PRACTICAL 06

To implement a Machine Learning Classification model using a Decision Tree Classifier algorithm and enhance the model by K Fold and GridSearchCV cross-validation.

In [4]:
```
%matplotlib inline
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import sklearn
from sklearn.model_selection import train_test_split
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score
from sklearn.metrics import accuracy_score
from sklearn.metrics import f1_score
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
import warnings
warnings.filterwarnings('ignore')
from sklearn import preprocessing
```

In [5]:
```
import pandas as pd
```

In [6]:
```
df = pd.read_csv('tennis - tennis.csv')
```

In [8]:
```
df
```

Out[8]:

	outlook	temp	humidity	windy	play
0	sunny	hot	high	False	no
1	sunny	hot	high	True	no
2	overcast	hot	high	False	yes
3	rainy	mild	high	False	yes
4	rainy	cool	normal	False	yes
5	rainy	cool	normal	True	no
6	overcast	cool	normal	True	yes
7	sunny	mild	high	False	no
8	sunny	cool	normal	False	yes
9	rainy	mild	normal	False	yes
10	sunny	mild	normal	True	yes
11	overcast	mild	high	True	yes
12	overcast	hot	normal	False	yes
13	rainy	mild	high	True	no

In [9]:
```
df.isnull().any()
```

Out[9]:
```
outlook     False
temp        False
humidity    False
windy       False
play        False
dtype: bool
```

In [10]:
```
df.shape
```

Out[10]:
```
(14, 5)
```

In [11]:
```
df.describe()
```

Out[11]:

	outlook	temp	humidity	windy	play
count	14	14	14	14	14
unique	3	3	2	2	2
top	sunny	mild	high	False	yes
freq	5	6	7	8	9

In [12]:
```
string_to_int= preprocessing.LabelEncoder()                    #encode your data
df=df.apply(string_to_int.fit_transform) #fit and transform it
df
```

Out[12]:

	outlook	temp	humidity	windy	play
0	2	1	0	0	0
1	2	1	0	1	0
2	0	1	0	0	1
3	1	2	0	0	1
4	1	0	1	0	1
5	1	0	1	1	0
6	0	0	1	1	1
7	2	2	0	0	0
8	2	0	1	0	1
9	1	2	1	0	1
10	2	2	1	1	1
11	0	2	0	1	1
12	0	1	1	0	1
13	1	2	0	1	0

In [13]:
```
feature_cols = ['outlook', 'temp', 'humidity', 'windy']
X = df[feature_cols]
y = df['play']
```

In [14]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=1)
```

In [15]:
```
model = DecisionTreeClassifier()
model = model.fit(X_train,y_train)
y_pred = model.predict(X_test)
```

In [16]:
```
from sklearn import metrics
print("Accuracy:",metrics.accuracy_score(y_test, y_pred)*100)
```

```
Accuracy: 66.66666666666666
```

In [17]:
```
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test,y_pred)
```

Out[17]:
```
array([[1, 0],
       [1, 1]], dtype=int64)
```

In [18]:
```
from sklearn.metrics import classification_report
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.50      1.00      0.67         1
           1       1.00      0.50      0.67         2

    accuracy                           0.67         3
   macro avg       0.75      0.75      0.67         3
weighted avg       0.83      0.67      0.67         3
```

In [19]:
```
data_p=pd.DataFrame({'Actual':y_test, 'Predicted':y_pred})
data_p
```

Out[19]:

	Actual	Predicted
3	1	0
7	0	0
6	1	1

In [20]:
```
def model_evaluation(y_test, y_pred, model_name):
    acc = accuracy_score(y_test, y_pred)
    prec = precision_score(y_test, y_pred)
    rec = recall_score(y_test, y_pred)
    f1 = f1_score(y_test, y_pred)
    results = pd.DataFrame([[model_name, acc, prec, rec, f1]],
                      columns = ["Model", "Accuracy", "Precision", "Recall",
                                 "F1 SCore"])
    results = results.sort_values(["Precision", "Recall"], ascending = False)
    return results
model_evaluation(y_test, y_pred, "KNN")
```

Out[20]:

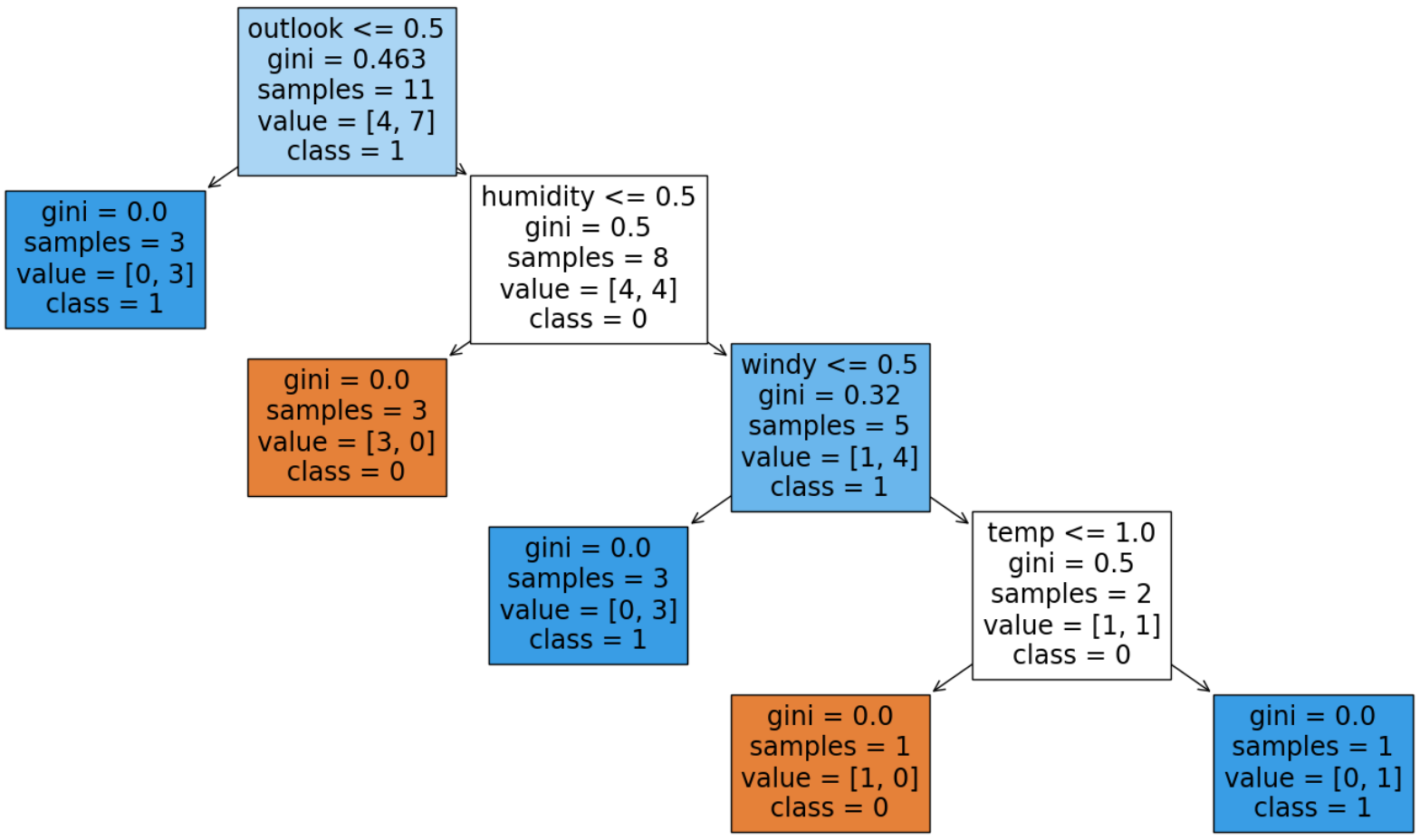
	Model	Accuracy	Precision	Recall	F1 SCore
0	KNN	0.666667	1.0	0.5	0.666667

In [21]:
```
features=X.columns
features
```

Out[21]: Index(['outlook', 'temp', 'humidity', 'windy'], dtype='object')

In [24]:
```
from io import StringIO
from sklearn.tree import export_graphviz
import pydotplus
from IPython.display import Image
from io import StringIO
```

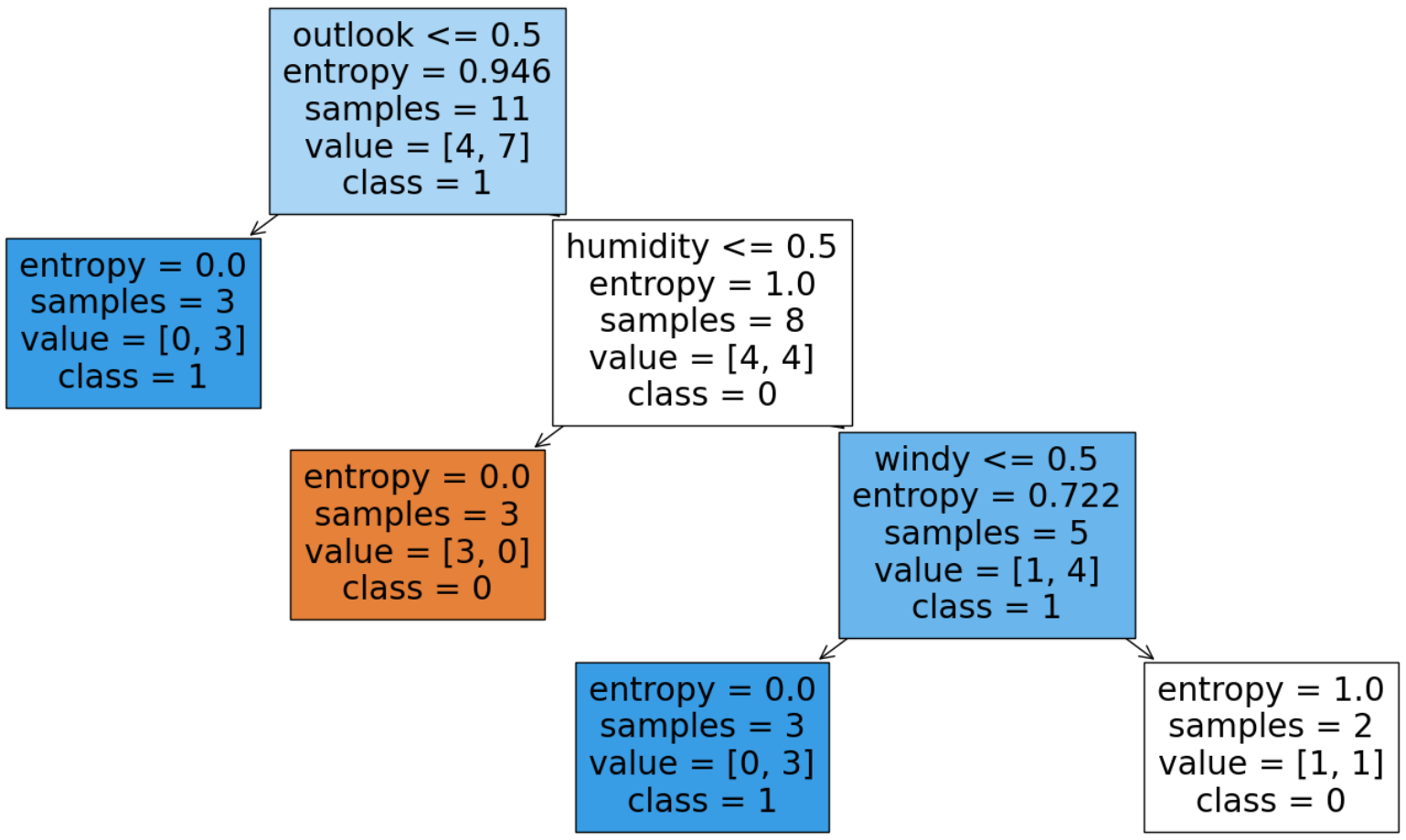
In [25]:
```
import matplotlib.pyplot as plt
from sklearn.tree import plot_tree
plt.figure(figsize=(20,10))
plot_tree(model, filled=True, feature_names=features, class_names=['0', '1'])
plt.savefig('diabetes_tree.png')
plt.show()
```



In [26]:
```
model = DecisionTreeClassifier(criterion="entropy", max_depth=3)
model = model.fit(X_train,y_train)
y_pred = model.predict(X_test)
print("Accuracy:",metrics.accuracy_score(y_test, y_pred)*100)
```

Accuracy: 66.66666666666666

In [27]:
```
import matplotlib.pyplot as plt
from sklearn.tree import plot_tree
plt.figure(figsize=(20, 10))
plot_tree(model, filled=True, feature_names=features, class_names=['0', '1'])
plt.savefig('diabetes_tree.png')
plt.show()
```



In [28]:
```
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
train_scores = []
test_scores = []
for i in range(1, min(15, len(X_train) - 1)):
```

```
    knn = KNeighborsClassifier(n_neighbors=i)
    knn.fit(X_train, y_train)
    train_scores.append(knn.score(X_train, y_train))
    test_scores.append(knn.score(X_test, y_test))
```

In [29]:
```
max_test_score =max(test_scores)
```

In [30]:
```
test_score_index = [i for i, v in enumerate(test_scores) if v== max_test_score]
print('Max test score {} % and k = {}'.format(max_test_score*100,list(map(lambda x: x+1, test_score_index))))
```

```
Max test score 100.0 % and k = [3, 6]
```

In [31]:
```
knn = KNeighborsClassifier(11)
knn.fit(X_train,y_train)
knn.score(X_test,y_test)
```

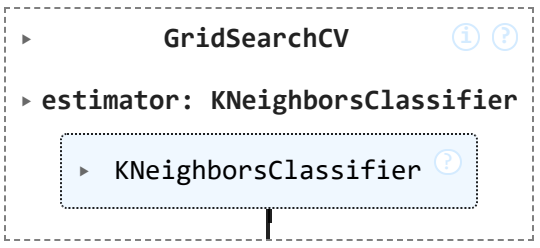
Out[31]:
```
0.6666666666666666
```

In [32]:
```
from sklearn.model_selection import KFold
from sklearn.metrics import accuracy_score
kf = KFold(n_splits=9, shuffle=True, random_state=42)
train_scores = []
test_scores = []
for train_index, test_index in kf.split(X):
    X_train, X_test = X.iloc[train_index], X.iloc[test_index]
    y_train, y_test = y.iloc[train_index], y.iloc[test_index]
    knn = KNeighborsClassifier(11)
    knn.fit(X_train, y_train)
    train_scores.append(knn.score(X_train, y_train))
    test_scores.append(knn.score(X_test, y_test))
mean_train_score = np.mean(train_scores)
mean_test_score = np.mean(test_scores)
print('Mean train score:', mean_train_score)
print('Mean test score:', mean_test_score)
```

```
Mean train score: 0.6431623931623931
Mean test score: 0.6666666666666666
```

In [33]:
```
from sklearn.model_selection import GridSearchCV
from sklearn.neighbors import KNeighborsClassifier
param_grid = {
    'n_neighbors': range(1, 13),
    'metric': ['manhattan', 'euclidean']
}
model = KNeighborsClassifier()
grid = GridSearchCV(model, param_grid, cv=5)
grid.fit(X,y)
grid
```

Out[33]:



In [34]:
```
print(grid.best_params_)
print(grid.best_estimator_)
```

```
{'metric': 'euclidean', 'n_neighbors': 6}
KNeighborsClassifier(metric='euclidean', n_neighbors=6)
```

In [ ]: