2022년 가을학기

앙상블 러닝

Lecture

11

앙상블 러닝

CONTENTS

A. What is Decision Tree?

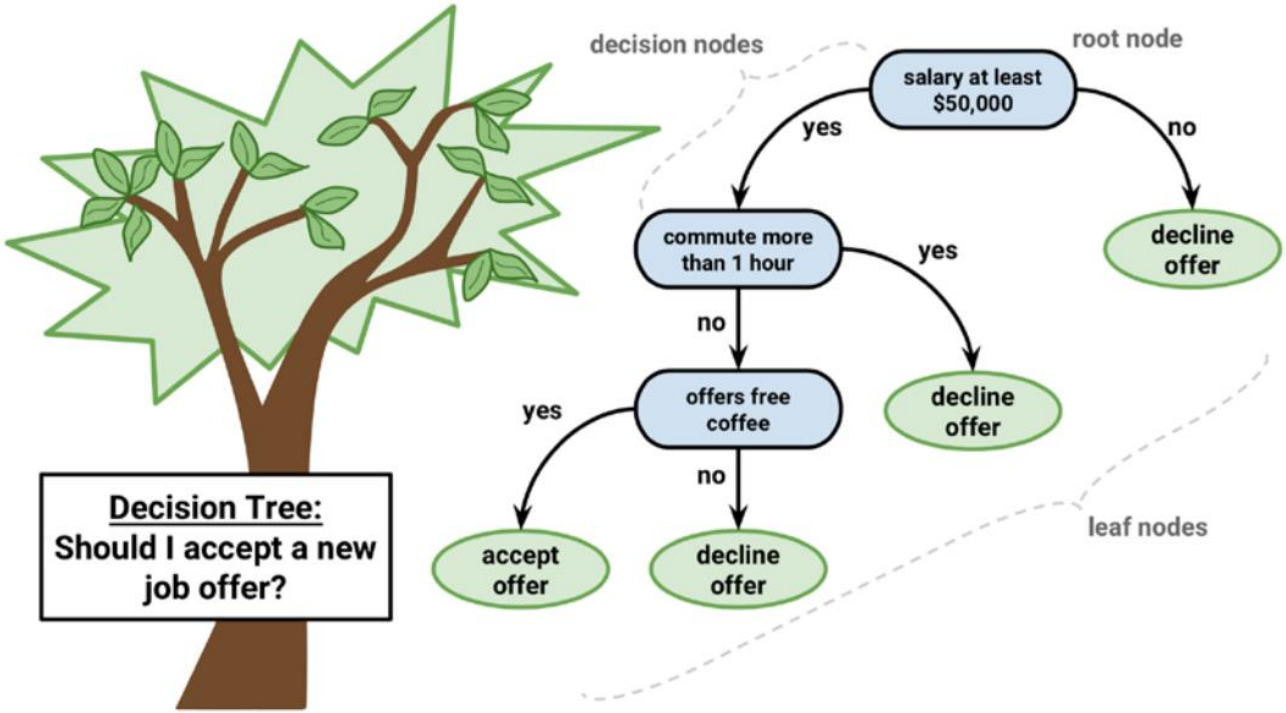
B. What is Random Forest?

C. 앙상블 러닝 실습

What is Decision Tree?

Decision Tree

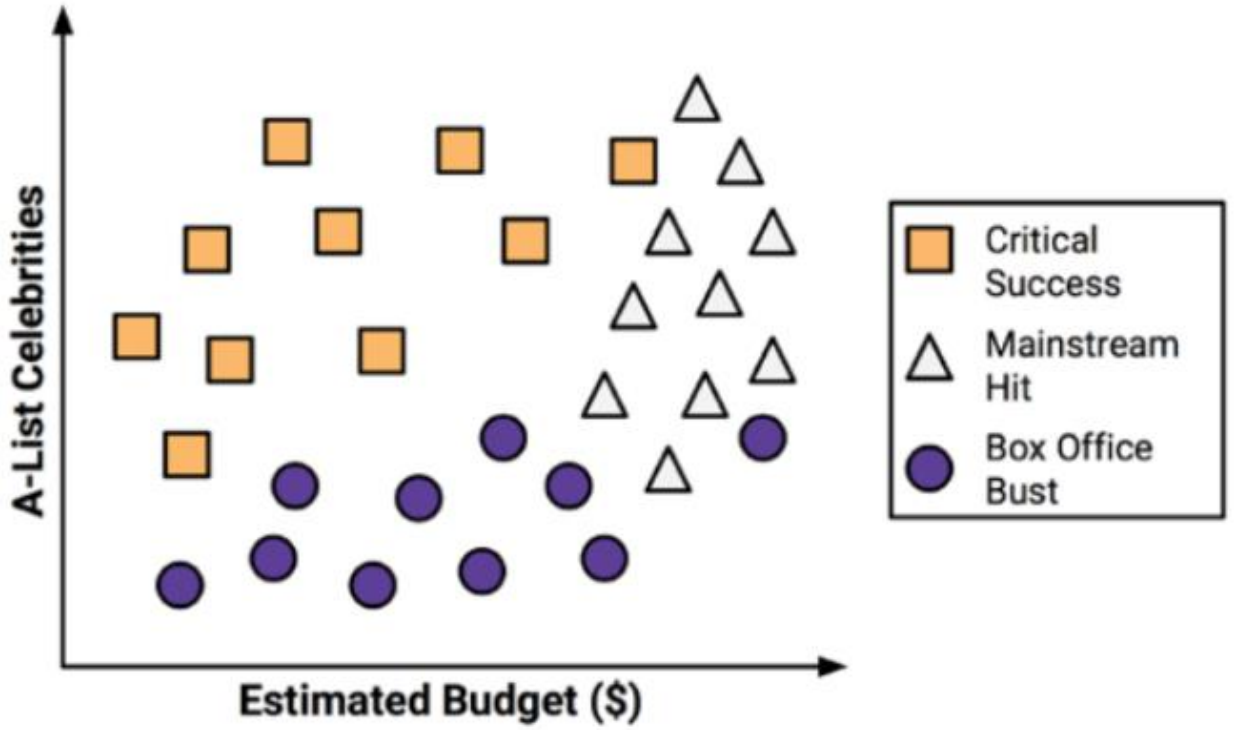
- What is Decision Tree?
  - A tree based classification



Decision Tree

❖ Divide and Conquer

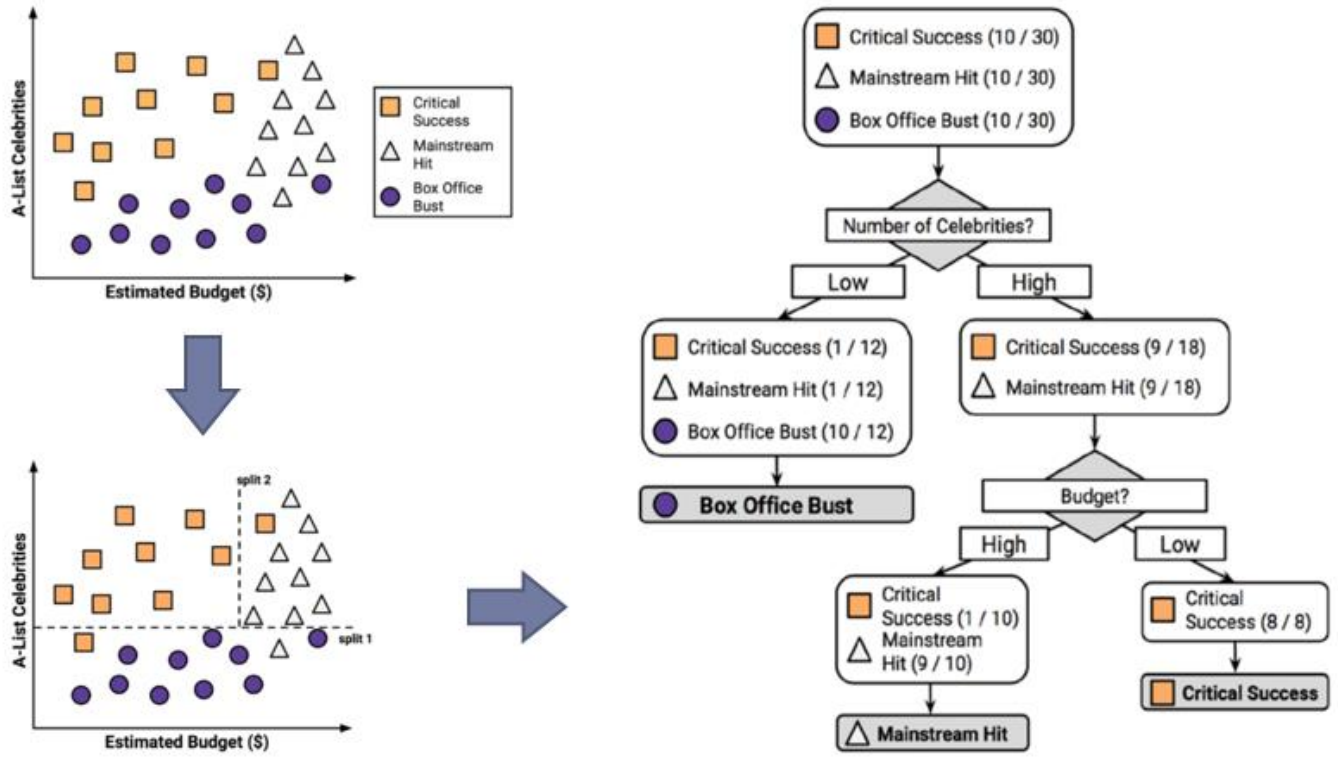
- Decision trees are built using a recursive partitioning
  - Commonly known as divide and conquer



Decision Tree

❖ Divide and Conquer

- Decision trees are built using a recursive partitioning
  - Commonly known as divide and conquer



Decision Tree

❖ Decision Tree in Python

- Loading dataset

```
#Import scikit-learn dataset library
from sklearn.datasets import load_iris

#Load dataset
iris = load_iris()

# print the label species(setosa, versicolor,virginica)
print(iris.target_names)

# print the names of the four features
print(iris.feature_names)
```

```
['setosa' 'versicolor' 'virginica']
['sepal length (cm)', 'sepal width (cm)', 'petal length (cm)', 'petal width (cm)']
```

Decision Tree

❖ Decision Tree in Python

- Split into train and test dataset

```
# Import train_test_split function
from sklearn.model_selection import train_test_split

train_points = iris.data
train_labels = iris.target

# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(train_points, train_labels,
                                                    test_size=0.2, random_state=15)
```

Decision Tree

❖ Decision Tree in Python

- Training with Decision Tree

```
#Import Decision Tree
from sklearn.tree import DecisionTreeClassifier

#Create a Gaussian Classifier
classifier = DecisionTreeClassifier(random_state=0)

#Train the model using the training sets
classifier.fit(X_train,y_train)

guesses = classifier.predict(X_test)
```

Decision Tree

❖ Decision Tree in Python

- Check out accuracy

```
#Import scikit-learn metrics module for checking confusion matrix and accuracy
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score

# Confusion matrix
print("Confusion Matrix: ", confusion_matrix(y_test, guesses))

# Model Accuracy, how often is the classifier correct?
print("Accuracy:", accuracy_score(y_test, guesses))
```

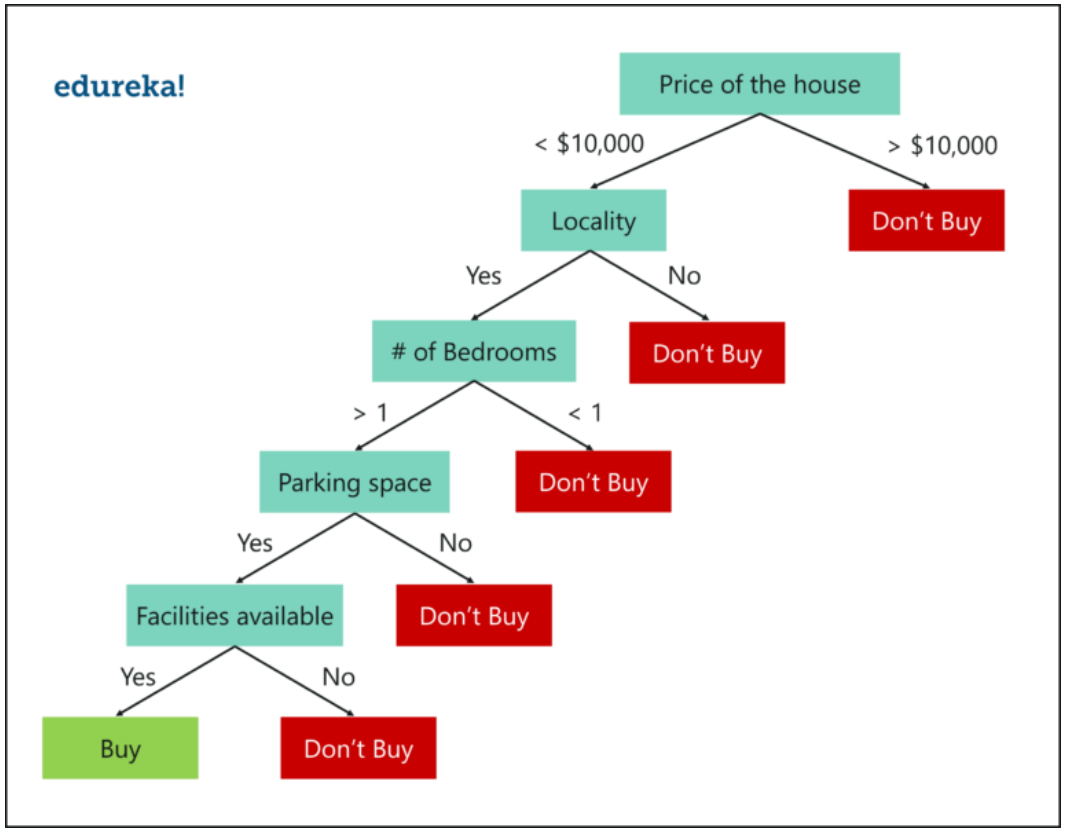
```
Confusion Matrix:    [[ 8  0  0]
                      [ 0  9  2]
                      [ 0  0 11]]

Accuracy: 0.9333333333333333
```

B

What is Random Forest

Random Forest

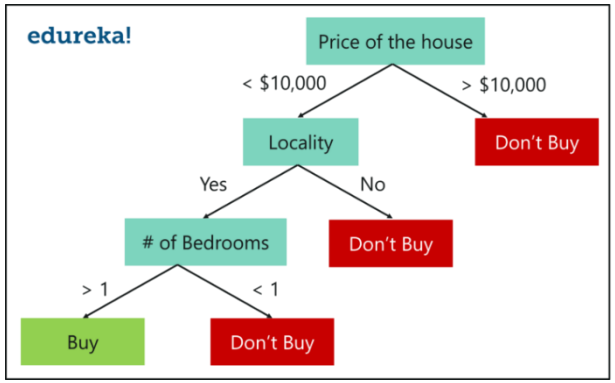
- **Problems of Decision Tree?**
  - Built on the entire dataset by using the same parameters and the same features

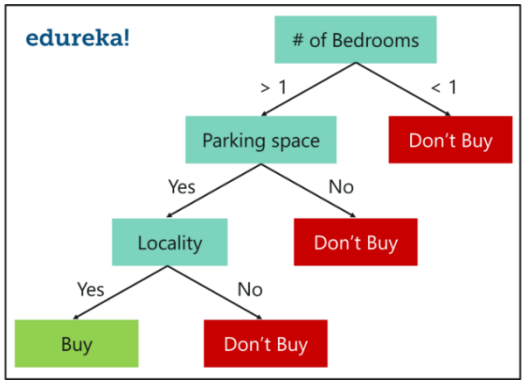


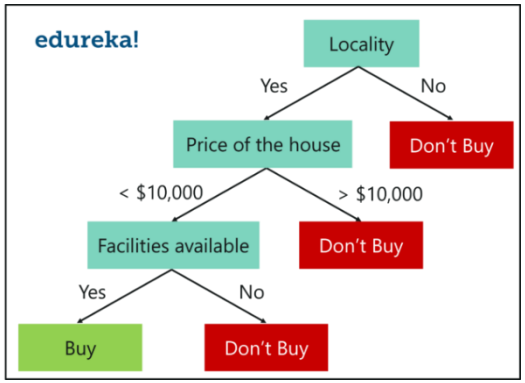
Random Forest

What is Random Forest?

- Is an ensemble of decision trees
- Randomly selects a set of parameters and creates a decision tree for each set of chosen parameters
- Only a selected a set of features are taken into consideration



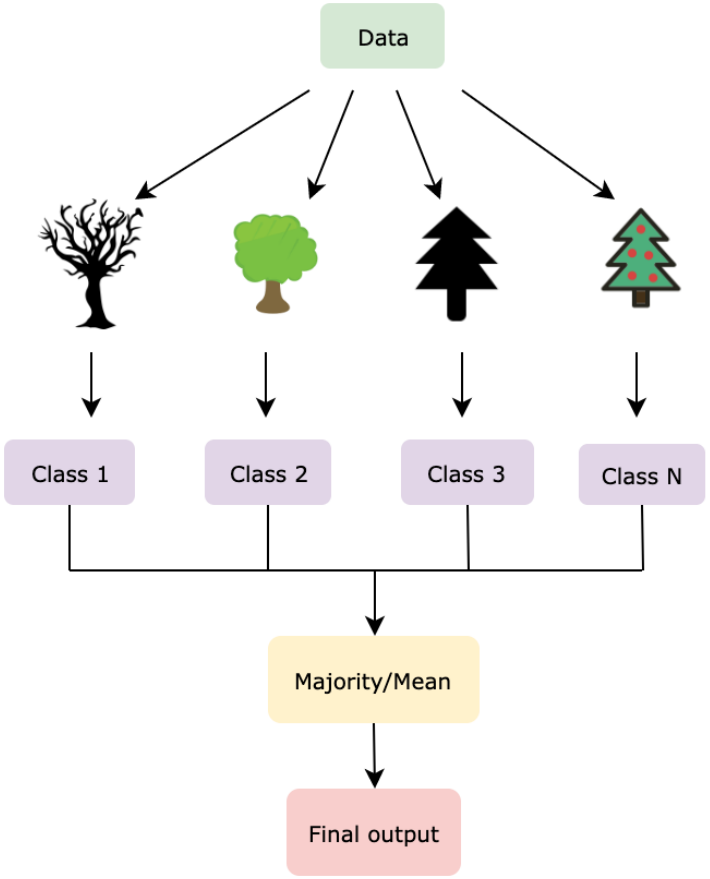


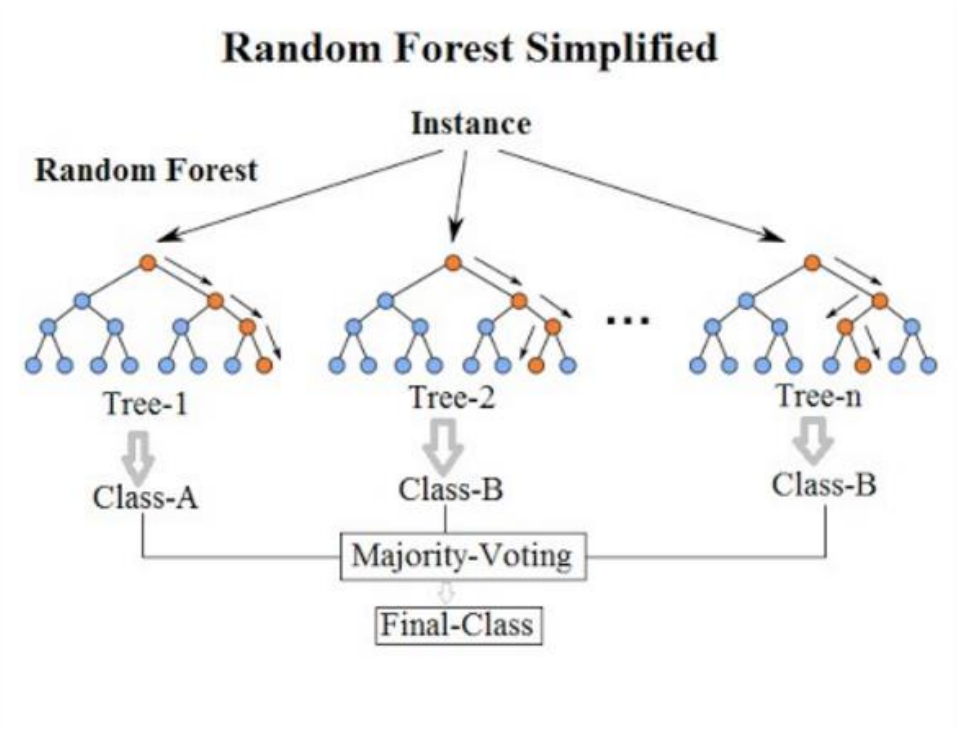


Random Forest

What is Random Forest?

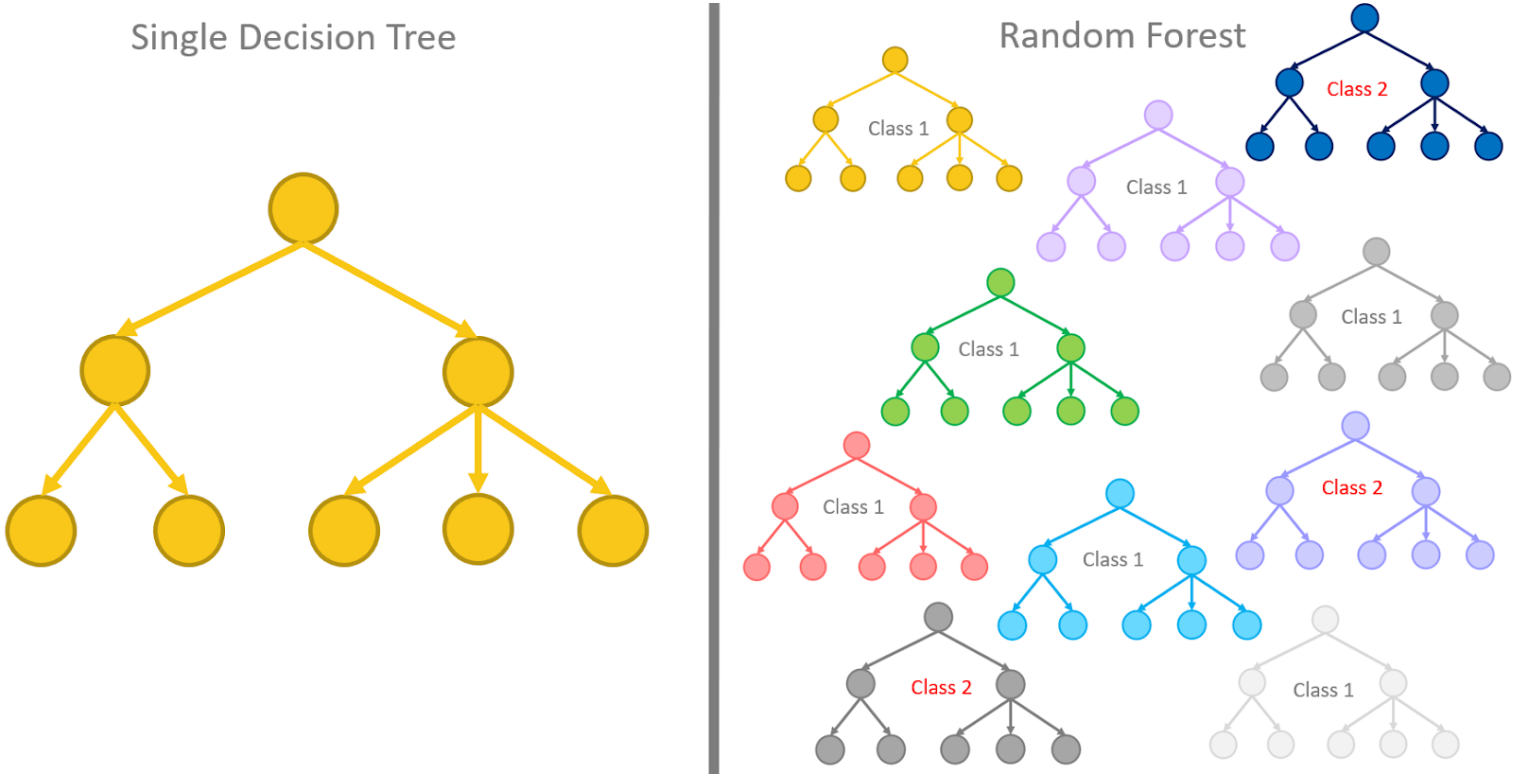
- Based on majority voting for every predicted result





Random Forest

❖ Difference between Decision Tree and Random Forest



Random Forest

❖ Random Forest in Python

- Loading dataset

```
#Import scikit-learn dataset library
from sklearn.datasets import load_iris

#Load dataset
iris = load_iris()

# print the label species(setosa, versicolor,virginica)
print(iris.target_names)

# print the names of the four features
print(iris.feature_names)
```

```
['setosa' 'versicolor' 'virginica']
['sepal length (cm)', 'sepal width (cm)', 'petal length (cm)', 'petal width (cm)']
```

Random Forest

❖ Random Forest in Python

- Split into train and test dataset

```
# Import train_test_split function
from sklearn.model_selection import train_test_split

train_points = iris.data
train_labels = iris.target

# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(train_points, train_labels,
                                                    test_size=0.2, random_state=15)
```

Random Forest

❖ Random Forest in Python

- Training with Random Forest

```
#Import Random Forest
from sklearn.ensemble import RandomForestClassifier

#Create a Gaussian Classifier
classifier = RandomForestClassifier(random_state=0, n_estimators=10)

#Train the model using the training sets y_pred=clf.predict(X_test)
classifier.fit(X_train,y_train)

guesses = classifier.predict(X_test)
```

Decision Tree

❖ Decision Tree in Python

- Check out accuracy

```
#Import scikit-learn metrics module for checking confusion matrix and accuracy
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score

# Confusion matrix
print("Confusion Matrix: ", confusion_matrix(y_test, guesses))

# Model Accuracy, how often is the classifier correct?
print("Accuracy:", accuracy_score(y_test, guesses))
```

```
Confusion Matrix:    [[ 8  0  0]
                      [ 0 13  0]
                      [ 0  2  7]]

Accuracy: 0.9333333333333333
```

C

앙상블 러닝 실습

앙상블 러닝 실습

❖ Dataset

- pima-indians-diabetes.csv

❖ Practice

- Step 1: Loading dataset
- Step 2: Normalize and split into train and test dataset
- Step 3: Training with Decision Tree/Random Forest
- Step 4: Checking accuracy
- Step 5: Improving accuracy
- Step 6: Visualize accuracy

앙상블 러닝 실습

❖ Step 1: Loading dataset

```
import pandas as pd

data = pd.read_csv("D:/pima-indians-diabetes.csv")

print(data.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Data columns (total 9 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   col1    768 non-null    int64
 1   col2    768 non-null    int64
 2   col3    768 non-null    int64
 3   col4    768 non-null    int64
 4   col4.1  768 non-null    int64
 5   col5    768 non-null    float64
 6   col6    768 non-null    float64
 7   col7    768 non-null    int64
 8   class   768 non-null    int64
dtypes: float64(2), int64(7)
memory usage: 54.1 KB
```

앙상블 러닝 실습

❖ Step 2:Normalize and split into train and test dataset

```
train_points = data.drop("class", axis=1)
train_labels = data["class"]

# standardize the dataset
from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()
train_points_scaled = scaler.fit_transform(train_points)

# Import train_test_split function
from sklearn.model_selection import train_test_split

# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(train_points_scaled, train_labels,
                                                    test_size=0.2, random_state=5)
```

앙상블 러닝 실습

❖ Step 3: Training with Random Forest

```
#Import Random Forest
from sklearn.ensemble import RandomForestClassifier

#Create a Gaussian Classifier
classifier = RandomForestClassifier(random_state=0, n_estimators=3)

#Train the model using the training sets y_pred=clf.predict(X_test)
classifier.fit(X_train,y_train)

guesses = classifier.predict(X_test)
```

앙상블 러닝 실습

❖ Step 4: Checking accuracy

```
#Import scikit-learn metrics module for checking confusion matrix and accuracy
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score

# Confusion matrix
print("Confusion Matrix: ", confusion_matrix(y_test, guesses))

# Model Accuracy, how often is the classifier correct?
print("Accuracy:", accuracy_score(y_test, guesses))
```

```
Confusion Matrix:    [[83 17]
                      [26 28]]

Accuracy: 0.7207792207792207
```

앙상블 러닝 실습

❖ Step 5: Improving accuracy

```
#Import Random Forest
from sklearn.ensemble import RandomForestClassifier

#Create a Gaussian Classifier
classifier = RandomForestClassifier(random_state=0, n_estimators=5)

#Train the model using the training sets y_pred=clf.predict(X_test)
classifier.fit(X_train,y_train)

guesses = classifier.predict(X_test)
```

Confusion Matrix: *[[83 17]*
[22 32]]

Accuracy: 0.7467532467532467

앙상블 러닝 실습

❖ Step 5: Improving accuracy

```
#Import Random Forest
from sklearn.ensemble import RandomForestClassifier

#Create a Gaussian Classifier
classifier = RandomForestClassifier(random_state=0, n_estimators=10)

#Train the model using the training sets y_pred=clf.predict(X_test)
classifier.fit(X_train,y_train)

guesses = classifier.predict(X_test)
```

Confusion Matrix: [[89 11]
[23 31]]

Accuracy: 0.7792207792207793

앙상블 러닝 실습

❖ Step 5: Improving accuracy

```
#Import Random Forest
from sklearn.ensemble import RandomForestClassifier

#Create a Gaussian Classifier
classifier = RandomForestClassifier(random_state=0, n_estimators=100)

#Train the model using the training sets y_pred=clf.predict(X_test)
classifier.fit(X_train,y_train)

guesses = classifier.predict(X_test)
```

Confusion Matrix: *[[87 13]*
[19 35]]

Accuracy: 0.7922077922077922

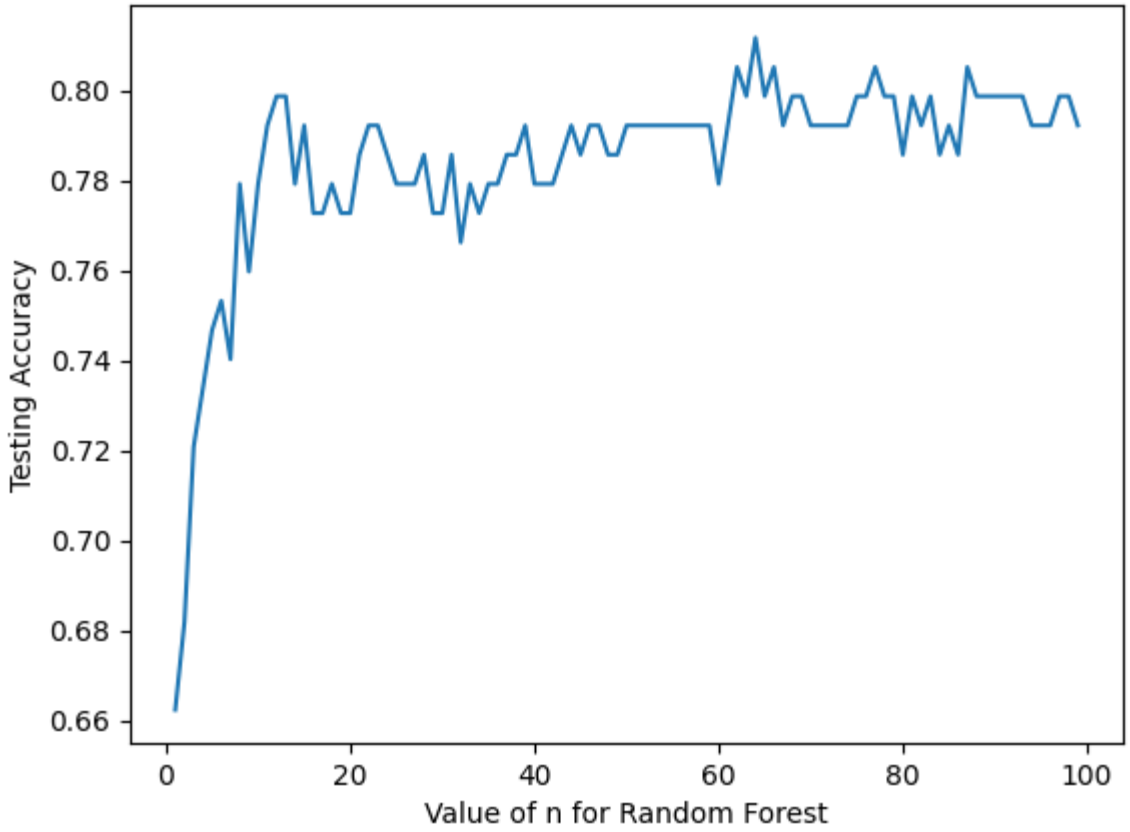
앙상블 러닝 실습

❖ Step 6: Visualize accuracy

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score

n_range = range(1, 100)
accuracy_scores = []

for n in n_range:
    classifier = RandomForestClassifier(random_state=0, n_estimators=n)
    classifier.fit(X_train, y_train)
    guesses = classifier.predict(X_test)
    accuracy_scores.append(accuracy_score(y_test, guesses))
print(accuracy_scores)

import matplotlib.pyplot as plt

plt.plot(n_range, accuracy_scores)
plt.xlabel('Value of n for Random Forest')
plt.ylabel('Testing Accuracy')
plt.show()
```

앙상블 러닝 실습

❖ Step 6: Visualize accuracy



Final Task

- **Submit your source code for the following task:**
  1. Try all source code in the lecture

- **Submission: source code, result screenshots and result explanation**

감사합니다!