Practical 5 Train and fine-tune a Decision Tree for the Moons Dataset

May 7, 2022

Practical 5: Train and fine-tune a Decision Tree for the Moons Dataset

[2]:
```
# GridSearchCV to fine-tune a Decision Tree Classifier
import numpy as np
import matplotlib.pyplot as plt
```

[3]:
```
#Visualization
# This function will help in visualization of our dataset.
def plot_dataset(X, y, axes):
    plt.figure(figsize=(10,6))
    plt.plot(X[:, 0][y==0], X[:, 1][y==0], "bs",alpha = 0.5)
    plt.plot(X[:, 0][y==1], X[:, 1][y==1], "g^",alpha = 0.2)
    plt.axis(axes)
    plt.grid(True, which='both')
    plt.xlabel(r"$x_1$", fontsize=20)
    plt.ylabel(r"$x_2$", fontsize=20, rotation=0)
```

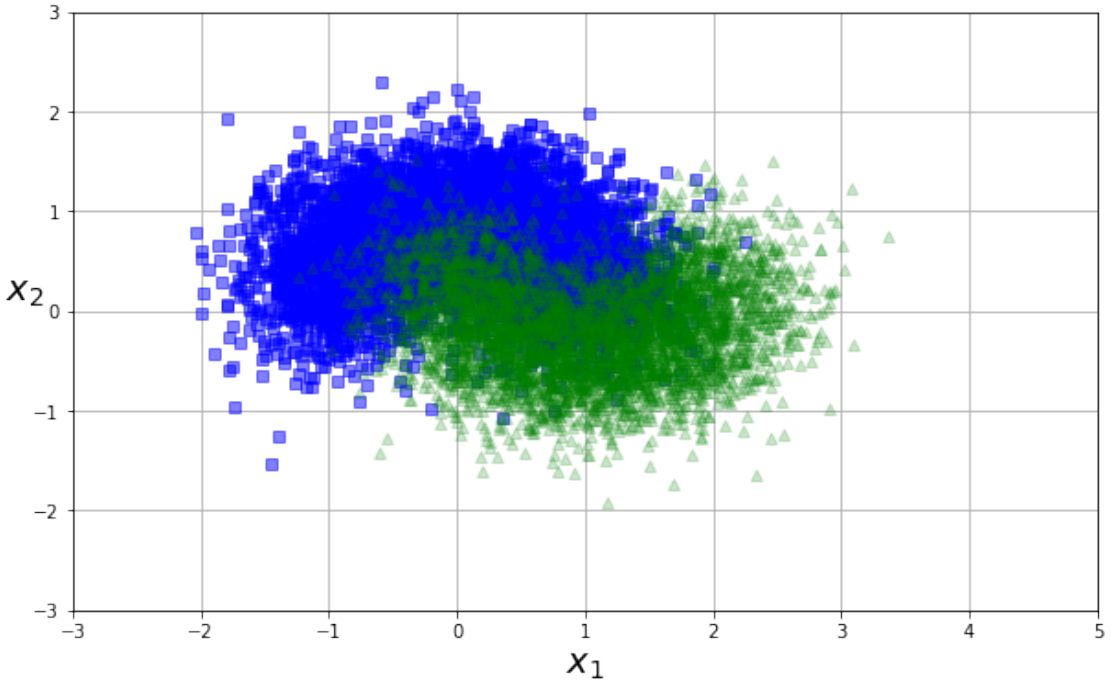
dataset contains two features x1 and x2 , it has ten thousand instances with a Guassian noise of 0.4. it's a binary classification the labels are either 0 or 1.

[4]:
```
from sklearn.datasets import make_moons

X, y = make_moons(n_samples=10000, noise=0.4, random_state=21)
```

Since we have two features it will be easy to visualize the data:

[5]:
```
plot_dataset(X, y, [-3, 5, -3, 3])
```



Splitting the dataset into training and testing set:

[10]:
```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X,y, test_size = 0.2)
```

Selecting the model

[11]:
```
from sklearn.tree import DecisionTreeClassifier

tree_clf = DecisionTreeClassifier()
```

We have to select the parameters for our GridSearch:

[12]:
```
from sklearn.model_selection import GridSearchCV

parameter = {
             'criterion' : ["gini", "entropy"],
             'max_leaf_nodes': list(range(2, 50)),
             'min_samples_split': [2, 3, 4]
            }
```

Using a cross validation of 5 and measuring accuracy.

[13]:
```
clf = GridSearchCV(tree_clf, parameter, cv = 5,scoring =␣
↪"accuracy",return_train_score=True,n_jobs=-1)
```

[14]:
```
clf.fit(X_train, y_train)
```

[14]:
```
GridSearchCV(cv=5, estimator=DecisionTreeClassifier(), n_jobs=-1,
             param_grid={'criterion': ['gini', 'entropy'],
                         'max_leaf_nodes': [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,
                                            13, 14, 15, 16, 17, 18, 19, 20, 21,
                                            22, 23, 24, 25, 26, 27, 28, 29, 30,
                                            31, …],
                         'min_samples_split': [2, 3, 4]},
             return_train_score=True, scoring='accuracy')
```

[15]:
```
# Getting the best parameter:
clf.best_params_
```

[15]:
```
{'criterion': 'gini', 'max_leaf_nodes': 23, 'min_samples_split': 2}
```

[16]:
```
#look at the training results:
cvres = clf.cv_results_
for mean_score, params in zip(cvres["mean_train_score"], cvres["params"]):
    print(mean_score, params)
```

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[17]:
```
#Getting the training score
clf.score(X_train, y_train)
```

[17]:
```
0.869625
```

We have an accuracy of approximately 87% but accuracy is sometimes not a good measure to use, lets see the confusion matrix.

[18]:
```
from sklearn.metrics import confusion_matrix

pred = clf.predict(X_train)
confusion_matrix(y_train,pred)
```

[18]:
```
array([[3572,  460],
       [ 583, 3385]], dtype=int64)
```

[19]:
```
#from the confusion matrix let's get our precision and recall, which are better␣
 ↪metrics.
from sklearn.metrics import precision_score, recall_score
```

```
pre = precision_score(y_train, pred)
re  = recall_score(y_train, pred)
print(f"Precision: {pre}  Recall:{re}")
```

```
Precision: 0.8803641092327699  Recall:0.8530745967741935
```

[20]:
```
#we have a higher precision than recall but lets combine the two metrics into␣
↪F1  score.
from sklearn.metrics import f1_score

f1_score(y_train, pred)
```

[20]:
```
0.8665045437092026
```

Our F1 Score and accuracy are almost the same.

[21]:
```
#Getting the testing score
clf.score(X_test, y_test)
```

[21]:
```
0.865
```

We have an accuracy of approximately 86% on the testing set.

[ ]:
```

```