ML0101EN-Clas-Decision-Trees-drug-py-v1

September 19, 2021

1 Decision Trees

Estimated time needed: **15** minutes

1.1 Objectives

After completing this lab you will be able to:

- Develop a classification model using Decision Tree Algorithm

In this lab exercise, you will learn a popular machine learning algorithm, Decision Trees. You will use this classification algorithm to build a model from the historical data of patients, and their response to different medications. Then you will use the trained decision tree to predict the class of a unknown patient, or to find a proper drug for a new patient.

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```

Import the Following Libraries:

numpy (as np)

pandas

DecisionTreeClassifier from sklearn.tree

[1]:
```
import numpy as np
import pandas as pd
from sklearn.tree import DecisionTreeClassifier
```

```
<h2>About the dataset</h2>
Imagine that you are a medical researcher compiling data for a study. You have collected data a
<br>
```

```
<br>
Part of your job is to build a model to find out which drug might be appropriate for a future p
<br>
<br>
It is a sample of multiclass classifier, and you can use the training part of the dataset
to build a decision tree, and then use it to predict the class of a unknown patient, or to pres
```

```
<h2>Downloading the Data</h2>
To download the data, we will use !wget to download it from IBM Object Storage.
```

[2]:
```
!wget -O drug200.csv https://cf-courses-data.s3.us.cloud-object-storage.
↪appdomain.cloud/IBMDeveloperSkillsNetwork-ML0101EN-SkillsNetwork/labs/
↪Module%203/data/drug200.csv
```

```
--2021-09-19 01:41:27--  https://cf-courses-data.s3.us.cloud-object-
storage.appdomain.cloud/IBMDeveloperSkillsNetwork-ML0101EN-
SkillsNetwork/labs/Module%203/data/drug200.csv
Resolving cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud (cf-
courses-data.s3.us.cloud-object-storage.appdomain.cloud)… 169.63.118.104
Connecting to cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud (cf-
courses-data.s3.us.cloud-object-storage.appdomain.cloud)|169.63.118.104|:443…
connected.
HTTP request sent, awaiting response… 200 OK
Length: 5827 (5.7K) [text/csv]
Saving to: 'drug200.csv'

drug200.csv         100%[===================>]   5.69K  --.-KB/s    in 0.1s

2021-09-19 01:41:27 (56.4 KB/s) - 'drug200.csv' saved [5827/5827]
```

Did you know? When it comes to Machine Learning, you will likely be working with large datasets. As a business, where can you host your data? IBM is offering a unique opportunity for businesses, with 10 Tb of IBM Cloud Object Storage: Sign up now for free

Now, read the data using pandas dataframe:

[3]:
```
my_data = pd.read_csv("drug200.csv", delimiter=",")
my_data[0:5]
```

[3]:

	Age	Sex	BP	Cholesterol	Na_to_K	Drug
0	23	F	HIGH	HIGH	25.355	drugY
1	47	M	LOW	HIGH	13.093	drugC
2	47	M	LOW	HIGH	10.114	drugC
3	28	F	NORMAL	HIGH	7.798	drugX
4	61	F	LOW	HIGH	18.043	drugY

```
<h3>Practice</h3>
What is the size of data?
```

[4]:
```python
my_data.shape
```

[4]:
```
(200, 6)
```

Click here for the solution

`my_data.shape`

`<h2>Pre-processing</h2>`

Using my_data as the Drug.csv data read by pandas, declare the following variables:

X as the Feature Matrix (data of my_data)

y as the response vector (target)

Remove the column containing the target name since it doesn't contain numeric values.

[5]:
```python
X = my_data[['Age', 'Sex', 'BP', 'Cholesterol', 'Na_to_K']].values
X[0:5]
```

[5]:
```
array([[23, 'F', 'HIGH', 'HIGH', 25.355],
       [47, 'M', 'LOW', 'HIGH', 13.093],
       [47, 'M', 'LOW', 'HIGH', 10.113999999999999],
       [28, 'F', 'NORMAL', 'HIGH', 7.797999999999999],
       [61, 'F', 'LOW', 'HIGH', 18.043]], dtype=object)
```

As you may figure out, some features in this dataset are categorical, such as **Sex** or **BP**. Unfortunately, Sklearn Decision Trees does not handle categorical variables. We can still convert these features to numerical values using **pandas.get_dummies()** to convert the categorical variable into dummy/indicator variables.

[6]:
```python
from sklearn import preprocessing
le_sex = preprocessing.LabelEncoder()
le_sex.fit(['F','M'])
X[:,1] = le_sex.transform(X[:,1])


le_BP = preprocessing.LabelEncoder()
le_BP.fit([ 'LOW', 'NORMAL', 'HIGH'])
X[:,2] = le_BP.transform(X[:,2])


le_Chol = preprocessing.LabelEncoder()
le_Chol.fit([ 'NORMAL', 'HIGH'])
X[:,3] = le_Chol.transform(X[:,3])

X[0:5]
```

[6]: array([[23, 0, 0, 0, 25.355],
        [47, 1, 1, 0, 13.093],
        [47, 1, 1, 0, 10.113999999999999],
        [28, 0, 2, 0, 7.797999999999999],
        [61, 0, 1, 0, 18.043]], dtype=object)

Now we can fill the target variable.

[7]:
```
y = my_data["Drug"]
y[0:5]
```

[7]:
```
0    drugY
1    drugC
2    drugC
3    drugX
4    drugY
Name: Drug, dtype: object
```

<h2>Setting up the Decision Tree</h2>
We will be using train/test split on our decision tree. Let's import <b>train_tes

[8]:
```
from sklearn.model_selection import train_test_split
```

Now train_test_split will return 4 different parameters. We will name them: X_trainset, X_testset, y_trainset, y_testset The train_test_split will need the parameters: X, y, test_size=0.3, and random_state=3. The X and y are the arrays required before the split, the test_size represents the ratio of the testing dataset, and the random_state ensures that we obtain the same splits.

[9]:
```
X_trainset, X_testset, y_trainset, y_testset = train_test_split(X, y,␣
↪test_size=0.3, random_state=3)
```

Practice

Print the shape of X_trainset and y_trainset. Ensure that the dimensions match.

[10]:
```
print('Shape of X training set {}'.format(X_trainset.shape),'&',' Size of Y␣
↪training set {}'.format(y_trainset.shape))
```

```
Shape of X training set (140, 5) &  Size of Y training set (140,)
```

Click here for the solution

```
print('Shape of X training set {}'.format(X_trainset.shape),'&',' Size of Y training set {}'.fo
```

Print the shape of X_testset and y_testset. Ensure that the dimensions match.

[11]:
```
print('Shape of X training set {}'.format(X_testset.shape),'&',' Size of Y␣
↪training set {}'.format(y_testset.shape))
```

```
Shape of X training set (60, 5) &  Size of Y training set (60,)
```

Click here for the solution

```
print('Shape of X training set {}'.format(X_testset.shape),'&',' Size of Y training set {}'.fo
```

```
<h2>Modeling</h2>
We will first create an instance of the <b>DecisionTreeClassifier</b> called <b>drugTree</b>.<
Inside of the classifier, specify <i> criterion="entropy" </i> so we can see the information ga
```

[12]:
```
drugTree = DecisionTreeClassifier(criterion="entropy", max_depth = 4)
drugTree # it shows the default parameters
```

[12]:
```
DecisionTreeClassifier(class_weight=None, criterion='entropy', max_depth=4,
            max_features=None, max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, presort=False, random_state=None,
            splitter='best')
```

Next, we will fit the data with the training feature matrix X_trainset and training response vector y_trainset

[13]:
```
drugTree.fit(X_trainset,y_trainset)
```

[13]:
```
DecisionTreeClassifier(class_weight=None, criterion='entropy', max_depth=4,
            max_features=None, max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, presort=False, random_state=None,
            splitter='best')
```

```
<h2>Prediction</h2>
Let's make some <b>predictions</b> on the testing dataset and store it into a variable called
```

[14]:
```
predTree = drugTree.predict(X_testset)
```

You can print out predTree and y_testset if you want to visually compare the predictions to the actual values.

[15]:
```
print (predTree [0:5])
print (y_testset [0:5])
```

```
['drugY' 'drugX' 'drugX' 'drugX' 'drugX']
40     drugY
51     drugX
139    drugX
197    drugX
170    drugX
Name: Drug, dtype: object
```

```
<h2>Evaluation</h2>
```

Next, let's import metrics from sklearn and check the accuracy of our model.

[16]:
```
from sklearn import metrics
import matplotlib.pyplot as plt
print("DecisionTrees's Accuracy: ", metrics.accuracy_score(y_testset, predTree))
```

```
DecisionTrees's Accuracy:  0.9833333333333333
```

Accuracy classification score computes subset accuracy: the set of labels predicted for a sample must exactly match the corresponding set of labels in y_true.

In multilabel classification, the function returns the subset accuracy. If the entire set of predicted labels for a sample strictly match with the true set of labels, then the subset accuracy is 1.0; otherwise it is 0.0.

<h2>Visualization</h2>

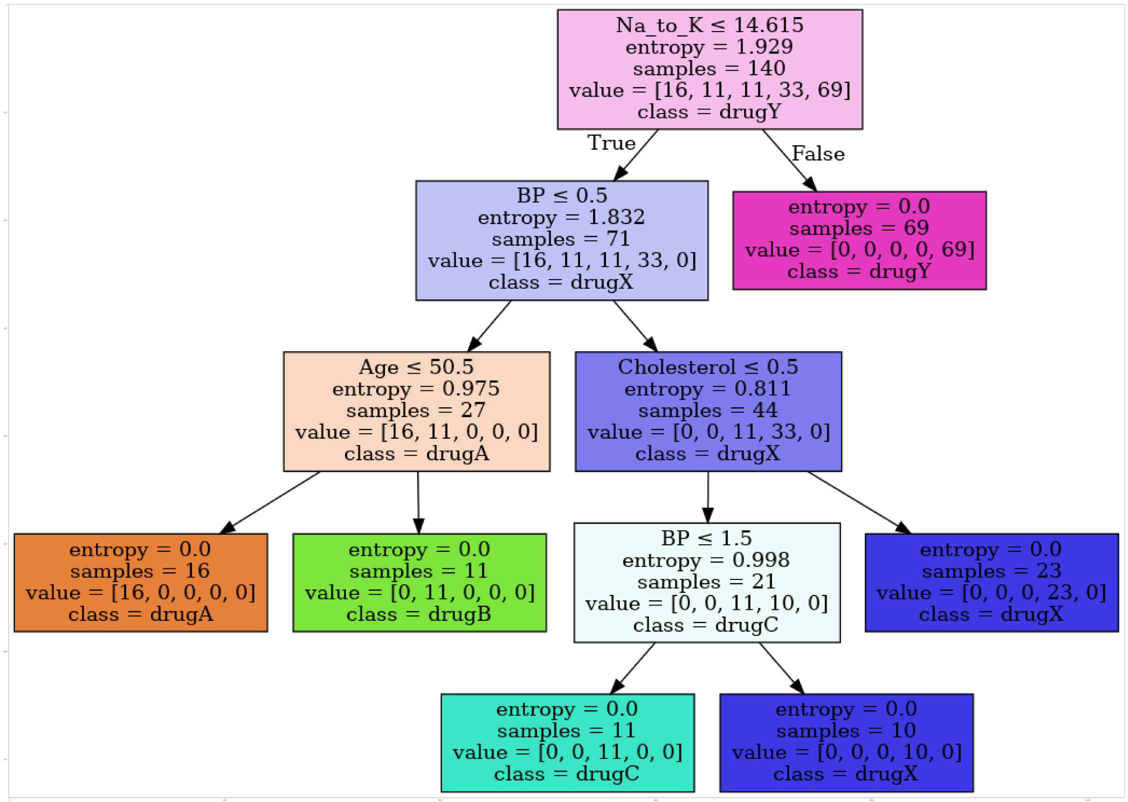
Let’s visualize the tree

[17]:
```
# Notice: You might need to uncomment and install the pydotplus and graphviz␣
↪libraries if you have not installed these before
#!conda install -c conda-forge pydotplus -y
#!conda install -c conda-forge python-graphviz -y
```

[18]:
```
from  io import StringIO
import pydotplus
import matplotlib.image as mpimg
from sklearn import tree
%matplotlib inline
```

[19]:
```
dot_data = StringIO()
filename = "drugtree.png"
featureNames = my_data.columns[0:5]
out=tree.export_graphviz(drugTree,feature_names=featureNames,␣
↪out_file=dot_data, class_names= np.unique(y_trainset), filled=True, ␣
↪special_characters=True,rotate=False)
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
graph.write_png(filename)
img = mpimg.imread(filename)
plt.figure(figsize=(100, 200))
plt.imshow(img,interpolation='nearest')
```

[19]:
```
<matplotlib.image.AxesImage at 0x7ff80c96ee80>
```



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1.1.1 Thank you for completing this lab!

1.2 Author

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1.2.1 Other Contributors

Joseph Santarcangelo

1.3 Change Log

Date (YYYY-MM-DD)	Version	Changed By	Change Description
2020-11-20	2.2	Lakshmi	Changed import statement of StringIO
2020-11-03	2.1	Lakshmi	Changed URL of the csv
2020-08-27	2.0	Lavanya	Moved lab to course repo in GitLab

##