CodeChalenge

July 5, 2020

```
In [371]: import numpy as np
          import sklearn as sk
          import pandas as pd
          import random
          import matplotlib.pyplot as plt
          from sklearn import datasets
          import seaborn as sns
          from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
          from sklearn.utils.random import sample_without_replacement
          from sklearn.preprocessing import normalize
          from sklearn.ensemble import RandomForestClassifier
          from sklearn.datasets import make_classification
          from sklearn.neural_network import MLPClassifier
          from sklearn.tree import export_graphviz
          from subprocess import call
          from sklearn.linear_model import LogisticRegression
          from sklearn.feature_selection import RFE
          from IPython.display import Image
          from copy import deepcopy
          import warnings
          warnings.filterwarnings('ignore')
```

```
In [372]: data = datasets.load_iris()
          iris = pd.DataFrame(np.column_stack((data.data, data.target)), columns = data.featur
          iris["target"] = iris["target"].astype(int)
          iris
```

```
Out[372]:      sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)  \
          0                  5.1               3.5                1.4               0.2
          1                  4.9               3.0                1.4               0.2
          2                  4.7               3.2                1.3               0.2
          3                  4.6               3.1                1.5               0.2
          4                  5.0               3.6                1.4               0.2
          ..                 ...               ...                ...               ...
          145                6.7               3.0                5.2               2.3
          146                6.3               2.5                5.0               1.9
          147                6.5               3.0                5.2               2.0
```

```
148                  6.2               3.4                5.4               2.3
149                  5.9               3.0                5.1               1.8

     target
0         0
1         0
2         0
3         0
4         0
..      ...
145       2
146       2
147       2
148       2
149       2

[150 rows x 5 columns]
```

```
In [373]: desc = iris.describe()
          desc
```

```
Out[373]:        sepal length (cm)  sepal width (cm)  petal length (cm)  \
          count         150.000000        150.000000         150.000000
          mean            5.843333          3.057333           3.758000
          std             0.828066          0.435866           1.765298
          min             4.300000          2.000000           1.000000
          25%             5.100000          2.800000           1.600000
          50%             5.800000          3.000000           4.350000
          75%             6.400000          3.300000           5.100000
          max             7.900000          4.400000           6.900000

                 petal width (cm)      target
          count        150.000000  150.000000
          mean           1.199333    1.000000
          std            0.762238    0.819232
          min            0.100000    0.000000
          25%            0.300000    0.000000
          50%            1.300000    1.000000
          75%            1.800000    2.000000
          max            2.500000    2.000000
```

From the matrix we can see the basic statistical propertey of each column.

```
In [374]: def data_cleansing(data, fill = None):
              # handle with empty value
              print("Check If the column contain Nan value")
              print(data.isna().any())
              if not fill is None:
                  print("Replace all empty values with {}".format(fill))
```

```
            data.fillna()
        else:
            print("Drop all rows that contains empty values")
            data.dropna()

        # handle with outliers
        # detect outliers in each column and remove them
        print("Detecting Outliers")
        indexs = []
        for col in data.columns[:-1]:
            IR = desc[col]["75%"] - desc[col]["25%"]
            ifOutlier = lambda x: x < desc[col]["25%"] - 1.5 * IR or x > desc[col]["75%"]
            index = data[col][data[col].apply(ifOutlier)].index
            indexs.extend(index)

        # now index is the list the rows that contain outlier. Remove them

        print("Rows with outlier: ", indexs)
        data.drop(indexs)
        data.reset_index(drop = True)

data = data_cleansing(iris)
```

```
Check If the column contain Nan value
sepal length (cm)    False
sepal width (cm)     False
petal length (cm)    False
petal width (cm)     False
target               False
dtype: bool
Drop all rows that contains empty values
Detecting Outliers
Rows with outlier:  [15, 32, 33, 60]
```

This function will remove the columns with empty value, or fill empty with value provided. For iris data set, there is no missing value.

This function will detect outliers in each column using quantile method, and remove the rows with outlier

```
In [375]: def statistical_relationship(data):

              # Correlation
              corr = data.corr()
              corr.to_csv("correlation.csv")

              # LR
              lr = LogisticRegression()
```

```
    rfe = RFE(lr, 1)
    fit = rfe.fit(data[data.columns[:-1]], iris["target"])
    print(fit.ranking_)

    return sns.heatmap(corr)
```

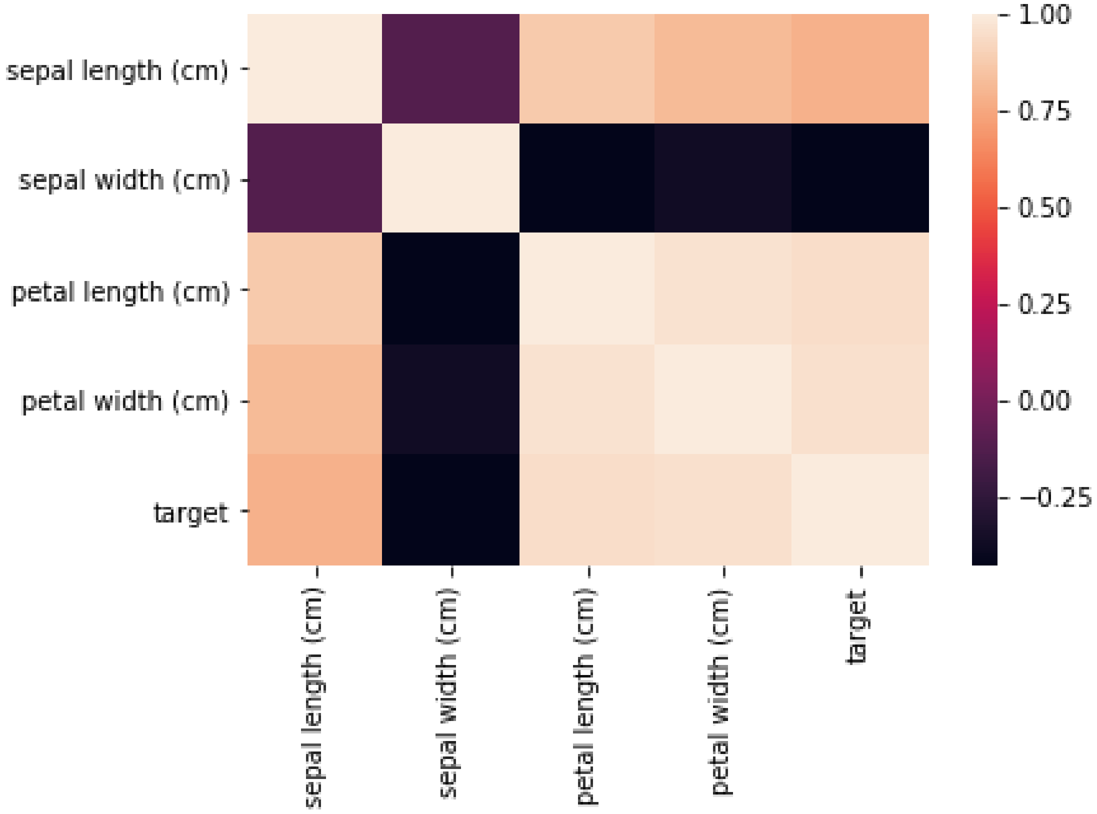
The funcion finds the relationship between features by finding the correlation matrix, output as csv, and visualize the result using heat map

The function use logistic regression to check the significance order of features.

```
In [376]: statistical_relationship(iris)
```

```
[4 2 3 1]
```

```
Out[376]: <matplotlib.axes._subplots.AxesSubplot at 0x1289da518>
```



We can see that sepal length is not correlated with other features and targets. However, the rest three features have strong corelation between each other.

From the rank list of four features, we can see that petal width (cm) is the most significant to target, followed by sepal width, petal length, sepal length.

In [377]:

```
random.seed(123)

irisc = deepcopy(iris)

index = sample_without_replacement(irisc.shape[0], 50)
irisc.loc[:,irisc.columns[:-1]] = normalize(irisc[irisc.columns[:-1]])
test = irisc.iloc[index]
test.reset_index(drop = True,inplace = True)
train = irisc[~irisc.index.isin(index)]
train.reset_index(drop = True,inplace = True)


result_test = iris.iloc[index]
result_train = iris.iloc[~iris.index.isin(index)]


## Random Forest

rdf = RandomForestClassifier()
rdf.fit(train[train.columns[:-1]],train["target"])
print(rdf.score(test[test.columns[:-1]],test["target"]))
result_test["Random Forest"] = rdf.predict(test[test.columns[:-1]])
result_train["Random Forest"] = rdf.predict(train[train.columns[:-1]])

export_graphviz(rdf.estimators_[9], out_file = 'tree.dot')
call(['dot', '-Tpng', 'tree.dot', '-o', 'tree.png', '-Gdpi=600'])

## Nueral Network

nn = MLPClassifier(activation = "relu",
                   solver = "adam",
                  learning_rate_init = 0.01)
nn.fit(train[train.columns[:-1]],train["target"])
print(nn.score(test[test.columns[:-1]],test["target"]))

result_test["Neural Network"] = nn.predict(test[test.columns[:-1]])
result_train["Neural Network"] = nn.predict(train[train.columns[:-1]])
results = pd.concat([result_train, result_test])
results.to_csv("results.csv")
#normalize(iris[])
```

```
0.96
0.96
```

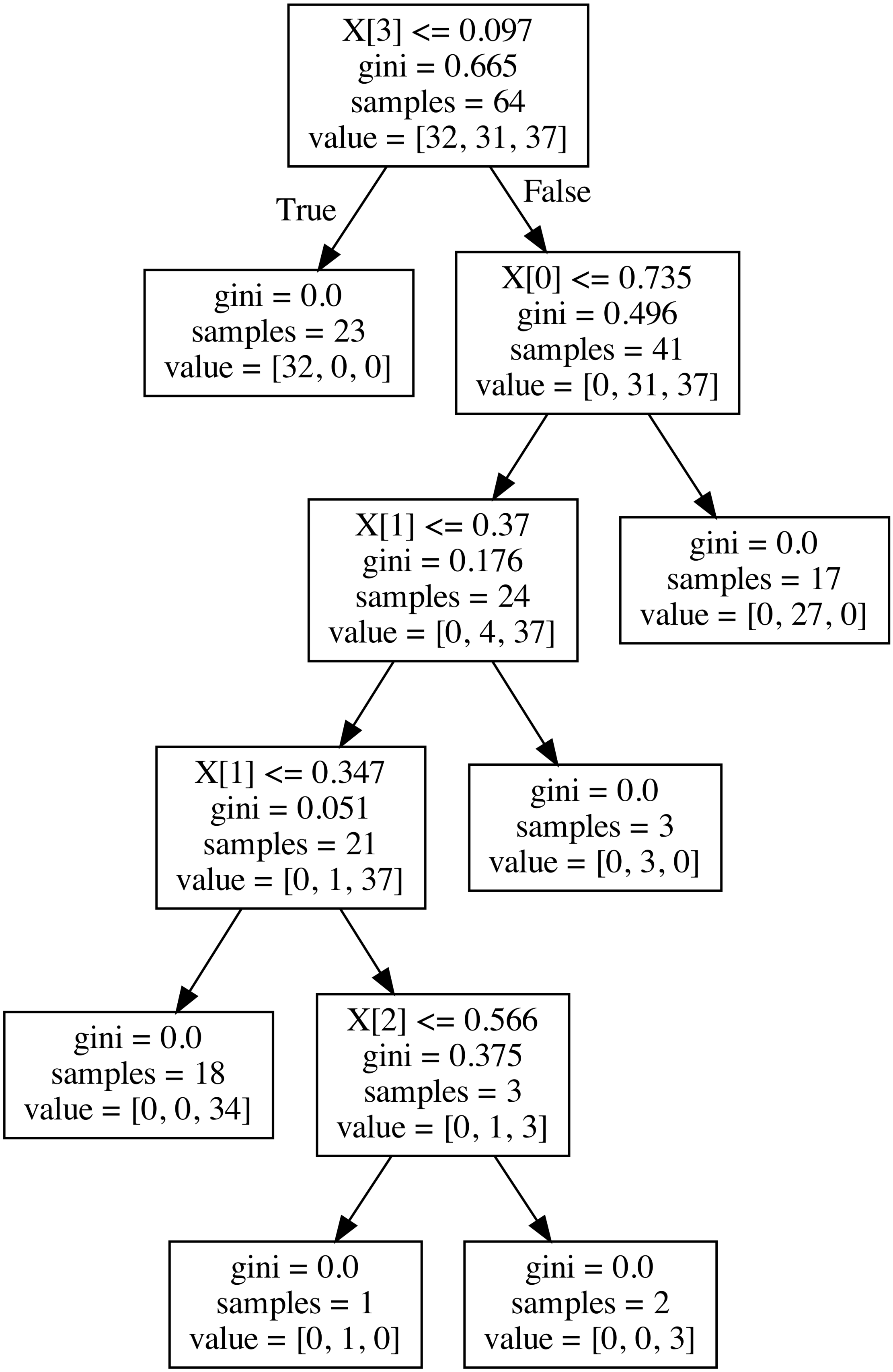
We use Random Forest and Neural Network to classify the iris data. we can see the accuracy is above 95% for both classifier.

In [378]:

```
# visualize the 10th tree of the random forest
```

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

Out[378]:


X[3] <= 0.097
gini = 0.665
samples = 64
value = [32, 31, 37]
True
False
gini = 0.0
samples = 23
value = [32, 0, 0]
X[0] <= 0.735
gini = 0.496
samples = 41
value = [0, 31, 37]
X[1] <= 0.37
gini = 0.176
samples = 24
value = [0, 4, 37]
gini = 0.0
samples = 17
value = [0, 27, 0]
X[1] <= 0.347
gini = 0.051
samples = 21
value = [0, 1, 37]
gini = 0.0
samples = 3
value = [0, 3, 0]
gini = 0.0
samples = 18
value = [0, 0, 34]
X[2] <= 0.566
gini = 0.375
samples = 3
value = [0, 1, 3]
gini = 0.0
samples = 1
value = [0, 1, 0]
gini = 0.0
samples = 2
value = [0, 0, 3]

The 10th tree of the random forest is visualized here.