In [1]:

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# Task 6: K-Nearest Neighbors (KNN) Classification

# Importing required libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.datasets import load_iris
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report

# 1. Load Dataset (Iris Dataset)
iris = load_iris()
X = iris.data
y = iris.target
feature_names = iris.feature_names
target_names = iris.target_names

# Convert to DataFrame for better understanding
df = pd.DataFrame(X, columns=feature_names)
df['target'] = y

print("First 5 rows of dataset:\n", df.head())

# 2. Normalize Features
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# 3. Train-Test Split
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.3, random_state=42)

# 4. Experiment with different values of K
k_values = [1, 3, 5, 7, 9]
accuracy_scores = []

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)
    accuracy_scores.append(acc)
    print(f"\nK={k}")
    print("Accuracy:", acc)
    print("Confusion Matrix:\n", confusion_matrix(y_test, y_pred))
    print("Classification Report:\n", classification_report(y_test, y_pred, target_names=target_names))

# Plot accuracy vs K
plt.figure(figsize=(6, 4))
plt.plot(k_values, accuracy_scores, marker='o')
plt.title("Accuracy vs K value")
plt.xlabel("K")
plt.ylabel("Accuracy")
plt.grid()
plt.show()

# 5. Visualize Decision Boundaries (using only 2 features for 2D plot)
X_2d = X_scaled[:, :2]  # take first two features
X_train2d, X_test2d, y_train2d, y_test2d = train_test_split(X_2d, y, test_size=0.3, random_state=42)

knn2d = KNeighborsClassifier(n_neighbors=5)
knn2d.fit(X_train2d, y_train2d)

# Create meshgrid for decision boundary
x_min, x_max = X_2d[:, 0].min() - 1, X_2d[:, 0].max() + 1
y_min, y_max = X_2d[:, 1].min() - 1, X_2d[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, 0.02),
                     np.arange(y_min, y_max, 0.02))

Z = knn2d.predict(np.c_[xx.ravel(), yy.ravel()])
Z = Z.reshape(xx.shape)

plt.figure(figsize=(8, 6))
plt.contourf(xx, yy, Z, alpha=0.3)
sns.scatterplot(x=X_2d[:, 0], y=X_2d[:, 1], hue=iris.target_names[y], palette="Set1", edgecolor="k")
plt.xlabel(feature_names[0])
plt.ylabel(feature_names[1])
plt.title("Decision Boundary with KNN (K=5)")
plt.show()
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First 5 rows of dataset:
    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

   target
0       0
1       0
2       0
3       0
4       0

K=1
Accuracy: 0.9777777777777777
Confusion Matrix:
 [[19  0  0]
 [ 0 12  1]
 [ 0  0 13]]
Classification Report:
               precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        19
  versicolor       1.00      0.92      0.96        13
   virginica       0.93      1.00      0.96        13

    accuracy                           0.98        45
   macro avg       0.98      0.97      0.97        45
weighted avg       0.98      0.98      0.98        45


K=3
Accuracy: 1.0
Confusion Matrix:
 [[19  0  0]
 [ 0 13  0]
 [ 0  0 13]]
Classification Report:
               precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        19
  versicolor       1.00      1.00      1.00        13
   virginica       1.00      1.00      1.00        13

    accuracy                           1.00        45
   macro avg       1.00      1.00      1.00        45
weighted avg       1.00      1.00      1.00        45


K=5
Accuracy: 1.0
Confusion Matrix:
 [[19  0  0]
 [ 0 13  0]
 [ 0  0 13]]
Classification Report:
               precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        19
  versicolor       1.00      1.00      1.00        13
   virginica       1.00      1.00      1.00        13

    accuracy                           1.00        45
   macro avg       1.00      1.00      1.00        45
weighted avg       1.00      1.00      1.00        45


K=7
Accuracy: 1.0
Confusion Matrix:
 [[19  0  0]
 [ 0 13  0]
 [ 0  0 13]]
Classification Report:
               precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        19
  versicolor       1.00      1.00      1.00        13
   virginica       1.00      1.00      1.00        13

    accuracy                           1.00        45
   macro avg       1.00      1.00      1.00        45
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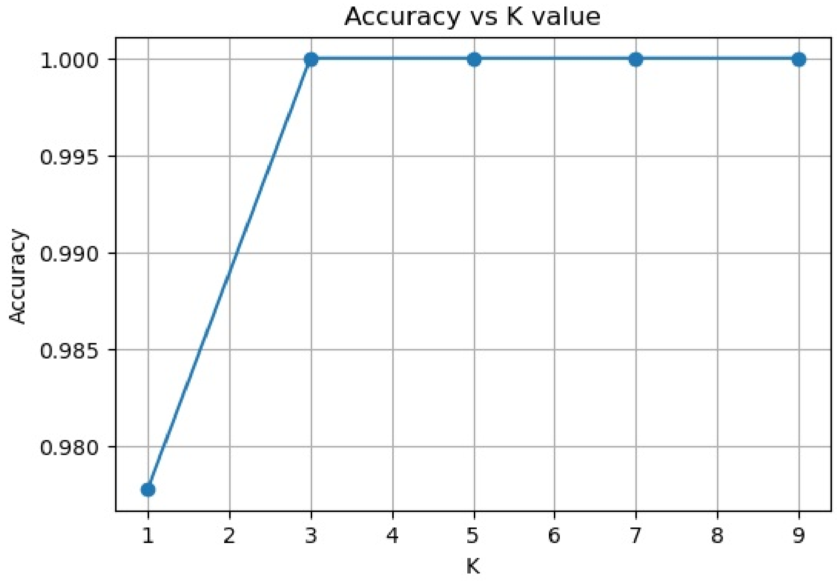
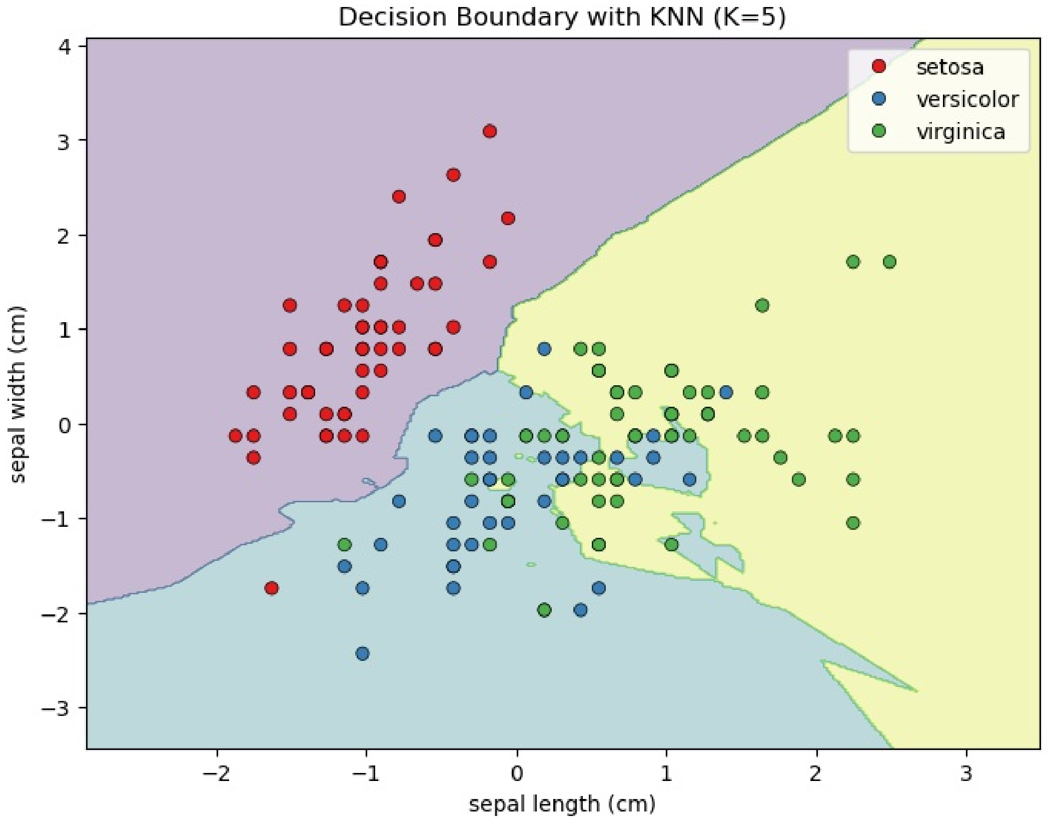
weighted avg       1.00      1.00      1.00        45


K=9
Accuracy: 1.0
Confusion Matrix:
 [[19  0  0]
 [ 0 13  0]
 [ 0  0 13]]
Classification Report:
               precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        19
  versicolor       1.00      1.00      1.00        13
   virginica       1.00      1.00      1.00        13

    accuracy                           1.00        45
   macro avg       1.00      1.00      1.00        45
weighted avg       1.00      1.00      1.00        45
```





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