:

```

GridSearchCV
  estimator: RandomForestClassifier
    RandomForestClassifier

```

In [20]: `grid_search.best_score_`

Out[20]: 0.5528571428571429

In [21]: `rf_best=grid_search.best_estimator_
print(rf_best)`

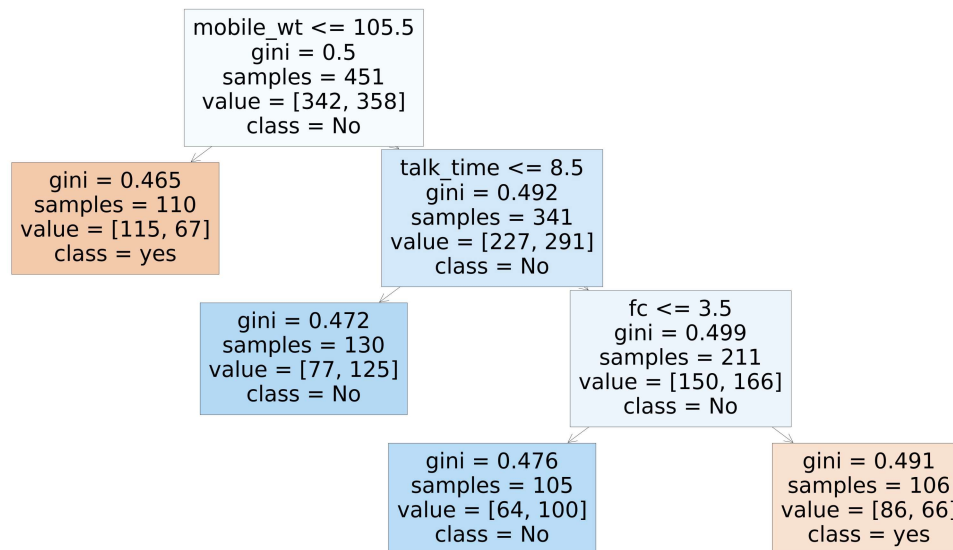
```

RandomForestClassifier(max_depth=3, min_samples_leaf=100, n_estimators=30)

```

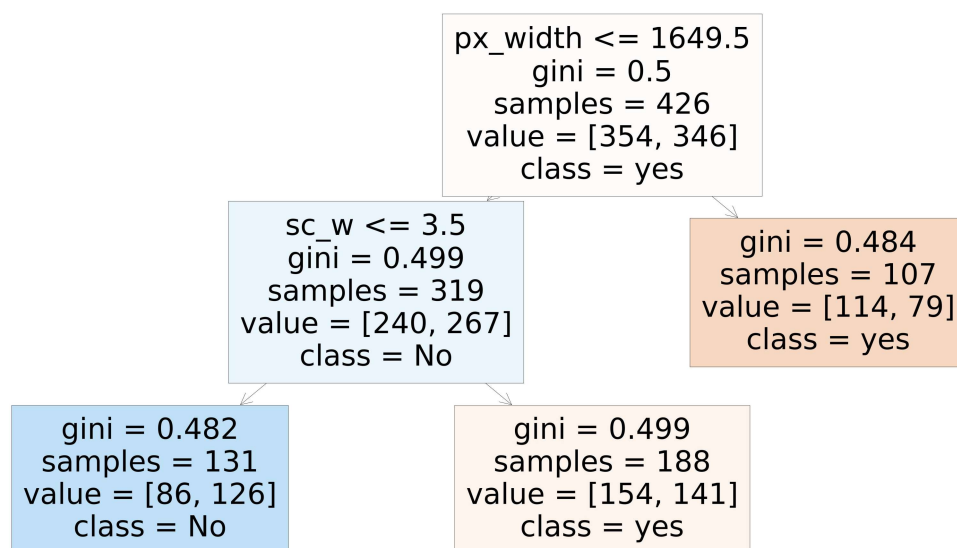
```
In [23]: from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[5],feature_names=x.columns,class_names=["yes
```

```
Out[23]: [Text(0.3333333333333333, 0.875, 'mobile_wt <= 105.5\ngini = 0.5\nsamples = 451\nvalue = [342, 358]\nnclass = No'),
Text(0.16666666666666666, 0.625, 'gini = 0.465\nsamples = 110\nvalue = [115, 67]\nnclass = yes'),
Text(0.5, 0.625, 'talk_time <= 8.5\ngini = 0.492\nsamples = 341\nvalue = [227, 291]\nnclass = No'),
Text(0.3333333333333333, 0.375, 'gini = 0.472\nsamples = 130\nvalue = [77, 125]\nnclass = No'),
Text(0.6666666666666666, 0.375, 'fc <= 3.5\ngini = 0.499\nsamples = 211\nvalue = [150, 166]\nnclass = No'),
Text(0.5, 0.125, 'gini = 0.476\nsamples = 105\nvalue = [64, 100]\nnclass = No'),
Text(0.8333333333333334, 0.125, 'gini = 0.491\nsamples = 106\nvalue = [86, 66]\nnclass = yes')]
```



```
In [24]: from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[7],feature_names=x.columns,class_names=["yes
```

```
Out[24]: [Text(0.6, 0.8333333333333334, 'px_width <= 1649.5\ngini = 0.5\nsamples =
426\nvalue = [354, 346]\nnclass = yes'),
Text(0.4, 0.5, 'sc_w <= 3.5\ngini = 0.499\nsamples = 319\nvalue = [240,
267]\nnclass = No'),
Text(0.2, 0.16666666666666666, 'gini = 0.482\nsamples = 131\nvalue = [8
6, 126]\nnclass = No'),
Text(0.6, 0.16666666666666666, 'gini = 0.499\nsamples = 188\nvalue = [15
4, 141]\nnclass = yes'),
Text(0.8, 0.5, 'gini = 0.484\nsamples = 107\nvalue = [114, 79]\nnclass =
yes')]
```



```
In [25]: rf_best.feature_importances_
```

```
Out[25]: array([0.04378865, 0.01906055, 0.          , 0.10309117, 0.03259169,
0.05663009, 0.02551192, 0.09105811, 0.07012547, 0.13641435,
0.00347005, 0.05710332, 0.05944265, 0.19018487, 0.03439025,
0.          , 0.03317861, 0.03921657, 0.          , 0.00474167])
```

```
In [26]: ▶ imp_df=pd.DataFrame({"varname":x_train.columns,"Imp":rf_best.feature_importances_})
imp_df.sort_values(by="Imp",ascending=False)
```

Out[26]:

	varname	Imp
13	px_width	0.190185
9	mobile_wt	0.136414
3	clock_speed	0.103091
7	int_memory	0.091058
8	m_dep	0.070125
12	px_height	0.059443
11	pc	0.057103
5	fc	0.056630
0	id	0.043789
17	talk_time	0.039217
14	ram	0.034390
16	sc_w	0.033179
4	dual_sim	0.032592
6	four_g	0.025512
1	battery_power	0.019061
19	touch_screen	0.004742
10	n_cores	0.003470
15	sc_h	0.000000
2	blue	0.000000
18	three_g	0.000000

In []: ▶