```
# Import Dependencies
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

1.Choose a classification dataset and normalize features

```
# Load the dataset
df=pd.read_csv('/content/Iris.csv')
```

```
# Check the first 5-rows
df.head()
```

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	1	5.1	3.5	1.4	0.2	Iris-setosa
1	2	4.9	3.0	1.4	0.2	Iris-setosa
2	3	4.7	3.2	1.3	0.2	Iris-setosa
3	4	4.6	3.1	1.5	0.2	Iris-setosa
4	5	5.0	3.6	1.4	0.2	Iris-setosa

Next steps: Generate code with df | View recommended plots | New interactive sheet

```
# Check the information
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Id             150 non-null    int64
 1   SepalLengthCm  150 non-null    float64
 2   SepalWidthCm   150 non-null    float64
 3   PetalLengthCm  150 non-null    float64
 4   PetalWidthCm   150 non-null    float64
 5   Species        150 non-null    object
dtypes: float64(4), int64(1), object(1)
memory usage: 7.2+ KB
```

```
# Drop the 'Id' and separate features and labels
features = df.drop(columns=["Id", "Species"])
labels = df["Species"]
```

```
from sklearn.preprocessing import MinMaxScaler
```

```
# Apply Min-Max normalization
scaler = MinMaxScaler()
normalized_features = scaler.fit_transform(features)
```

```
# Convert the result back to a DataFrame
normalized_df = pd.DataFrame(normalized_features, columns=features.columns)
normalized_df["Species"] = labels
```

```
normalized_df.head()
```

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	0.222222	0.625000	0.067797	0.041667	Iris-setosa
1	0.166667	0.416667	0.067797	0.041667	Iris-setosa
2	0.111111	0.500000	0.050847	0.041667	Iris-setosa
3	0.083333	0.458333	0.084746	0.041667	Iris-setosa
4	0.194444	0.666667	0.067797	0.041667	Iris-setosa

Next steps: Generate code with normalized_df | View recommended plots | New interactive sheet

2.Use KNeighborsClassifier from sklearn

```
# Split features and target
X = normalized_df.drop(columns=["Species"])
y = normalized_df["Species"]
```

```
from sklearn.model_selection import train_test_split
```

```
# Train-test split (80% train, 20% test)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

```
from sklearn.neighbors import KNeighborsClassifier
```

```
# Initialize KNN classifier with default n_neighbors=5
knn = KNeighborsClassifier(n_neighbors=5)
knn.fit(X_train, y_train)
```

```
KNeighborsClassifier
KNeighborsClassifier()
```

```
# Predict on test set
y_pred = knn.predict(X_test)
```

Evaluation

```
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report
```

```
# Accuracy
print("Accuracy:", accuracy_score(y_test, y_pred))
```

```
Accuracy: 1.0
```

```
# Confusion matrix
print("\nConfusion Matrix:\n", confusion_matrix(y_test, y_pred))
```

```
Confusion Matrix:
 [[10  0  0]
 [ 0  9  0]
 [ 0  0 11]]
```

```
# Detailed report
print("\nClassification Report:\n", classification_report(y_test, y_pred))
```

```
Classification Report:
                    precision    recall  f1-score   support

        Iris-setosa       1.00      1.00      1.00        10
    Iris-versicolor       1.00      1.00      1.00         9
     Iris-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
```

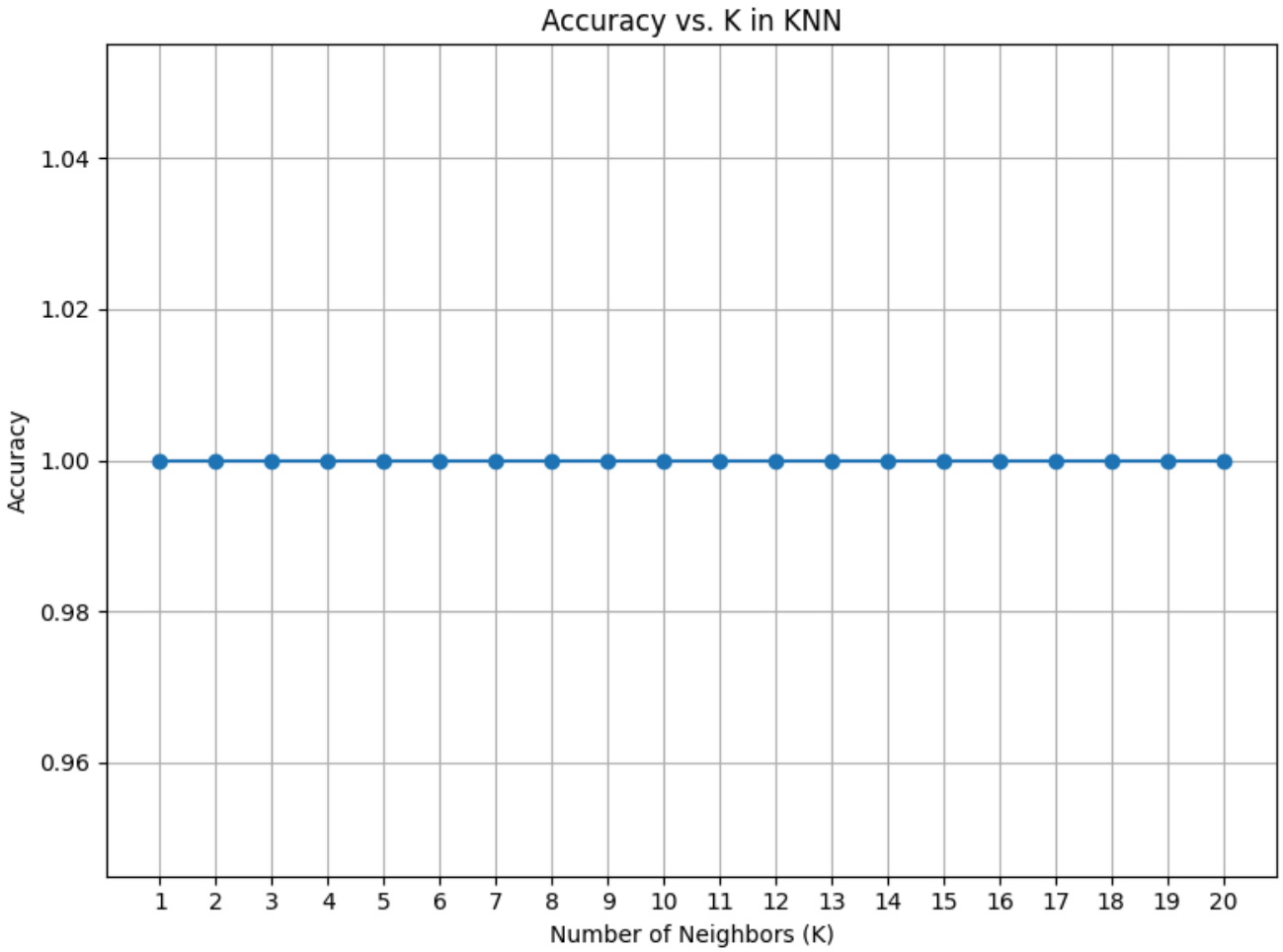
3.Experiment with different values of K.

```
# Try Multiple K Values and Store Accuracy

# Store accuracies for each K
k_values = list(range(1, 21))
accuracies = []

for k in k_values:
    knn = KNeighborsClassifier(n_neighbors=k)
    knn.fit(X_train, y_train)
    y_pred = knn.predict(X_test)
    acc = accuracy_score(y_test, y_pred)
    accuracies.append(acc)
```

```
# Plot Accuracy vs. K
plt.figure(figsize=(8, 6))
plt.plot(k_values, accuracies, marker='o', linestyle='-')
plt.title('Accuracy vs. K in KNN')
plt.xlabel('Number of Neighbors (K)')
plt.ylabel('Accuracy')
plt.xticks(k_values)
plt.grid(True)
plt.tight_layout()
plt.show()
```




```
# Find the Best K
best_k = k_values[accuracies.index(max(accuracies))]
print(f"Best K is: {best_k} with Accuracy = {max(accuracies):.2f}")
```

```
Best K is: 1 with Accuracy = 1.00
```

4.Evaluate model using accuracy, confusion matrix.

```
# Train Model Using Best K
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report
```

```
# Train the final model
knn_final = KNeighborsClassifier(n_neighbors=best_k)
knn_final.fit(X_train, y_train)
```

```
KNeighborsClassifier
KNeighborsClassifier(n_neighbors=1)
```

```
# Predict on test data
y_pred_final = knn_final.predict(X_test)
```

```
# Evaluate Accuracy
accuracy = accuracy_score(y_test, y_pred_final)
print(f"Accuracy for K={best_k}: {accuracy:.2f}")
```

```
Accuracy for K=1: 1.00
```

```
# Confusion Matrix
cm = confusion_matrix(y_test, y_pred_final)
print("Confusion Matrix:")
print(cm)
```

```
Confusion Matrix:
[[10  0  0]
 [ 0  9  0]
 [ 0  0 11]]
```

```
# Classification Report (for precision, recall, F1-score)
print("\nClassification Report:")
print(classification_report(y_test, y_pred_final))
```

```
Classification Report:
                 precision    recall  f1-score   support

    Iris-setosa       1.00      1.00      1.00        10
Iris-versicolor       1.00      1.00      1.00         9
 Iris-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
```

5.Visualize decision boundaries.

```
# Extract Two Features + Target
from matplotlib.colors import ListedColormap
```

```
# Use only 2 features
X_vis = normalized_df[['PetalLengthCm', 'PetalWidthCm']].values
y_vis = normalized_df['Species'].astype('category').cat.codes  # Encode species as numbers
```

```
# Train KNN on 2D data
knn_vis = KNeighborsClassifier(n_neighbors=best_k)
knn_vis.fit(X_vis, y_vis)
```

```
KNeighborsClassifier
KNeighborsClassifier(n_neighbors=1)
```

Create Meshgrid and Plot Decision Boundaries

```
# Create a meshgrid
h = 0.02
x_min, x_max = X_vis[:, 0].min() - 0.1, X_vis[:, 0].max() + 0.1
y_min, y_max = X_vis[:, 1].min() - 0.1, X_vis[:, 1].max() + 0.1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h),
                     np.arange(y_min, y_max, h))
```

```
# Predict on mesh
Z = knn_vis.predict(np.c_[xx.ravel(), yy.ravel()])
Z = Z.reshape(xx.shape)
```

```
# Define color maps
cmap_light = ListedColormap(['#FFAAAA', '#AAFFAA', '#AAAAFF'])
cmap_bold  = ListedColormap(['#FF0000', '#00FF00', '#0000FF'])
```

```
# Plot
plt.figure(figsize=(8, 6))
plt.contourf(xx, yy, Z, cmap=cmap_light)

# Scatter original points
plt.scatter(X_vis[:, 0], X_vis[:, 1], c=y_vis, cmap=cmap_bold, edgecolor='k', s=50)
plt.xlabel('Petal Length (Normalized)')
plt.ylabel('Petal Width (Normalized)')
plt.title(f'KNN Decision Boundaries (K={best_k})')
plt.show()
```