In [38]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt,seaborn as sns
```

In [39]:
```
df=pd.read_csv(r"C:\Users\rubin\Downloads\Mobile_Price_Classification_test.csv")
df
```

Out[39]:

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

1000 rows × 21 columns

In [40]:
```
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 [41]:
```
x=df.drop('wifi',axis=1)
y=df['wifi']
```

In [42]:
```
df['dual_sim'].value_counts()
```

Out[42]:
```
dual_sim
1    517
0    483
Name: count, dtype: int64
```

In [43]:
```
m={"three_g":{"yes":1,"No":0}}
df=df.replace(m)
print(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 [44]:
```
x=df.drop('wifi',axis=1)
y=df['wifi']
```

In [45]:
```
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[45]:
```
((700, 20), (300, 20))
```

In [46]:
```
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[46]:
```
▾ RandomForestClassifier
RandomForestClassifier()
```

In [47]:
```
rf=RandomForestClassifier()
```

In [48]:
```
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 [49]:
```
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[49]:
```
▸          GridSearchCV
▸ estimator: RandomForestClassifier
      ▸ RandomForestClassifier
```

In [50]:
```
grid_search.best_score_
```

Out[50]:
```
0.5585714285714285
```

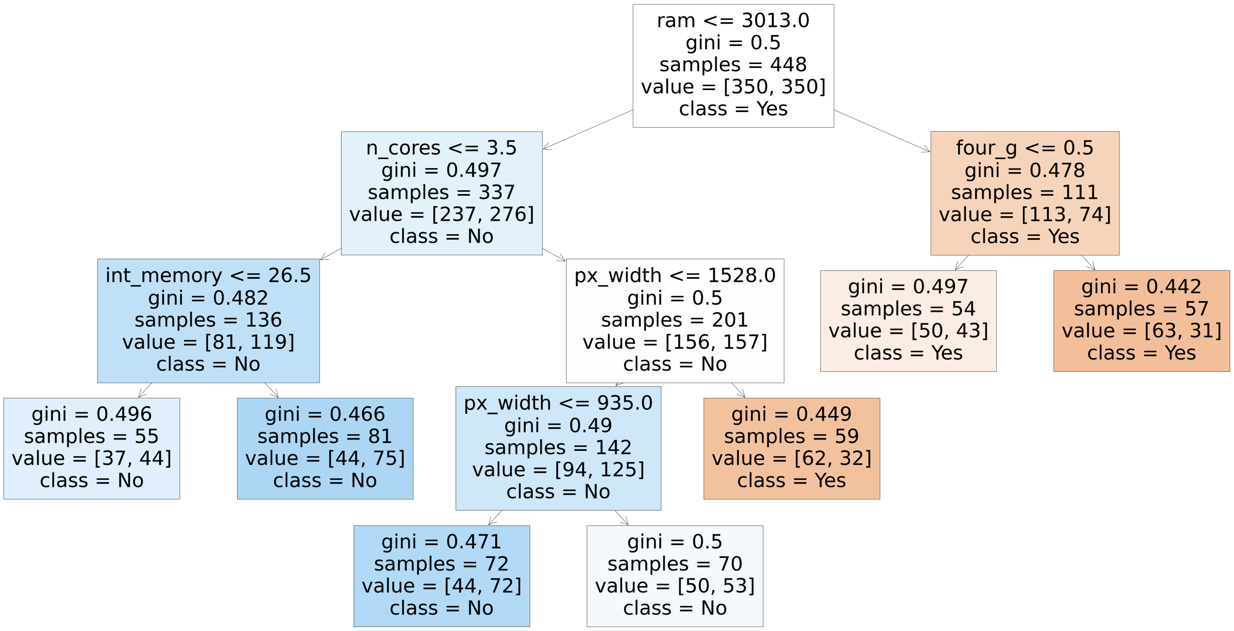
In [51]:
```
rf_best=grid_search.best_estimator_
print(rf_best)
```

```
RandomForestClassifier(max_depth=10, min_samples_leaf=50, n_estimators=25)
```

In [52]:
```
rf_best=grid_search.best_estimator_
print(rf_best)
```

```
RandomForestClassifier(max_depth=10, min_samples_leaf=50, n_estimators=25)
```

In [53]:
```
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);
```



In [54]:
```
rf_best.feature_importances_
```

Out[54]:
```
array([0.01935261, 0.09042734, 0.00642415, 0.10323425, 0.00971603,
       0.05259203, 0.01292893, 0.09791666, 0.07734202, 0.07305336,
       0.02049047, 0.02167026, 0.07284256, 0.15961238, 0.0833602 ,
       0.01958759, 0.02364368, 0.05501841, 0.        , 0.00078706])
```

In [55]:

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

Out[55]:

	Variance	Imp
13	px_width	0.159612
3	clock_speed	0.103234
7	int_memory	0.097917
1	battery_power	0.090427
14	ram	0.083360
8	m_dep	0.077342
9	mobile_wt	0.073053
12	px_height	0.072843
17	talk_time	0.055018
5	fc	0.052592
16	sc_w	0.023644
11	pc	0.021670
10	n_cores	0.020490
15	sc_h	0.019588
0	id	0.019353
6	four_g	0.012929
4	dual_sim	0.009716
2	blue	0.006424
19	touch_screen	0.000787
18	three_g	0.000000

Train data

In [56]:

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

In [57]:

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

Out[57]:

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

2000 rows × 21 columns

In [58]:
```
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 [59]:
```
x=df.drop('wifi',axis=1)
y=df['wifi']
```

In [60]:
```
df['dual_sim'].value_counts()
```

Out[60]:
```
dual_sim
1    1019
0     981
Name: count, dtype: int64
```

In [61]:
```
m={"three_g":{"yes":1,"No":0}}
df=df.replace(m)
print(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 [62]:
```
x=df.drop('wifi',axis=1)
y=df['wifi']
```

In [63]:
```
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[63]:
```
((1400, 20), (600, 20))
```

In [64]:
```
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[64]:
```
▾ RandomForestClassifier
RandomForestClassifier()
```

In [65]:
```
rf=RandomForestClassifier()
```

In [66]:
```
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 [67]:
```
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[67]:
```
▸             GridSearchCV
▸ estimator: RandomForestClassifier
       ▸ RandomForestClassifier
```

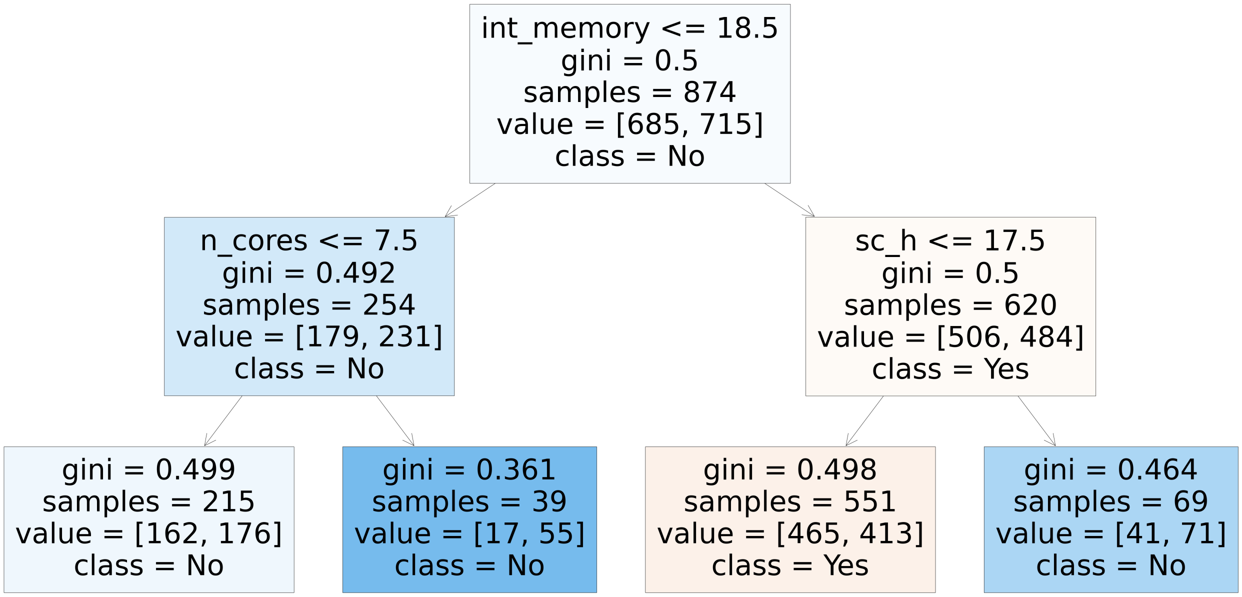
In [68]:
```
grid_search.best_score_
```

Out[68]:
```
0.5214285714285715
```

In [69]:
```
rf_best=grid_search.best_estimator_
print(rf_best)
```

```
RandomForestClassifier(max_depth=2, min_samples_leaf=20, n_estimators=30)
```

In [70]:
```
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);
```



In [71]:
```
rf_best.feature_importances_
```

Out[71]:
```
array([0.07797357, 0.        , 0.02753791, 0.        , 0.10236667,
       0.        , 0.04337652, 0.04463954, 0.08411783, 0.05308713,
       0.09182443, 0.1653675 , 0.04609829, 0.11579419, 0.05757145,
       0.01291756, 0.05587465, 0.        , 0.00848559, 0.01296719])
```

In [72]:

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

Out[72]:

	Varname	IMP
11	px_height	0.165368
13	ram	0.115794
4	fc	0.102367
10	pc	0.091824
8	mobile_wt	0.084118
0	battery_power	0.077974
14	sc_h	0.057571
16	talk_time	0.055875
9	n_cores	0.053087
12	px_width	0.046098
7	m_dep	0.044640
6	int_memory	0.043377
2	clock_speed	0.027538
19	price_range	0.012967
15	sc_w	0.012918
18	touch_screen	0.008486
5	four_g	0.000000
1	blue	0.000000
3	dual_sim	0.000000
17	three_g	0.000000