Random Forest

In [1]:

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

In [2]:

```
train_data=pd.read_csv(r"C:\Users\91949\Downloads\Mobile_Price_Classification_train.csv")
train_data
```

Out[2]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_cores	...	px_height	px_wi
0	842	0	2.2	0	1	0	7	0.6	188	2	...	20	
1	1021	1	0.5	1	0	1	53	0.7	136	3	...	905	1
2	563	1	0.5	1	2	1	41	0.9	145	5	...	1263	1
3	615	1	2.5	0	0	0	10	0.8	131	6	...	1216	1
4	1821	1	1.2	0	13	1	44	0.6	141	2	...	1208	1
...	...	...	...	...	...	...	...	...	...	...	...	...	
1995	794	1	0.5	1	0	1	2	0.8	106	6	...	1222	1
1996	1965	1	2.6	1	0	0	39	0.2	187	4	...	915	1
1997	1911	0	0.9	1	1	1	36	0.7	108	8	...	868	1
1998	1512	0	0.9	0	4	1	46	0.1	145	5	...	336	
1999	510	1	2.0	1	5	1	45	0.9	168	6	...	483	

2000 rows × 21 columns

In [3]:

```
test_data=pd.read_csv(r"C:\Users\91949\Downloads\Mobile_Price_Classification_test.csv")
test_data
```

Out[3]:

	id	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	...	pc	px_height	px_wi
0	1	1043	1	1.8	1	14	0	5	0.1	193	...	16	226	1
1	2	841	1	0.5	1	4	1	61	0.8	191	...	12	746	
2	3	1807	1	2.8	0	1	0	27	0.9	186	...	4	1270	1
3	4	1546	0	0.5	1	18	1	25	0.5	96	...	20	295	1
4	5	1434	0	1.4	0	11	1	49	0.5	108	...	18	749	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
995	996	1700	1	1.9	0	0	1	54	0.5	170	...	17	644	
996	997	609	0	1.8	1	0	0	13	0.9	186	...	2	1152	1
997	998	1185	0	1.4	0	1	1	8	0.5	80	...	12	477	
998	999	1533	1	0.5	1	0	0	50	0.4	171	...	12	38	
999	1000	1270	1	0.5	0	4	1	35	0.1	140	...	19	457	

1000 rows × 21 columns

In [4]:

```
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: 328.2 KB
```

In [5]:

```
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 [6]:

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

In [7]:

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

In [8]:

```
train_data['dual_sim'].value_counts()
```

Out[8]:

```
1    1019
0     981
Name: dual_sim, dtype: int64
```

In [9]:

```
test_data['dual_sim'].value_counts()
```

Out[9]:

```
1    517
0    483
Name: dual_sim, dtype: int64
```

In [10]:

```
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 [11]:

```
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_memory  \
0       1           1043     1          1.8         1  14       0           5   
1       2            841     1          0.5         1   4       1          61   
2       3           1807     1          2.8         0   1       0          27   
3       4           1546     0          0.5         1  18       1          25   
4       5           1434     0          1.4         0  11       1          49   
..    ...            ...   ...          ...       ...  ..     ...         ...   
995   996           1700     1          1.9         0   0       1          54   
996   997            609     0          1.8         1   0       0          13   
997   998           1185     0          1.4         0   1       1           8   
998   999           1533     1          0.5         1   0       0          50   
999  1000           1270     1          0.5         0   4       1          35   

     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 [12]:

```
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_state=42)
x_train.shape,x_test.shape
```

Out[12]:

```
((700, 20), (300, 20))
```

In [13]:

```
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[13]:

```
▾ RandomForestClassifier
RandomForestClassifier()
```

In [14]:

```
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 [15]:

```
from sklearn.model_selection import GridSearchCV
grid_search=GridSearchCV(estimator=rf,param_grid=params,cv=2,scoring='accuracy')
grid_search.fit(x_train,y_train)
```

Out[15]:

```
▸            GridSearchCV
▸ estimator: RandomForestClassifier
      ▸ RandomForestClassifier
```

In [16]:

```
grid_search.best_score_
```

Out[16]:

```
0.5571428571428572
```

In [17]:

```
rf_best=grid_search.best_estimator_
print(rf_best)
```

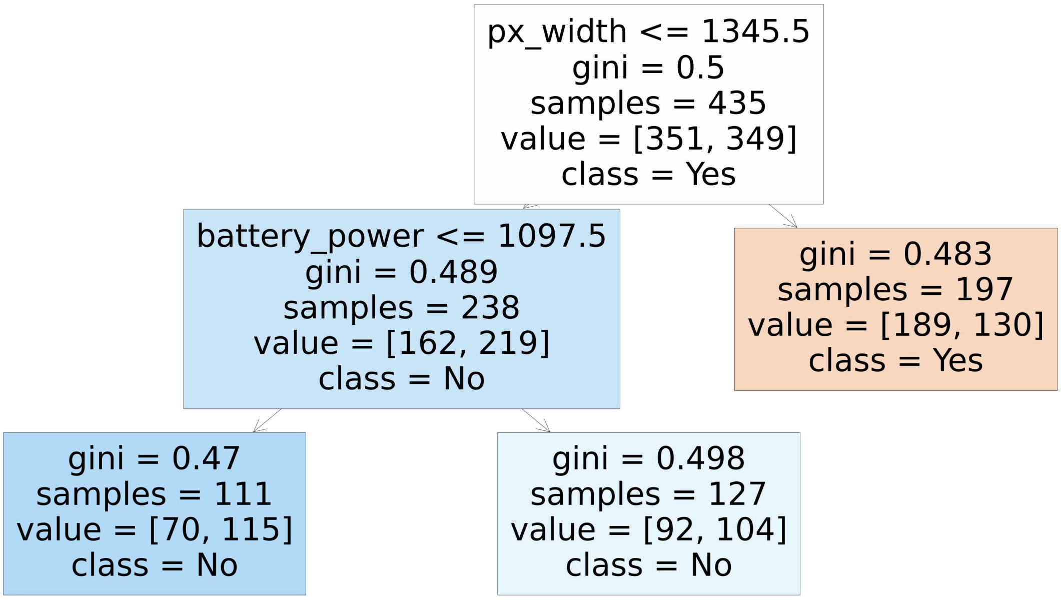
```
RandomForestClassifier(max_depth=2, min_samples_leaf=100, n_estimators=30)
```

In [18]:

```
from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[5],feature_names=x.columns,class_names=["Yes","No"],filled=True)
```

Out[18]:

```
[Text(0.6, 0.8333333333333334, 'px_width <= 1345.5\ngini = 0.5\nsamples = 435\nvalue = [351, 349]\nc
lass = Yes'),
 Text(0.4, 0.5, 'battery_power <= 1097.5\ngini = 0.489\nsamples = 238\nvalue = [162, 219]\nclass = N
o'),
 Text(0.2, 0.16666666666666666, 'gini = 0.47\nsamples = 111\nvalue = [70, 115]\nclass = No'),
 Text(0.6, 0.16666666666666666, 'gini = 0.498\nsamples = 127\nvalue = [92, 104]\nclass = No'),
 Text(0.8, 0.5, 'gini = 0.483\nsamples = 197\nvalue = [189, 130]\nclass = Yes')]
```

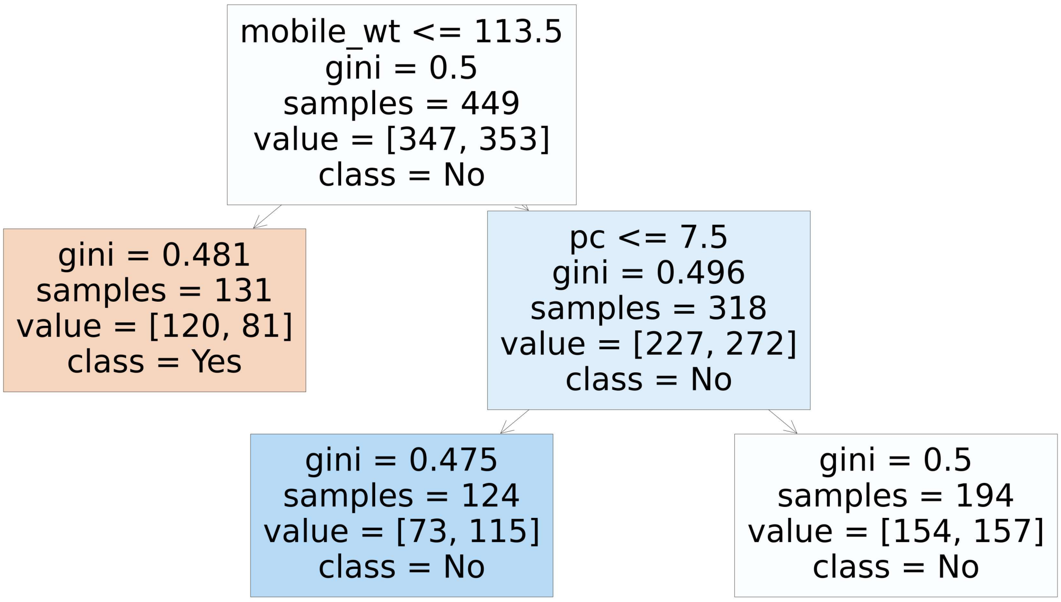


In [19]:

```
from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[7],feature_names=x.columns,class_names=["Yes","No"],filled=True)
```

Out[19]:

```
[Text(0.4, 0.8333333333333334, 'mobile_wt <= 113.5\ngini = 0.5\nsamples = 449\nvalue = [347, 353]\nc
lass = No'),
 Text(0.2, 0.5, 'gini = 0.481\nsamples = 131\nvalue = [120, 81]\nclass = Yes'),
 Text(0.6, 0.5, 'pc <= 7.5\ngini = 0.496\nsamples = 318\nvalue = [227, 272]\nclass = No'),
 Text(0.4, 0.16666666666666666, 'gini = 0.475\nsamples = 124\nvalue = [73, 115]\nclass = No'),
 Text(0.8, 0.16666666666666666, 'gini = 0.5\nsamples = 194\nvalue = [154, 157]\nclass = No')]
```



In [20]:

```
rf_best.feature_importances_
```

Out[20]:

```
array([0.07088638, 0.06396147, 0.00721854, 0.07456214, 0.00611361,
       0.07712982, 0.02052133, 0.0501076 , 0.13255938, 0.08858561,
       0.        , 0.10716665, 0.01492751, 0.1697181 , 0.04748206,
       0.01059658, 0.0081685 , 0.03018817, 0.01404501, 0.00606152])
```

In [21]:

```python
imp_df=pd.DataFrame({"varname":x_train.columns,"Imp":rf_best.feature_importances_})
imp_df.sort_values(by="Imp",ascending=False)
```

Out[21]:

	varname	Imp
13	px_width	0.169718
8	m_dep	0.132559
11	pc	0.107167
9	mobile_wt	0.088586
5	fc	0.077130
3	clock_speed	0.074562
0	id	0.070886
1	battery_power	0.063961
7	int_memory	0.050108
14	ram	0.047482
17	talk_time	0.030188
6	four_g	0.020521
12	px_height	0.014928
18	three_g	0.014045
15	sc_h	0.010597
16	sc_w	0.008168
2	blue	0.007219
4	dual_sim	0.006114
19	touch_screen	0.006062
10	n_cores	0.000000