ASBD lab9

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```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

Decision Tree model on fimi dataset

```
# Load the dataset
data = pd.read_csv('Social_Network_Ads.csv')
data.head()
```

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19	19000	0
1	15810944	Male	35	20000	0
2	15668575	Female	26	43000	0
3	15603246	Female	27	57000	0
4	15804002	Male	19	76000	0

```
# take only Age and EstimatedSalary as our independent variables x
# because of other features like Gender and User ID are irrelevant and have no effect on the purchasing capacity of a person.
feature_cols = ['Age','EstimatedSalary' ]
X = data.iloc[:,[2,3]].values
y = data.iloc[:,4].values          # Purchased is our dependent variable y
```

```
# split the dataset into training and test
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test =  train_test_split(X,y,test_size = 0.25, random_state= 0)
```

```
#feature scaling
from sklearn.preprocessing import StandardScaler
sc_X = StandardScaler()
X_train = sc_X.fit_transform(X_train)
X_test = sc_X.transform(X_test)
```

```
# Fit the model in the Decision Tree classifier.

from sklearn.tree import DecisionTreeClassifier
classifier = DecisionTreeClassifier()
classifier = classifier.fit(X_train,y_train)
```

```
#prediction
y_pred = classifier.predict(X_test)#Accuracy
from sklearn import metrics
print('Accuracy Score:', metrics.accuracy_score(y_test,y_pred))
```

```
Accuracy Score: 0.89
```

```
# Confusion Matrix

from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)

# Output:
# array([[62  6]
#        [ 5 27]])
# This means 11 observations have been falsely classified.

print(cm)
```

```
[[62  6]
 [ 5 27]]
```

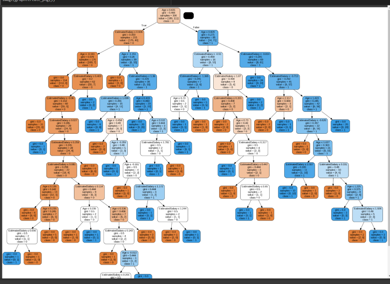
Let first visualize the model prediction results.

```
from matplotlib.colors import ListedColormap
X_set, y_set = X_test, y_test
X1, X2 = np.meshgrid(np.arange(start = X_set[:,0].min()-1, stop= X_set[:,0].max()+1, step = 0.01),np.arange(start = X_set[:,1].min()-1, stop= X_set[:,1].max()+1, step = 0.01))
plt.contourf(X1,X2, classifier.predict(np.array([X1.ravel(), X2.ravel()]).T).reshape(X1.shape), alpha=0.75, cmap = ListedColormap(("red","green")))
plt.xlim(X1.min(), X1.max())
plt.ylim(X2.min(), X2.max())
for i,j in enumerate(np.unique(y_set)):
    plt.scatter(X_set[y_set==j,0],X_set[y_set==j,1], c = ListedColormap(("red","green"))(i),label = j)
plt.title("Decision Tree(Test set)")
plt.xlabel("Age")
plt.ylabel("Estimated Salary")
plt.legend()
plt.show()
```

```
<ipython-input-13-a3a866ccee33>:8: UserWarning: *c* argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in case its
  plt.scatter(X_set[y_set==j,0],X_set[y_set==j,1], c = ListedColormap(("red","green"))(i),label = j)
```

Let us also visualize the tree:

```
from sklearn.tree import export_graphviz
from six import StringIO
from IPython.display import Image
import pydotplus
dot_data = StringIO()
export_graphviz(classifier, out_file=dot_data,
                filled=True, rounded=True,
                special_characters=True,feature_names = feature_cols,class_names=['0','1'])
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
Image(graph.create_png())
```



In the decision tree chart, each internal node has a decision rule that splits the data. Gini referred to as the Gini ratio, which measures the impurity of the node. We can say a node is pure when all of its records belong to the same class, such nodes known as the leaf node.

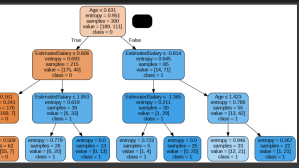
Here, the resultant tree is unpruned. This unpruned tree is unexplainable and not easy to understand. In the next section, let's optimize it by pruning.

In Scikit-learn, optimization of decision tree classifier performed by only pre-pruning. The maximum depth of the tree can be used as a control variable for pre-pruning.

```
# Create Decision Tree classifer object
classifier = DecisionTreeClassifier(criterion="entropy", max_depth=3)# Train Decision Tree Classifer
classifier = classifier.fit(X_train,y_train)#Predict the response for test dataset
y_pred = classifier.predict(X_test)# Model Accuracy, how often is the classifier correct?
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))
```

```
Accuracy: 0.94
```

```
#Now let us again visualize the pruned Decision tree after optimization.

dot_data = StringIO()
export_graphviz(classifier, out_file=dot_data,
                filled=True, rounded=True,
                special_characters=True, feature_names = feature_cols,class_names=['0','1'])
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
Image(graph.create_png())
```



This pruned model is less complex, explainable, and easy to understand than the previous decision tree model plot.

Decision Tree model on the dataset discussed in the class

```
# Load the dataset

data = pd.read_csv('class_data.csv')
data.head()
```

	age	income	student	credit_rating	buys_computer
0	1	3	0	0	0
1	1	3	0	1	0
2	2	3	0	0	1
3	3	2	0	0	1
4	3	1	1	0	1

```
feature_cols = ['age','income']
X = data.iloc[:,[0,1]].values
y = data.iloc[:,2].values
```

```
# split the dataset into training and test
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test =  train_test_split(X,y,test_size = 0.25, random_state= 0)
```

```
#feature scaling
from sklearn.preprocessing import StandardScaler
sc_X = StandardScaler()
X_train = sc_X.fit_transform(X_train)
X_test = sc_X.transform(X_test)
```

```
# Fit the model in the Decision Tree classifier.

from sklearn.tree import DecisionTreeClassifier
classifier = DecisionTreeClassifier()
classifier = classifier.fit(X_train,y_train)
```

```
#prediction
y_pred = classifier.predict(X_test)#Accuracy
from sklearn import metrics
print('Accuracy Score:', metrics.accuracy_score(y_test,y_pred))
```

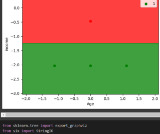
```
Accuracy Score: 1.0
```

```
# Confusion Matrix

from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)

# Output:
# array([[62  6]
#        [ 5 27]])
# This means 11 observations have been falsely classified.

print(cm)
```

```
[[1 0]
 [0 3]]
```

```
from matplotlib.colors import ListedColormap
X_set, y_set = X_test, y_test
X1, X2 = np.meshgrid(np.arange(start = X_set[:,0].min()-1, stop= X_set[:,0].max()+1, step = 0.01),np.arange(start = X_set[:,1].min()-1, stop= X_set[:,1].max()+1, step = 0.01))
plt.contourf(X1,X2, classifier.predict(np.array([X1.ravel(), X2.ravel()]).T).reshape(X1.shape), alpha=0.75, cmap = ListedColormap(("red","green")))
plt.xlim(X1.min(), X1.max())
plt.ylim(X2.min(), X2.max())
for i,j in enumerate(np.unique(y_set)):
    plt.scatter(X_set[y_set==j,0],X_set[y_set==j,1], c = ListedColormap(("red","green"))(i),label = j)
plt.title("Decision Tree(Test set)")
plt.xlabel("Age")
plt.ylabel("income")
plt.legend()
plt.show()
```

```
<ipython-input-25-f7fde786c95e>:8: UserWarning: *c* argument looks like a single numeric RGB or RGBA sequence, which should be avoided as value-mapping will have precedence in case its
  plt.scatter(X_set[y_set==j,0],X_set[y_set==j,1], c = ListedColormap(("red","green"))(i),label = j)
```

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import pydotplus
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graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
Image(graph.create_png())
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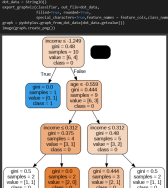

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