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

In [2]:
```
.read_csv(r"C:\Users\dinesh reddy\AppData\Local\Microsoft\Windows\INetCache\IE\SYERC185\Mobile_Price_Classification_train[1].csv"
```

Out[2]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_cores	...	px_height	px_width	ram	sc_h	sc_w	talk_time
0	842	0	2.2	0	1	0	7	0.6	188	2	...	20	756	2549	9	7	19
1	1021	1	0.5	1	0	1	53	0.7	136	3	...	905	1988	2631	17	3	7
2	563	1	0.5	1	2	1	41	0.9	145	5	...	1263	1716	2603	11	2	9
3	615	1	2.5	0	0	0	10	0.8	131	6	...	1216	1786	2769	16	8	11
4	1821	1	1.2	0	13	1	44	0.6	141	2	...	1208	1212	1411	8	2	15
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1995	794	1	0.5	1	0	1	2	0.8	106	6	...	1222	1890	668	13	4	19
1996	1965	1	2.6	1	0	0	39	0.2	187	4	...	915	1965	2032	11	10	16
1997	1911	0	0.9	1	1	1	36	0.7	108	8	...	868	1632	3057	9	1	5
1998	1512	0	0.9	0	4	1	46	0.1	145	5	...	336	670	869	18	10	19
1999	510	1	2.0	1	5	1	45	0.9	168	6	...	483	754	3919	19	4	2

2000 rows × 21 columns

In [3]:
```
test_df=pd.read_csv(r"C:\Users\dinesh reddy\AppData\Local\Microsoft\Windows\INetCache\IE\3UKEA11U\Mobile_Price_Classification_tes
test_df
```

Out[3]:

	id	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	...	pc	px_height	px_width	ram	sc_h	sc_w	talk_time
0	1	1043	1	1.8	1	14	0	5	0.1	193	...	16	226	1412	3476	12	7	2
1	2	841	1	0.5	1	4	1	61	0.8	191	...	12	746	857	3895	6	0	7
2	3	1807	1	2.8	0	1	0	27	0.9	186	...	4	1270	1366	2396	17	10	10
3	4	1546	0	0.5	1	18	1	25	0.5	96	...	20	295	1752	3893	10	0	7
4	5	1434	0	1.4	0	11	1	49	0.5	108	...	18	749	810	1773	15	8	7
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
995	996	1700	1	1.9	0	0	1	54	0.5	170	...	17	644	913	2121	14	8	15
996	997	609	0	1.8	1	0	0	13	0.9	186	...	2	1152	1632	1933	8	1	19
997	998	1185	0	1.4	0	1	1	8	0.5	80	...	12	477	825	1223	5	0	14
998	999	1533	1	0.5	1	0	0	50	0.4	171	...	12	38	832	2509	15	11	6
999	1000	1270	1	0.5	0	4	1	35	0.1	140	...	19	457	608	2828	9	2	3

1000 rows × 21 columns

In [4]:
```
train_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
```

In [5]:
```
test_df.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=test_df.drop('dual_sim',axis=1)
y=test_df['dual_sim']
```

In [7]:
```
x=test_df.drop('dual_sim',axis=1)
y=test_df['dual_sim']
```

In [8]:
```
train_df['blue'].value_counts()
```

Out[8]:
```
blue
0    1010
1     990
Name: count, dtype: int64
```

In [9]:
```
test_df['blue'].value_counts()
```

Out[9]:
```
blue
1    516
0    484
Name: count, dtype: int64
```

In [10]:
```
T={"three_g":{'Yes':1,'No':0}}
train_df=train_df.replace(T)
print(train_df)
```

```
      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]:
```
T={"three_g":{'Yes':1,'No':0}}
test_df=test_df.replace(T)
print(test_df)
```

```
       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]:
```
x=train_df.drop('dual_sim',axis=1)
y=train_df['dual_sim']
```

In [13]:
```
x=test_df.drop('dual_sim',axis=1)
y=test_df['dual_sim']
```

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_state=42)
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()
```

In [17]:
```
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 [18]:
```
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[18]:

GridSearchCV
estimator: RandomForestClassifier
RandomForestClassifier

In [19]:
```
grid_search.best_score_
```

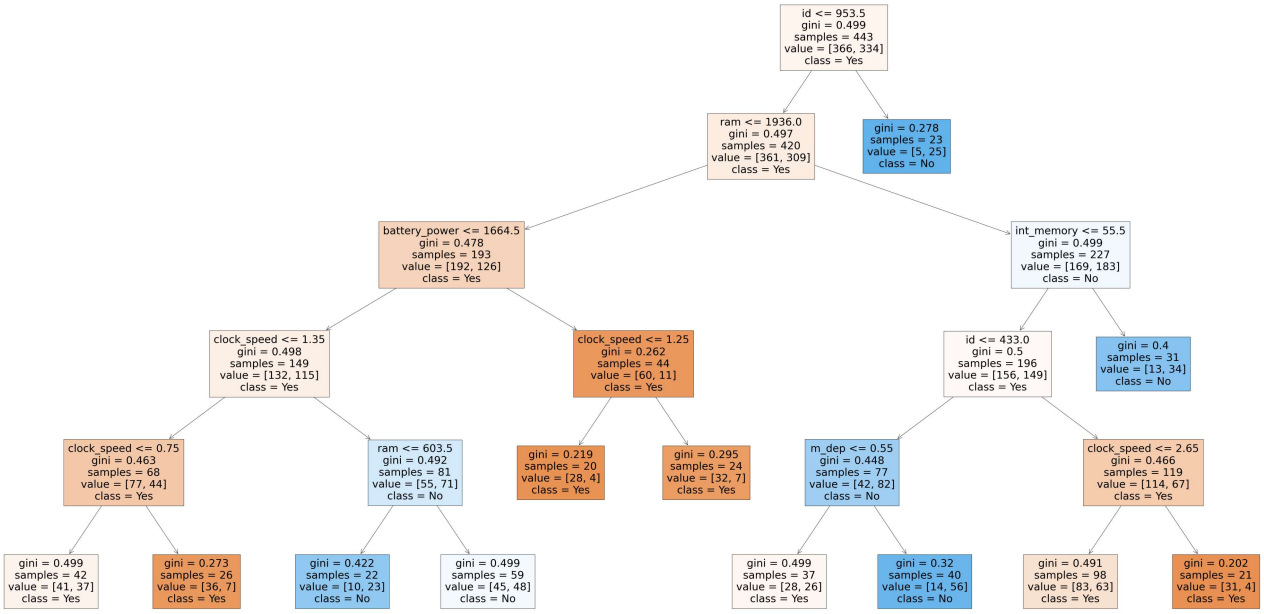
Out[19]:
```
0.54
```

In [20]:
```
rf_best=grid_search.best_estimator_
print(rf_best)
```

```
RandomForestClassifier(max_depth=5, min_samples_leaf=20, n_estimators=30)
```

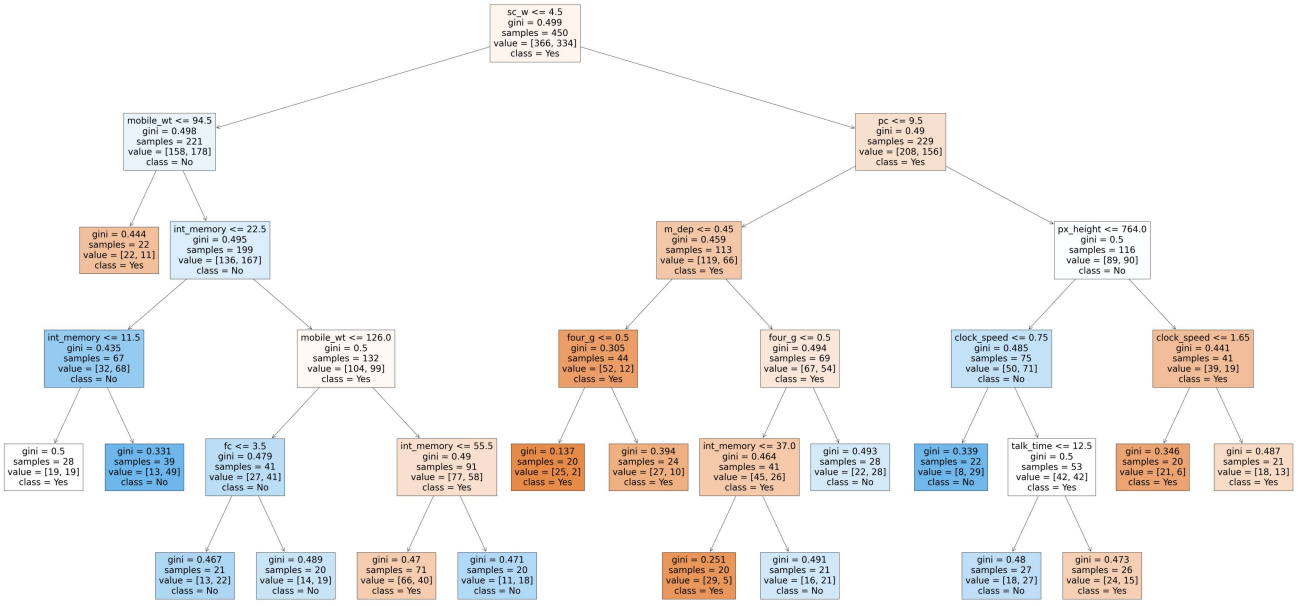
In [21]:
```
from sklearn.tree import plot_tree
plt.figure(figsize=(80,40))
plot_tree(rf_best.estimators_[5],feature_names=x.columns,class_names=['Yes','No'],filled=True)
```

Out[21]:
```
[Text(0.6527777777777778, 0.9166666666666666, 'id <= 953.5\ngini = 0.499\nsamples = 443\nvalue = [366, 334]\nclass = Yes'),
 Text(0.5972222222222222, 0.75, 'ram <= 1936.0\ngini = 0.497\nsamples = 420\nvalue = [361, 309]\nclass = Yes'),
 Text(0.3611111111111111, 0.5833333333333334, 'battery_power <= 1664.5\ngini = 0.478\nsamples = 193\nvalue = [192, 126]\nclass
= Yes'),
 Text(0.2222222222222222, 0.4166666666666667, 'clock_speed <= 1.35\ngini = 0.498\nsamples = 149\nvalue = [132, 115]\nclass = Ye
s'),
 Text(0.1111111111111111, 0.25, 'clock_speed <= 0.75\ngini = 0.463\nsamples = 68\nvalue = [77, 44]\nclass = Yes'),
 Text(0.05555555555555555, 0.08333333333333333, 'gini = 0.499\nsamples = 42\nvalue = [41, 37]\nclass = Yes'),
 Text(0.16666666666666666, 0.08333333333333333, 'gini = 0.273\nsamples = 26\nvalue = [36, 7]\nclass = Yes'),
 Text(0.3333333333333333, 0.25, 'ram <= 603.5\ngini = 0.492\nsamples = 81\nvalue = [55, 71]\nclass = No'),
 Text(0.2777777777777778, 0.08333333333333333, 'gini = 0.422\nsamples = 22\nvalue = [10, 23]\nclass = No'),
 Text(0.3888888888888889, 0.08333333333333333, 'gini = 0.499\nsamples = 59\nvalue = [45, 48]\nclass = No'),
 Text(0.5, 0.4166666666666667, 'clock_speed <= 1.25\ngini = 0.262\nsamples = 44\nvalue = [60, 11]\nclass = Yes'),
 Text(0.4444444444444444, 0.25, 'gini = 0.219\nsamples = 20\nvalue = [28, 4]\nclass = Yes'),
 Text(0.5555555555555556, 0.25, 'gini = 0.295\nsamples = 24\nvalue = [32, 7]\nclass = Yes'),
 Text(0.8333333333333334, 0.5833333333333334, 'int_memory <= 55.5\ngini = 0.499\nsamples = 227\nvalue = [169, 183]\nclass = N
o'),
 Text(0.7777777777777778, 0.4166666666666667, 'id <= 433.0\ngini = 0.5\nsamples = 196\nvalue = [156, 149]\nclass = Yes'),
 Text(0.6666666666666666, 0.25, 'm_dep <= 0.55\ngini = 0.448\nsamples = 77\nvalue = [42, 82]\nclass = No'),
 Text(0.6111111111111112, 0.08333333333333333, 'gini = 0.499\nsamples = 37\nvalue = [28, 26]\nclass = Yes'),
 Text(0.7222222222222222, 0.08333333333333333, 'gini = 0.32\nsamples = 40\nvalue = [14, 56]\nclass = No'),
 Text(0.8888888888888888, 0.25, 'clock_speed <= 2.65\ngini = 0.466\nsamples = 119\nvalue = [114, 67]\nclass = Yes'),
 Text(0.8333333333333334, 0.08333333333333333, 'gini = 0.491\nsamples = 98\nvalue = [83, 63]\nclass = Yes'),
 Text(0.9444444444444444, 0.08333333333333333, 'gini = 0.202\nsamples = 21\nvalue = [31, 4]\nclass = Yes'),
 Text(0.8888888888888888, 0.4166666666666667, 'gini = 0.4\nsamples = 31\nvalue = [13, 34]\nclass = No'),
 Text(0.7083333333333334, 0.75, 'gini = 0.278\nsamples = 23\nvalue = [5, 25]\nclass = No')]
```



In [22]:
```
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[22]:
```
[Text(0.41346153846153844, 0.9166666666666666, 'sc_w <= 4.5\ngini = 0.499\nsamples = 450\nvalue = [366, 334]\nclass = Yes'),
 Text(0.1346153846153846, 0.75, 'mobile_wt <= 94.5\ngini = 0.498\nsamples = 221\nvalue = [158, 178]\nclass = No'),
 Text(0.09615384615384616, 0.5833333333333334, 'gini = 0.444\nsamples = 22\nvalue = [22, 11]\nclass = Yes'),
 Text(0.17307692307692307, 0.5833333333333334, 'int_memory <= 22.5\ngini = 0.495\nsamples = 199\nvalue = [136, 167]\nclass = No'),
 Text(0.07692307692307693, 0.4166666666666667, 'int_memory <= 11.5\ngini = 0.435\nsamples = 67\nvalue = [32, 68]\nclass = No'),
 Text(0.038461538461538464, 0.25, 'gini = 0.5\nsamples = 28\nvalue = [19, 19]\nclass = Yes'),
 Text(0.11538461538461539, 0.25, 'gini = 0.331\nsamples = 39\nvalue = [13, 49]\nclass = No'),
 Text(0.2692307692307692, 0.4166666666666667, 'mobile_wt <= 126.0\ngini = 0.5\nsamples = 132\nvalue = [104, 99]\nclass = Yes'),
 Text(0.19230769230769232, 0.25, 'fc <= 3.5\ngini = 0.479\nsamples = 41\nvalue = [27, 41]\nclass = No'),
 Text(0.15384615384615385, 0.08333333333333333, 'gini = 0.467\nsamples = 21\nvalue = [13, 22]\nclass = No'),
 Text(0.23076923076923078, 0.08333333333333333, 'gini = 0.489\nsamples = 20\nvalue = [14, 19]\nclass = No'),
 Text(0.34615384615384615, 0.25, 'int_memory <= 55.5\ngini = 0.49\nsamples = 91\nvalue = [77, 58]\nclass = Yes'),
 Text(0.3076923076923077, 0.08333333333333333, 'gini = 0.47\nsamples = 71\nvalue = [66, 40]\nclass = Yes'),
 Text(0.38461538461538464, 0.08333333333333333, 'gini = 0.471\nsamples = 20\nvalue = [11, 18]\nclass = No'),
 Text(0.6923076923076923, 0.75, 'pc <= 9.5\ngini = 0.49\nsamples = 229\nvalue = [208, 156]\nclass = Yes'),
 Text(0.5384615384615384, 0.5833333333333334, 'm_dep <= 0.45\ngini = 0.459\nsamples = 113\nvalue = [119, 66]\nclass = Yes'),
 Text(0.46153846153846156, 0.4166666666666667, 'four_g <= 0.5\ngini = 0.305\nsamples = 44\nvalue = [52, 12]\nclass = Yes'),
 Text(0.4230769230769231, 0.25, 'gini = 0.137\nsamples = 20\nvalue = [25, 2]\nclass = Yes'),
 Text(0.5, 0.25, 'gini = 0.394\nsamples = 24\nvalue = [27, 10]\nclass = Yes'),
 Text(0.6153846153846154, 0.4166666666666667, 'four_g <= 0.5\ngini = 0.494\nsamples = 69\nvalue = [67, 54]\nclass = Yes'),
 Text(0.5769230769230769, 0.25, 'int_memory <= 37.0\ngini = 0.464\nsamples = 41\nvalue = [45, 26]\nclass = Yes'),
 Text(0.5384615384615384, 0.08333333333333333, 'gini = 0.251\nsamples = 20\nvalue = [29, 5]\nclass = Yes'),
 Text(0.6153846153846154, 0.08333333333333333, 'gini = 0.491\nsamples = 21\nvalue = [16, 21]\nclass = No'),
 Text(0.6538461538461539, 0.25, 'gini = 0.493\nsamples = 28\nvalue = [22, 28]\nclass = No'),
 Text(0.8461538461538461, 0.5833333333333334, 'px_height <= 764.0\ngini = 0.5\nsamples = 116\nvalue = [89, 90]\nclass = No'),
 Text(0.7692307692307693, 0.4166666666666667, 'clock_speed <= 0.75\ngini = 0.485\nsamples = 75\nvalue = [50, 71]\nclass = No'),
 Text(0.7307692307692307, 0.25, 'gini = 0.339\nsamples = 22\nvalue = [8, 29]\nclass = No'),
 Text(0.8076923076923077, 0.25, 'talk_time <= 12.5\ngini = 0.5\nsamples = 53\nvalue = [42, 42]\nclass = Yes'),
 Text(0.7692307692307693, 0.08333333333333333, 'gini = 0.48\nsamples = 27\nvalue = [18, 27]\nclass = No'),
 Text(0.8461538461538461, 0.08333333333333333, 'gini = 0.473\nsamples = 26\nvalue = [24, 15]\nclass = Yes'),
 Text(0.9230769230769231, 0.4166666666666667, 'clock_speed <= 1.65\ngini = 0.441\nsamples = 41\nvalue = [39, 19]\nclass = Yes'),
 Text(0.8846153846153846, 0.25, 'gini = 0.346\nsamples = 20\nvalue = [21, 6]\nclass = Yes'),
 Text(0.9615384615384616, 0.25, 'gini = 0.487\nsamples = 21\nvalue = [18, 13]\nclass = Yes')]
```



In [23]:
```
rf_best.feature_importances_
```

Out[23]:
```
array([0.10586947, 0.07741492, 0.00400731, 0.07508846, 0.03478509,
       0.00658804, 0.10753632, 0.04033311, 0.05944287, 0.02921685,
       0.08363281, 0.0674476 , 0.06710616, 0.09544289, 0.04006483,
       0.03878565, 0.03494972, 0.00490142, 0.02053677, 0.00684972])
```

In [24]:
```
imp_df=pd.DataFrame({'Varname':x_train.columns,"Imp":rf_best.feature_importances_})
imp_df.sort_values(by="Imp",ascending=False)
```

Out[24]:

	Varname	Imp
6	int_memory	0.107536
0	id	0.105869
13	ram	0.095443
10	pc	0.083633
1	battery_power	0.077415
3	clock_speed	0.075088
11	px_height	0.067448
12	px_width	0.067106
8	mobile_wt	0.059443
7	m_dep	0.040333
14	sc_h	0.040065
15	sc_w	0.038786
16	talk_time	0.034950
4	fc	0.034785
9	n_cores	0.029217
18	touch_screen	0.020537
19	wifi	0.006850
5	four_g	0.006588
17	three_g	0.004901
2	blue	0.004007

In [ ]:
```

```