K-nearest Neighbour (KNN)

KNN is a supervised machine learning algorithm that can be used to solve both classification and regression problems.

It is a non-parametric, lazy learning algorithm. Non-parametric means that it does not make any assumptions on the underlying data distribution. Lazy learning means that it does not require any training data points for model generation. All training data used in the testing phase. This makes training faster and testing phase slower and costlier.

KNN algorithm at the training phase just stores the dataset and when it gets new data, then it classifies that data into a category that is much similar to the new data.

In [1]:
```
# Example of KNN classfier on IRIS data using SNS

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns


# load the dataset
df = sns.load_dataset('iris')
df.head()
```

Out[1]:

	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	setosa
1	4.9	3.0	1.4	0.2	setosa
2	4.7	3.2	1.3	0.2	setosa
3	4.6	3.1	1.5	0.2	setosa
4	5.0	3.6	1.4	0.2	setosa

In [2]:
```
df.info()
```

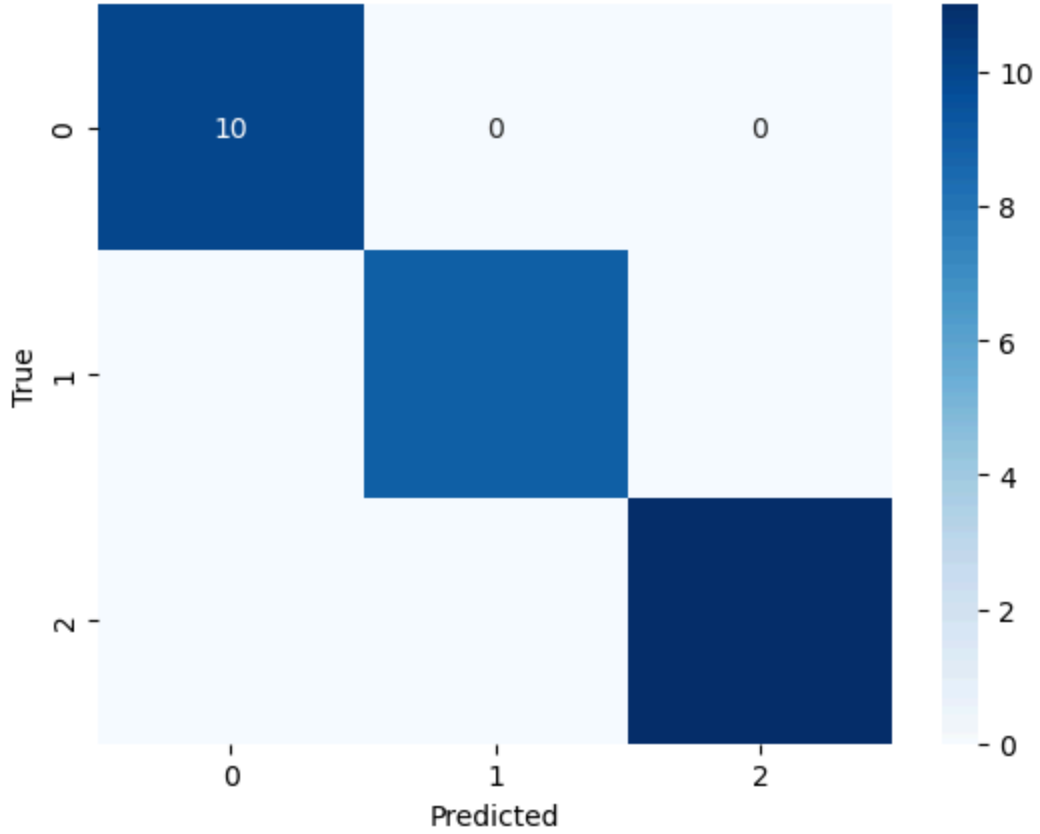
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 5 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   sepal_length  150 non-null    float64
 1   sepal_width   150 non-null    float64
 2   petal_length  150 non-null    float64
 3   petal_width   150 non-null    float64
 4   species       150 non-null    object 
dtypes: float64(4), object(1)
memory usage: 6.0+ KB
```

In [3]:
```
# split the data into X and y
X = df.drop('species', axis=1)
y = df['species']
```

In [4]:
```
# train test split the data
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

model = KNeighborsClassifier(n_neighbors=11)
# fit the model on the training data
model.fit(X_train, y_train)

# predict the species for the test data
y_pred = model.predict(X_test)

# evaluate the model
from sklearn.metrics import classification_report, confusion_matrix

print(confusion_matrix(y_test, y_pred))
print(classification_report(y_test, y_pred))

# plot the confusion matrix
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, cmap='Blues')
plt.xlabel('Predicted')
plt.ylabel('True')
```

```
[[10  0  0]
 [ 0  9  0]
 [ 0  0 11]]
              precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        10
  versicolor       1.00      1.00      1.00         9
   virginica       1.00      1.00      1.00        11

    accuracy                           1.00        30
   macro avg       1.00      1.00      1.00        30
weighted avg       1.00      1.00      1.00        30
```

Out[4]: Text(50.722222222222214, 0.5, 'True')



Regression using KNN

In [5]:
```
# Reggression problem on tips dataset

# load the dataset
tips = sns.load_dataset('tips')
tips.head()
```

Out[5]:

	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
1	10.34	1.66	Male	No	Sun	Dinner	3
2	21.01	3.50	Male	No	Sun	Dinner	3
3	23.68	3.31	Male	No	Sun	Dinner	2
4	24.59	3.61	Female	No	Sun	Dinner	4

In [6]:
```
# split the data into X and y
X = tips.drop('tip', axis=1)
y = tips['tip']
```

In [7]:
```
tips.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 244 entries, 0 to 243
Data columns (total 7 columns):
 #   Column      Non-Null Count  Dtype   
---  ------      --------------  -----   
 0   total_bill  244 non-null    float64 
 1   tip         244 non-null    float64 
 2   sex         244 non-null    category
 3   smoker      244 non-null    category
 4   day         244 non-null    category
 5   time        244 non-null    category
 6   size        244 non-null    int64   
dtypes: category(4), float64(2), int64(1)
memory usage: 7.4 KB
```

In [8]:
```
# encode the categorical columns using for lopp and le
from sklearn.preprocessing import LabelEncoder

le = LabelEncoder()
for col in X.columns:
    if X[col].dtype == 'object' or X[col].dtype == 'category':
        X[col] = le.fit_transform(X[col])
```

In [9]:
```
# train test split the data and run the model
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsRegressor

X_train, X_test, y_train, y_test = train_test_split(X, y,
                                                    test_size=0.2,
                                                    random_state=42)

model = KNeighborsRegressor(n_neighbors=5, metric='minkowski', p=2)

# fit the model on the training data
model.fit(X_train, y_train)

# predict the species for the test data
y_pred = model.predict(X_test)

# evaluate the model
from sklearn.metrics import mean_squared_error, r2_score
```

```
print(f"Mean Squared Error: {mean_squared_error(y_test, y_pred)}")
print(f"R2 Score: {r2_score(y_test, y_pred)}")
print(f"RMSE: {np.sqrt(mean_squared_error(y_test, y_pred))}")
```

```
Mean Squared Error: 0.8382265306122448
R2 Score: 0.3294034029001649
RMSE: 0.9155471209130881
```

In [10]:
```
X_test.head()
```

Out[10]:

	total_bill	sex	smoker	day	time	size
24	19.82	1	0	1	0	2
6	8.77	1	0	2	0	2
153	24.55	1	0	2	0	4
211	25.89	1	1	1	0	4
198	13.00	0	1	3	1	2

In [11]:
```
# predict a specific value
model.predict([[45, 1, 0, 1, 1, 3]])
```

```
C:\Users\ustb\.anaconda\anwaar\Lib\site-packages\sklearn\base.py:450: UserWarning: X does not have valid feature name
s, but KNeighborsRegressor was fitted with feature names
  warnings.warn(
```

Out[11]:
```
array([4.946])
```

In [ ]:
```

```