In [1]:

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

Random Forest & Ansemble(Clone Coding Iris data)

In [2]:

```
import pandas as pd
from sklearn import datasets
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn import metrics
from IPython.display import Image
```

In [3]:

```
iris = datasets.load_iris()
print('아이리스 종류 :', iris.target_names)
print('target : [0:setosa, 1:versicolor, 2:virginica]')
print('데어터 수 :', len(iris.data))
print('데이터 열 이름 :', iris.feature_names)

# iris data Dataframe으로
data = pd.DataFrame(
    {
    'sepal length': iris.data[:, 0],
    'sepal width': iris.data[:, 1],
    'petal length': iris.data[:, 2],
    'petal width': iris.data[:, 3],
    'species': iris.target
    }
)
data.head()
```

```
아이리스 종류 : ['setosa' 'versicolor' 'virginica']
target : [0:setosa, 1:versicolor, 2:virginica]
데어터 수 : 150
데이터 열 이름 : ['sepal length (cm)', 'sepal width (cm)', 'petal len
gth (cm)', 'petal width (cm)']
```

Out[3]:

	sepal length	sepal width	petal length	petal width	species
0	5.1	3.5	1.4	0.2	0
1	4.9	3.0	1.4	0.2	0
2	4.7	3.2	1.3	0.2	0
3	4.6	3.1	1.5	0.2	0
4	5.0	3.6	1.4	0.2	0

In [4]:

```
x = data[['sepal length', 'sepal width', 'petal length', 'petal width']]
y = data['species']

# 테스트 데이터 30%
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3)
print(len(x_train))
print(len(x_test))
print(len(y_train))
print(len(y_test))
```

```
105
45
105
45
```

In [5]:

```
# 학습 진행
forest = RandomForestClassifier(n_estimators=100)
forest.fit(x_train, y_train)
```

Out[5]:

```
RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=
None,
                       criterion='gini', max_depth=None, max_featu
res='auto',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_spl
it=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=
100,
                       n_jobs=None, oob_score=False, random_state=
None,
                       verbose=0, warm_start=False)
```

In [6]:

```
# 예측
y_pred = forest.predict(x_test)
print(y_pred)
print(list(y_test))
```

```
[2 1 1 2 1 2 2 1 0 1 2 0 2 1 0 0 1 0 0 1 0 1 1 2 2 2 0 1 0 0 0 1 0 1
1 2 1
 1 1 0 0 1 2 1 0]
[2, 1, 2, 2, 1, 2, 2, 1, 0, 1, 2, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1,
1, 2, 2, 2, 0, 2, 0, 0, 0, 1, 0, 2, 1, 2, 1, 1, 1, 0, 0, 1, 2, 1, 0
]
```

In [7]:

```
# 정확도 확인
print('정확도 :', metrics.accuracy_score(y_test, y_pred))
```

정확도 : 0.9111111111111111

Random Forest & Ansemble(Regression)

참고사항

Train Data

In [8]:

```
train = pd.read_csv("train.csv")
```

In [9]:

```
train
```

Out[9]:

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

2000 rows × 21 columns

In [10]:

```
train.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 [11]:

```
train.columns
```

Out[11]:

```
Index(['battery_power', 'blue', 'clock_speed', 'dual_sim', 'fc', 'f
our_g',
       'int_memory', 'm_dep', 'mobile_wt', 'n_cores', 'pc', 'px_hei
ght',
```

```
       'px_width', 'ram', 'sc_h', 'sc_w', 'talk_time', 'three_g',
       'touch_screen', 'wifi', 'price_range'],
      dtype='object')
```

In [12]:

```
x_train = train.drop("price_range", axis = 1)
x_train
```

Out[12]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_cores	pc	px_he
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 [13]:

```
y_train = train["price_range"]
for i in range(len(y_train)):
    if y_train[i] == 0:
        y_train[i] = "Low Cost"
    elif y_train[i] == 1:
        y_train[i] = "Medium Cost"
    else:
        y_train[i] = "Very High Cost"
y_train
```

Out[13]:

```
0          Medium Cost
1       Very High Cost
2       Very High Cost
3       Very High Cost
4          Medium Cost
             ...
1995        Low Cost
1996    Very High Cost
1997    Very High Cost
1998        Low Cost
1999    Very High Cost
Name: price_range, Length: 2000, dtype: object
```

Test Data

In [14]:

```
test = pd.read_csv("train.csv")
```

In [15]:

```
x_test = test.drop("price_range", axis = 1)
x_test
```

Out[15]:

	battery_power	blue	clock_speed	dual_sim	fc	four_g	int_memory	m_dep	mobile_wt	n_cores	pc	px_he
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 [16]:

```
y_test = test["price_range"]
for i in range(len(y_test)):
    if y_test[i] == 0:
        y_test[i] = "Low Cost"
    elif y_test[i] == 1:
        y_test[i] = "Medium Cost"
    else:
        y_test[i] = "Very High Cost"
y_test
```

Out[16]:

```
0          Medium Cost
1       Very High Cost
2       Very High Cost
3       Very High Cost
4          Medium Cost
             ...
1995         Low Cost
1996    Very High Cost
1997    Very High Cost
1998         Low Cost
1999    Very High Cost
Name: price_range, Length: 2000, dtype: object
```

GridSearch CV를 통한 랜덤포레스트 하이퍼파라미터 튜닝

In [17]:

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import accuracy_score
```

In [18]:

```
params = { 'n_estimators' : [10, 100],
           'max_depth' : [6, 8, 10, 12],
           'min_samples_leaf' : [8, 12, 18],
           'min_samples_split' : [8, 16, 20]
```

```
            }
```

In [19]:

```
rf_clf = RandomForestClassifier(random_state = 0, n_jobs = -1)
grid_cv = GridSearchCV(rf_clf, param_grid = params, cv = 3, n_jobs = -1)
grid_cv.fit(x_train, y_train)

print('최적 하이퍼 파라미터: ', grid_cv.best_params_)
print('최고 예측 정확도: {:.4f}'.format(grid_cv.best_score_))
```

```
최적 하이퍼 파라미터:  {'max_depth': 12, 'min_samples_leaf': 8, 'min_s
amples_split': 8, 'n_estimators': 100}
최고 예측 정확도: 0.9100
```

In [20]:

```
best_param_clf = RandomForestClassifier(n_estimators = 100,
                                        max_depth = 10,
                                        min_samples_leaf = 8,
                                        min_samples_split = 20,
                                        n_jobs = -1)
```

In [21]:

```
best_param_clf.fit(x_train, y_train)
prediction = best_param_clf.predict(x_test)
print("예측 정확도: {:.4f}".format(accuracy_score(y_test, prediction)))
```

```
예측 정확도: 0.9660
```

Random Forest의 각 특성 중요도 시각화

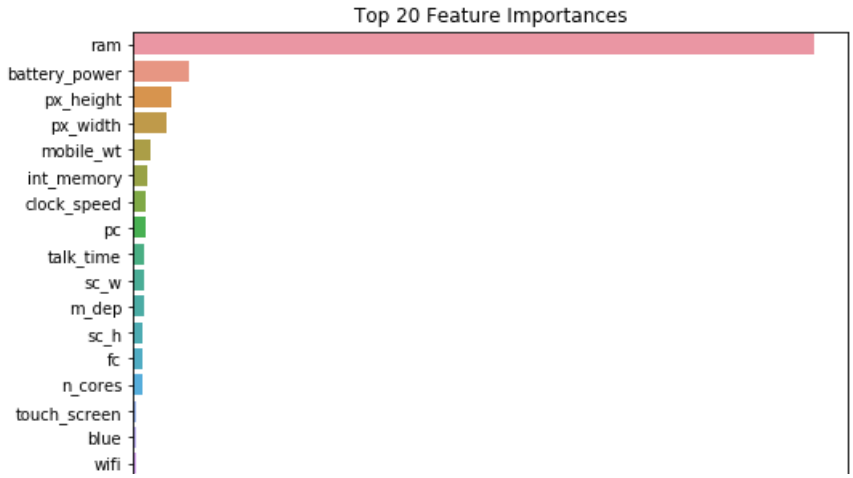
In [22]:

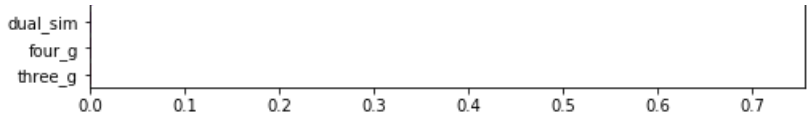
```
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [23]:

```
ftr_importances_values = best_param_clf.feature_importances_
ftr_importances = pd.Series(ftr_importances_values, index = x_train.columns)
ftr_top20 = ftr_importances.sort_values(ascending=False)[:20]

plt.figure(figsize=(8,6))
plt.title('Top 20 Feature Importances')
sns.barplot(x=ftr_top20, y=ftr_top20.index)
plt.show()
```





In [24]:

```
from sklearn.tree import export_graphviz
```

In [25]:

```
model = RandomForestClassifier()
model.fit(x_train, y_train)


estimator = model.estimators_[3]

export_graphviz(estimator, out_file='tree.dot',
                feature_names = x_train.columns,
                class_names = y_train.unique(),
                max_depth = 3, # 표현하고 싶은 최대 depth
                precision = 3, # 소수점 표기 자릿수
                filled = True, # class별 color 채우기
                rounded=True, # 박스의 모양을 둥글게
               )
```

In [33]:

```
from subprocess import call
call(['dot', '-Tpng', 'tree.dot','-o', 'tree.png', '-Gdpi=600'])
```

```
---------------------------------------------------------------------
----------
FileNotFoundError                         Traceback (most recent c
all last)
<ipython-input-33-0a11d1de2db7> in <module>
      1 from subprocess import call
----> 2 call(['dot', '-Tpng', 'tree.dot','-o', 'tree.png', '-Gdpi=6
00'])

~\Anaconda3\lib\subprocess.py in call(timeout, *popenargs, **kwargs
)
    337     retcode = call(["ls", "-l"])
    338     """
--> 339     with Popen(*popenargs, **kwargs) as p:
    340         try:
    341             return p.wait(timeout=timeout)

~\Anaconda3\lib\subprocess.py in __init__(self, args, bufsize, exec
utable, stdin, stdout, stderr, preexec_fn, close_fds, shell, cwd, e
nv, universal_newlines, startupinfo, creationflags, restore_signals
, start_new_session, pass_fds, encoding, errors, text)
    798                                 c2pread, c2pwrite,
    799                                 errread, errwrite,
--> 800                                 restore_signals, start_new
_session)
    801         except:
    802             # Cleanup if the child failed starting.

~\Anaconda3\lib\subprocess.py in _execute_child(self, args, executa
ble, preexec_fn, close_fds, pass_fds, cwd, env, startupinfo, creati
onflags, shell, p2cread, p2cwrite, c2pread, c2pwrite, errread, errw
rite, unused_restore_signals, unused_start_new_session)
   1205                                         env,
   1206                                         os.fspath(cwd) i
f cwd is not None else None,
-> 1207                                         startupinfo)
   1208             finally:
```

```
   1209                    # Child is launched. Close the parent's co
py of those pipe

FileNotFoundError: [WinError 2] 지정된 파일을 찾을 수 없습니다
```

In [34]:

```
# Display in jupyter notebook
from IPython.display import Image
```

In [35]:

```
Image(filename = 'tree.png')
```

```
---------------------------------------------------------------------
----------
FileNotFoundError                         Traceback (most recent c
all last)
<ipython-input-35-04b3b31865e2> in <module>
----> 1 Image(filename = 'tree.png')

~\Anaconda3\lib\site-packages\IPython\core\display.py in __init__(s
elf, data, url, filename, format, embed, width, height, retina, unc
onfined, metadata)
   1202         self.unconfined = unconfined
   1203         super(Image, self).__init__(data=data, url=url, fil
ename=filename,
-> 1204                 metadata=metadata)
   1205
   1206         if self.width is None and self.metadata.get('width'
, {}):

~\Anaconda3\lib\site-packages\IPython\core\display.py in __init__(s
elf, data, url, filename, metadata)
    625             self.metadata = {}
    626
--> 627         self.reload()
    628         self._check_data()
    629

~\Anaconda3\lib\site-packages\IPython\core\display.py in reload(sel
f)
   1233         """Reload the raw data from file or URL."""
   1234         if self.embed:
-> 1235             super(Image,self).reload()
   1236             if self.retina:
   1237                 self._retina_shape()

~\Anaconda3\lib\site-packages\IPython\core\display.py in reload(sel
f)
    650         """Reload the raw data from file or URL."""
    651         if self.filename is not None:
--> 652             with open(self.filename, self._read_flags) as
f:
    653                 self.data = f.read()
    654         elif self.url is not None:

FileNotFoundError: [Errno 2] No such file or directory: 'tree.png'
```