23. Data Science – Machine Learning – Random Forest Algorithm

Contents

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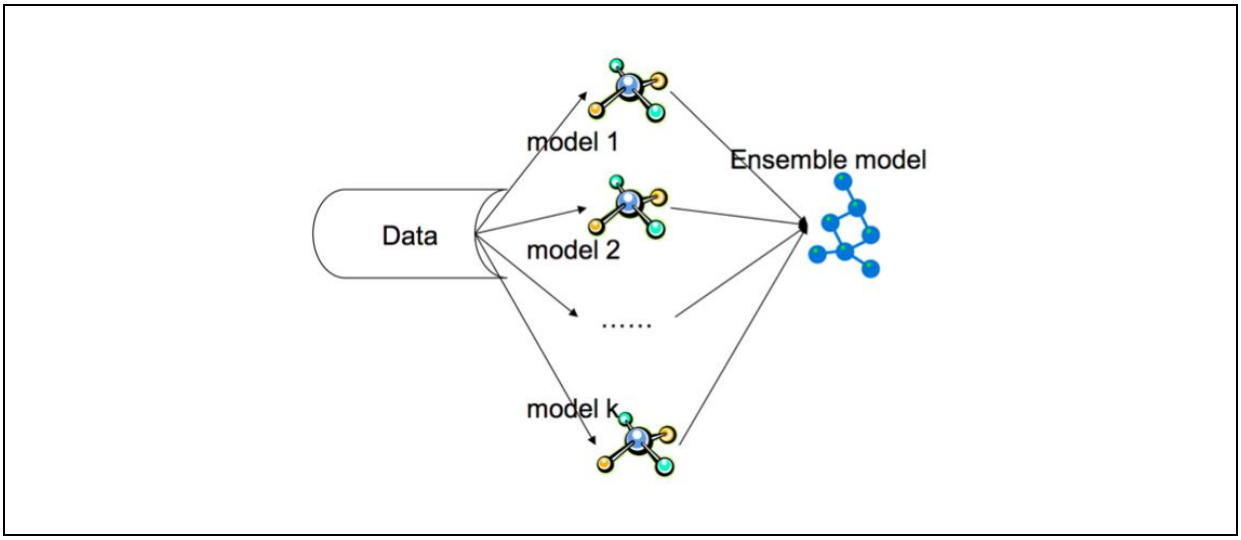
1. Random Forest

- ✓ Random Forest is supervised learning technique.
- ✓ It can be used for both Classification and Regression problems in ML.
- ✓ Random forest is the concept of ensemble learning.

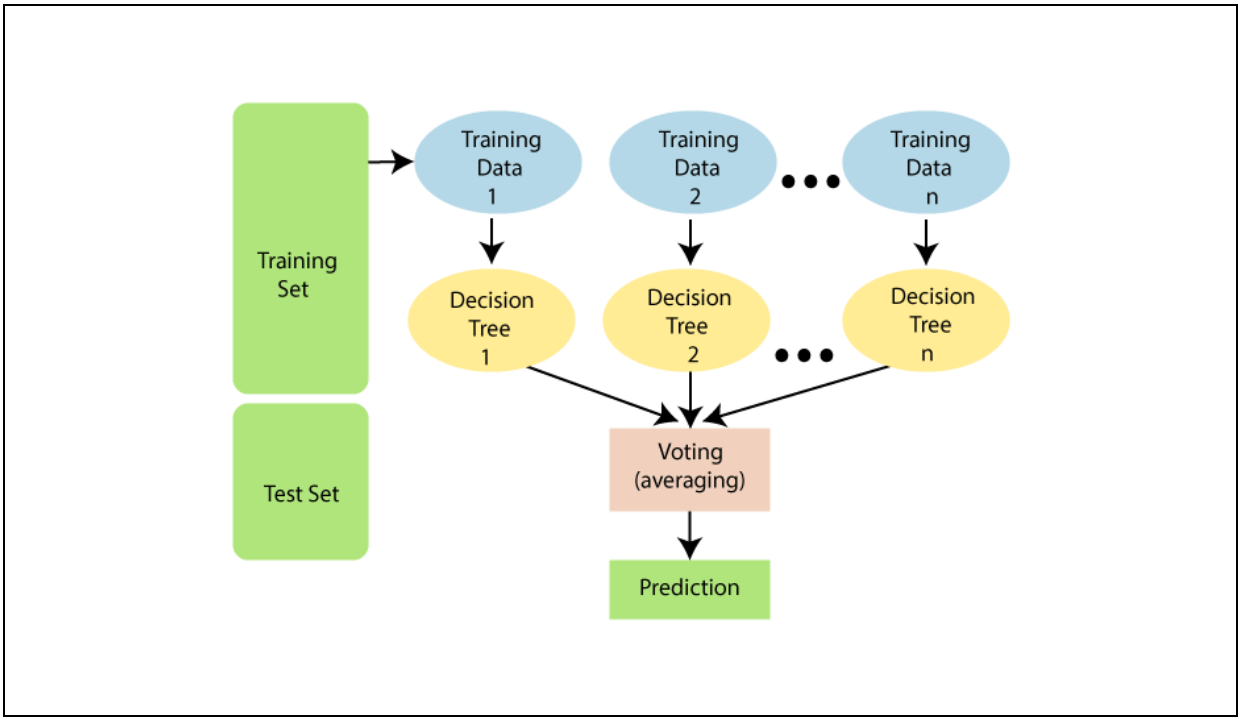
2. Ensemble learning

- ✓ This is the process of combining multiple classifiers to solve a complex problem and to improve the performance of the model.



3. Process behind in Random Forest

- ✓ Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset.
- ✓ It takes the average of all decision trees to improve the predictive accuracy of that dataset.
  - Instead of believing on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output.
- ✓ The greater number of trees in the forest leads to higher accuracy.



5. Why use Random Forest?

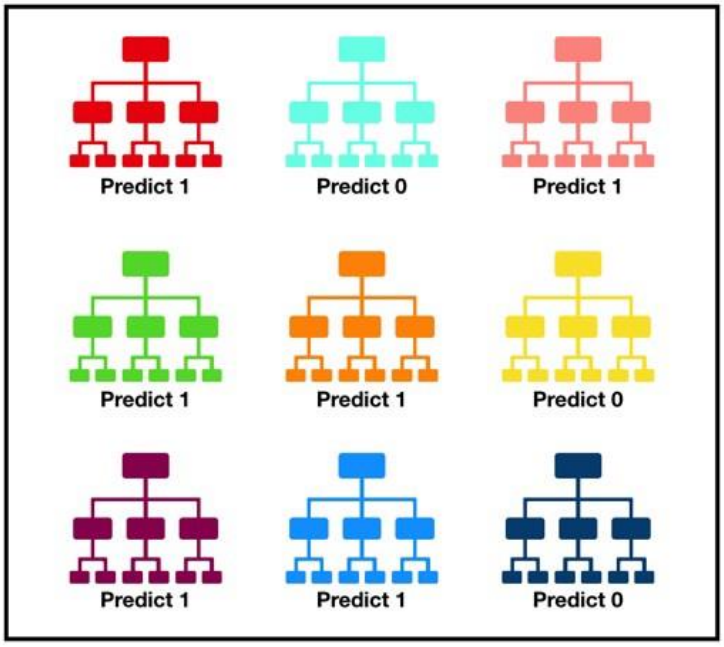
- ✓ It takes less training time as compared to other algorithms.
- ✓ It predicts output with high accuracy, even for the large dataset it runs efficiently.
- ✓ It can also maintain accuracy when a large proportion of data is missing.

6. How does Random Forest algorithm work?

- ✓ Random Forest works in two-phase,
  - First it creates the random forest by combining N decision tree.
  - Second is to make predictions for each tree created in the first phase.

7. Steps in Random Forest

- ✓ Step-1: Select random K data points from the training set.
- ✓ Step-2: Build the decision trees associated with the selected data points
- ✓ Step-3: Choose the number N for decision trees that you want to build.
- ✓ Step-4: Repeat Step 1 & 2.
- ✓ Step-5: For new data points, find the predictions of each decision tree, and assign the new data points to the category that wins the majority votes.

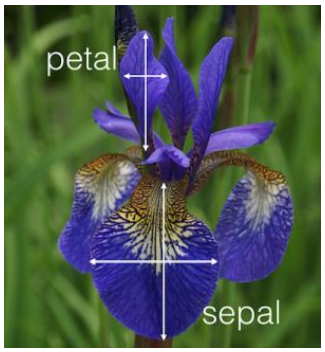


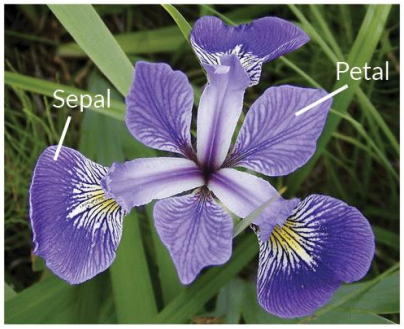
Tally: Six 1s and Three 0s
Prediction: 1

8. Use case

- ✓ Assuming that Abhi had a hobby which is interested in distinguishing the species of some iris flowers that he has found
- ✓ He has collected some measurements associated with each iris, which are:
  - The length and width of the petals
  - The length and width of the sepals, all measured in centimetres.

- ✓ He also has the measurements of some irises that have been previously identified to the species
  - setosa,
  - versicolor
  - virginica
- ✓ The goal is to create a machine learning model that can learn from the measurements of these irises whose species are already known.
- ✓ So that we can predict the species for the new irises that she has found.





Iris Versicolor

Iris Setosa

Iris Virginica

Flower codes

- ✓ Setosa - 0
- ✓ Versicolor - 1
- ✓ Virginica - 2

Program Name: Loading iris dataset
demo1.py

```
from sklearn.datasets import load_iris

iris = load_iris()

print(dir(iris))
```

Output

```
['DESCR', 'data', 'feature_names', 'filename', 'frame', 'target',
'target_names']
```

Program Name: Displaying feature names
demo2.py

```
from sklearn.datasets import load_iris

iris = load_iris()

print(iris.feature_names)
```

Output

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

Program Name: Displaying target names
demo3.py

```
from sklearn.datasets import load_iris

iris = load_iris()

print(iris.target_names)
```

Output

```
['setosa' 'versicolor' 'virginica']
```

Program Name: Displaying data
demo4.py

```
from sklearn.datasets import load_iris

iris = load_iris()

print(iris.data)
```

Output

```
[[5.1 3.5 1.4 0.2]
 [4.9 3.  1.4 0.2]
 [4.7 3.2 1.3 0.2]
 [4.6 3.1 1.5 0.2]
 [5.  3.6 1.4 0.2]
 [5.4 3.9 1.7 0.4]
 [4.6 3.4 1.4 0.3]
 [5.  3.4 1.5 0.2]
 [4.4 2.9 1.4 0.2]
 [4.9 3.1 1.5 0.1]
 [5.4 3.7 1.5 0.2]
 [4.8 3.4 1.6 0.2]
 [4.8 3.  1.4 0.1]
 [4.3 3.  1.1 0.1]
```

Program Name: Length of the data
demo5.py

```
from sklearn.datasets import load_iris

iris = load_iris()

print(len(iris.data))
```

Output

```
150
```

Program Name: Create a Dataframe by using data and features
demo6.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)

print(df)
```

Output

```
     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

[150 rows x 4 columns]
```

Program Name: Adding target column to the dataframe
demo7.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns = iris.feature_names)
df['target'] = iris.target

print(df.head())
```

Output

```
   sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)  target
0                5.1               3.5                1.4               0.2       0
1                4.9               3.0                1.4               0.2       0
2                4.7               3.2                1.3               0.2       0
3                4.6               3.1                1.5               0.2       0
4                5.0               3.6                1.4               0.2       0
```

Program Name: Displaying target == 0 flowers
demo8.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns = iris.feature_names)
df['target'] = iris.target

print(df[df.target == 0].head())
```

Output

```
   sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)  target
0                5.1               3.5                1.4               0.2       0
1                4.9               3.0                1.4               0.2       0
2                4.7               3.2                1.3               0.2       0
3                4.6               3.1                1.5               0.2       0
4                5.0               3.6                1.4               0.2       0
```

Program Name: Displaying length of the target == 0 flowers
demo9.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns = iris.feature_names)
df['target'] = iris.target

print(len(df[df.target == 0]))
```

Output

```
50
```

Program Name: Displaying target == 1 flowers

demo10.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)
df['target'] = iris.target

print(df[df.target == 1].head())
```

Output

```
    sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)  target
50                7.0               3.2                4.7               1.4       1
51                6.4               3.2                4.5               1.5       1
52                6.9               3.1                4.9               1.5       1
53                5.5               2.3                4.0               1.3       1
54                6.5               2.8                4.6               1.5       1
```

Program Name: Displaying length of the target == 1 flowers
demo11.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)
df['target'] = iris.target

print(len(df[df.target==1]))
```

Output

```
50
```

Program Name: Displaying target == 2 flowers
demo12.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns = iris.feature_names)
df['target'] = iris.target

print(df[df.target==2].head())
```

Output

```
     sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)  target
100                6.3               3.3                6.0               2.5       2
101                5.8               2.7                5.1               1.9       2
102                7.1               3.0                5.9               2.1       2
103                6.3               2.9                5.6               1.8       2
104                6.5               3.0                5.8               2.2       2
```

Program Name: Displaying length of the target == 2 flowers
demo13.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns = iris.feature_names)
df['target'] = iris.target

print(len(df[df.target == 2]))
```

Output

```
50
```

Program Name: Displaying the flower names
demo14.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)
df['target'] = iris.target

a = lambda x: iris.target_names[x]
df['flower_name'] = df.target.apply(a)
print(df)
```

Output

```
     sepal length (cm)  sepal width (cm)  petal length (cm)  petal width (cm)  target flower_name
0                  5.1               3.5                1.4               0.2       0      setosa
1                  4.9               3.0                1.4               0.2       0      setosa
2                  4.7               3.2                1.3               0.2       0      setosa
3                  4.6               3.1                1.5               0.2       0      setosa
4                  5.0               3.6                1.4               0.2       0      setosa
..                 ...               ...                ...               ...     ...         ...
145                6.7               3.0                5.2               2.3       2   virginica
146                6.3               2.5                5.0               1.9       2   virginica
147                6.5               3.0                5.2               2.0       2   virginica
148                6.2               3.4                5.4               2.3       2   virginica
149                5.9               3.0                5.1               1.8       2   virginica

[150 rows x 6 columns]
```

Program Name: All setosa flowers
demo15.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)

df['target'] = iris.target
a = lambda x: iris.target_names[x]
df['flower_name'] = df.target.apply(a)

setosa_50 = df[:50]
print(setosa_50.head())
```

Output

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)	target	flower_name
0	5.1	3.5	1.4	0.2	0	setosa
1	4.9	3.0	1.4	0.2	0	setosa
2	4.7	3.2	1.3	0.2	0	setosa
3	4.6	3.1	1.5	0.2	0	setosa
4	5.0	3.6	1.4	0.2	0	setosa

Program Name: All versicolor flowers
demo16.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)

df['target'] = iris.target
a = lambda x: iris.target_names[x]
df['flower_name'] = df.target.apply(a)

versicolor_50 = df[50:100]
print(versicolor_50.head())
```

Output

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)	target	flower_name
50	7.0	3.2	4.7	1.4	1	versicolor
51	6.4	3.2	4.5	1.5	1	versicolor
52	6.9	3.1	4.9	1.5	1	versicolor
53	5.5	2.3	4.0	1.3	1	versicolor
54	6.5	2.8	4.6	1.5	1	versicolor

Program Name: All virginica flowers
demo17.py

```
import pandas as pd
from sklearn.datasets import load_iris

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)

df['target'] = iris.target
a = lambda x: iris.target_names[x]
df['flower_name'] = df.target.apply(a)

verginica_50 = df[100:]
print(verginica_50.head())
```

Output

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)	target	flower_name
100	6.3	3.3	6.0	2.5	2	virginica
101	5.8	2.7	5.1	1.9	2	virginica
102	7.1	3.0	5.9	2.1	2	virginica
103	6.3	2.9	5.6	1.8	2	virginica
104	6.5	3.0	5.8	2.2	2	virginica

Program Name: Splitting the data
demo18.py

```
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)

df['target'] = iris.target
a = lambda x: iris.target_names[x]
df['flower_name'] = df.target.apply(a)


X = df.drop(['target', 'flower_name'], axis = 'columns')
y = df.target

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

print("Splitting the data")
```

Output

```
Splitting the data
```

Program Name: Model training
demo19.py

```
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)

df['target'] = iris.target
a = lambda x: iris.target_names[x]
df['flower_name'] = df.target.apply(a)

X = df.drop(['target', 'flower_name'], axis='columns')
y = df.target

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

# Train Using RandomForestClassifier

model = RandomForestClassifier(n_estimators=40)
model.fit(X_train, y_train)
print("Model got trained")
```

Output

```
Model got trained
```

Program Name: Model score
demo20.py

```
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)

df['target'] = iris.target
a = lambda x: iris.target_names[x]
df['flower_name'] = df.target.apply(a)


X = df.drop(['target', 'flower_name'], axis='columns')
y = df.target

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

model = RandomForestClassifier(n_estimators=40)
model.fit(X_train, y_train)
print(model.score(X_test, y_test))
```

Output

```
0.9666666666666667
```

Note

- ✓ n_estimators=40 parameter defines the number of trees in the random forest.

Program Name: Model prediction
demo21.py

```
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier

iris = load_iris()

df = pd.DataFrame(iris.data, columns=iris.feature_names)

df['target'] = iris.target
a = lambda x: iris.target_names[x]
df['flower_name'] = df.target.apply(a)

X = df.drop(['target', 'flower_name'], axis='columns')
y = df.target

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

model = RandomForestClassifier(n_estimators = 40)

model.fit(X_train.values, y_train)

print(model.predict([[4.8,3.0,1.5,0.3]]))
```

Output

```
[0]
```