ML - KNN Algorithm

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In [ ]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.datasets import load_iris
```

1. Create KNN class.

In [ ]:
```
class KNN:
    def __init__(self, k=3):
        self.k = k

    def fit(self, X_train, y_train):
        self.X_train = np.array(X_train)
        self.y_train = np.array(y_train)

    def predict(self, X_test):
        X_test = np.array(X_test)
        predictions = []

        for sample in X_test:
            distances = np.linalg.norm(self.X_train - sample, axis=1)
            nearest_neighbors = np.argsort(distances)[:self.k]
            k_nearest_labels = self.y_train[nearest_neighbors]

            unique_labels, counts = np.unique(k_nearest_labels, return_counts=True)
            predicted_label = unique_labels[np.argmax(counts)]

            predictions.append(predicted_label)

        return np.array(predictions)
```

2. Load dataset and pre-process

In [ ]:
```
iris = load_iris()
iris_df = pd.DataFrame(iris.data, columns=iris.feature_names)
iris_df["target"] = iris.target
```

In [ ]:
```
print("Data scale: ", iris.data.shape)
print("Feature names: ", iris.feature_names)
print("Target names: ", iris.target_names)
print("Data info:")
```

```
Data scale:  (150, 4)
Feature names:  ['sepal length (cm)', 'sepal width (cm)', 'petal length (cm)', 'petal w
idth (cm)']
Target names:  ['setosa' 'versicolor' 'virginica']
Data info:
```

In [ ]:
```
print(iris_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 (cm)  150 non-null    float64
 1   sepal width (cm)   150 non-null    float64
 2   petal length (cm)  150 non-null    float64
 3   petal width (cm)   150 non-null    float64
 4   target             150 non-null    int64  
dtypes: float64(4), int64(1)
memory usage: 6.0 KB
None
```

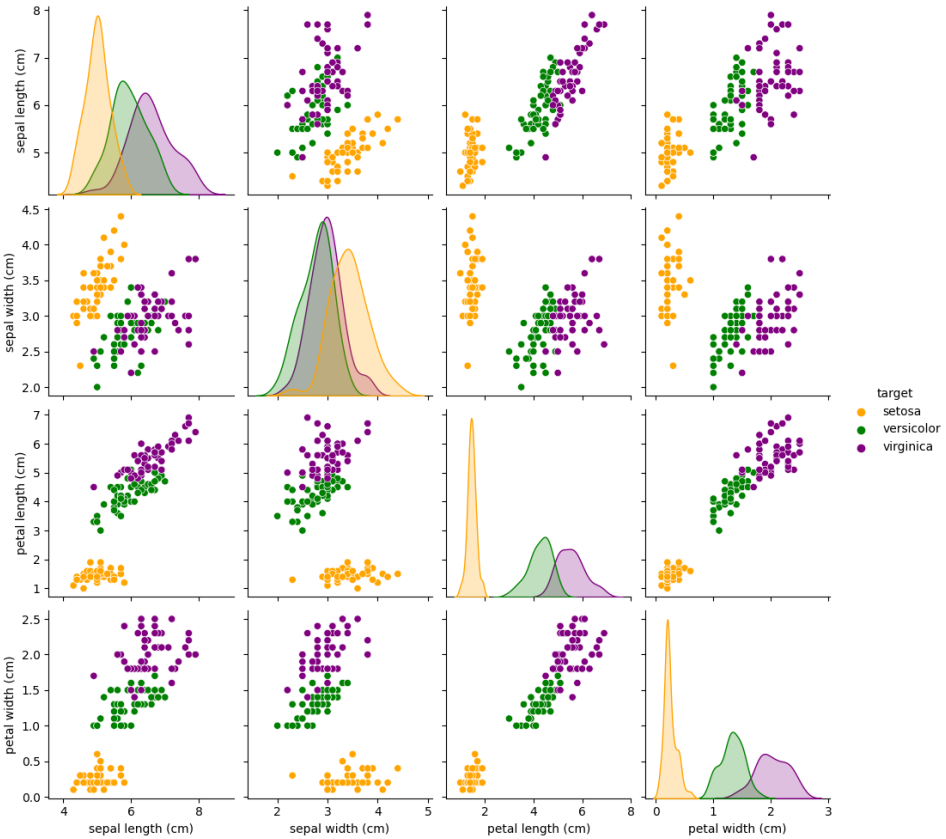
In [ ]:
```
iris_df.describe()
```

Out[ ]:

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)	target
count	150.000000	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.057333	3.758000	1.199333	1.000000
std	0.828066	0.435866	1.765298	0.762238	0.819232
min	4.300000	2.000000	1.000000	0.100000	0.000000
25%	5.100000	2.800000	1.600000	0.300000	0.000000
50%	5.800000	3.000000	4.350000	1.300000	1.000000
75%	6.400000	3.300000	5.100000	1.800000	2.000000
max	7.900000	4.400000	6.900000	2.500000	2.000000

- Draw scatter plot.

In [ ]:
```
# Convert to DataFrame for easier plotting
iris_df = pd.DataFrame(data=iris.data, columns=iris.feature_names)
iris_df["target"] = iris.target

# Use seaborn's pairplot for a scatter plot matrix
vis_iris = iris_df.copy()
vis_iris['target'].replace({0:'setosa', 1:'versicolor', 2:'virginica'}, inplace=True)
palette = {'setosa': 'orange', 'versicolor': 'green', 'virginica': 'purple'}
sns.pairplot(vis_iris, hue="target", palette=palette)
plt.show()
```



- Split the dataset into training and testing sets.

In [ ]:
```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(iris.data, iris.target, test_size=0
```

3. Train, Prediction, Evaluation

In [ ]:
```
from sklearn.metrics import accuracy_score, classification_report

# Instantiate the KNN classifier
knn_classifier = KNN(k=5)

# Train the classifier
knn_classifier.fit(X_train, y_train)

# Make predictions
y_train_pred = knn_classifier.predict(X_train)
y_test_pred = knn_classifier.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_train, y_train_pred)
```

```
print(f"\nTrain accuracy:\t{accuracy:.2f}")
accuracy = accuracy_score(y_test, y_test_pred)
print(f"\nTest accuracy:\t{accuracy:.2f}")
print("\nTest classification report:\n")
print(classification_report(y_test, y_test_pred, target_names = iris.target_names))
```

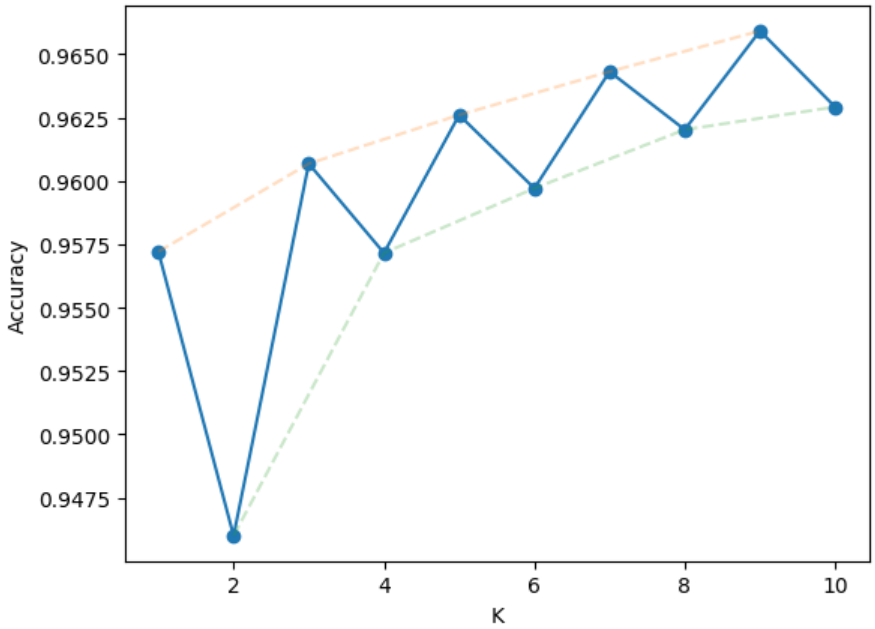
```
Train accuracy: 0.98

Test accuracy:  0.93

Test classification report:

              precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        10
  versicolor       1.00      0.83      0.91        12
   virginica       0.80      1.00      0.89         8

    accuracy                           0.93        30
   macro avg       0.93      0.94      0.93        30
weighted avg       0.95      0.93      0.93        30
```

4. Accuracy for each K

In [ ]:
```
accuracies = np.zeros(10)

for _ in range(1000):
    # Split the dataset into training and testing sets
    X_train, X_test, y_train, y_test = train_test_split(iris.data, iris.target, test_si
    for i in range(10):
        # Instantiate the KNN classifier
        knn_classifier = KNN(k=i + 1)
        # Train the classifier
        knn_classifier.fit(X_train, y_train)
        # Make predictions
        predictions = knn_classifier.predict(X_test)
        # Calculate accuracy
        accuracy = accuracy_score(y_test, predictions)
        accuracies[i] += accuracy

# Calculate mean of accuracies for each K
accuracies /= 1000
```

In [ ]:
```
print(accuracies)
plt.plot(range(1, 11), accuracies, marker="o")
plt.plot(range(1, 11, 2), accuracies[::2], linestyle="dashed", alpha= 0.25)
plt.plot(range(2, 11, 2), accuracies[1::2], linestyle="dashed", alpha= 0.25)

plt.ylabel("Accuracy")
plt.xlabel("K")
plt.show()
```

```
[0.95721053 0.946      0.96068421 0.95715789 0.96260526 0.95971053
 0.96431579 0.96202632 0.96592105 0.96292105]
```



Report best K:

In [ ]:
```
print("Best K =", np.argmax(accuracies) + 1)
```

```
Best K = 9
```

In [ ]: