=== Model Accuracy Summary ===

Model Accuracy

0 SVM (rbf) 0.96148

1 KNN (k=10) 0.95936

2 SVM (linear) 0.95900

3 KNN (k=6) 0.95892

4 KNN (k=8) 0.95880

5 KNN (k=4) 0.95808

6 KNN (k=2) 0.95780

7 KNN (k=3) 0.95536

8 Decision Tree 0.95024

[{'Model': 'SVM (linear)', 'confusion\_matrix': array([[22702, 97],

[ 928, 1273]])}, {'Model': 'SVM (rbf)', 'confusion\_matrix': array([[22775, 24],

[ 939, 1262]])}, {'Model': 'KNN (k=2)', 'confusion\_matrix': array([[22680, 119],

[ 936, 1265]])}, {'Model': 'KNN (k=3)', 'confusion\_matrix': array([[22525, 274],

[ 842, 1359]])}, {'Model': 'KNN (k=4)', 'confusion\_matrix': array([[22704, 95],

[ 953, 1248]])}, {'Model': 'KNN (k=6)', 'confusion\_matrix': array([[22735, 64],

[ 963, 1238]])}, {'Model': 'KNN (k=8)', 'confusion\_matrix': array([[22740, 59],

[ 971, 1230]])}, {'Model': 'KNN (k=10)', 'confusion\_matrix': array([[22758, 41],

[ 975, 1226]])}, {'Model': 'Decision Tree', 'confusion\_matrix': array([[22146, 653],

[ 591, 1610]])}]

Multi-class classification

=== SVM with linear kernel ===

Confusion Matrix:

[[115 1 0 0]

[ 4 111 11 0]

[ 0 3 127 5]

[ 0 0 4 119]]

Classification Report:

precision recall f1-score support

0 0.97 0.99 0.98 116

1 0.97 0.88 0.92 126

2 0.89 0.94 0.92 135

3 0.96 0.97 0.96 123

accuracy 0.94 500

macro avg 0.95 0.95 0.95 500

weighted avg 0.94 0.94 0.94 500

Accuracy: 0.944

=== SVM with rbf kernel ===

Confusion Matrix:

[[105 11 0 0]

[ 12 99 15 0]

[ 0 19 112 4]

[ 0 0 9 114]]

Classification Report:

precision recall f1-score support

0 0.90 0.91 0.90 116

1 0.77 0.79 0.78 126

2 0.82 0.83 0.83 135

3 0.97 0.93 0.95 123

accuracy 0.86 500

macro avg 0.86 0.86 0.86 500

weighted avg 0.86 0.86 0.86 500

Accuracy: 0.86

=== SVM with poly kernel ===

Confusion Matrix:

[[92 24 0 0]

[12 86 28 0]

[ 0 27 94 14]

[ 0 0 27 96]]

Classification Report:

precision recall f1-score support

0 0.88 0.79 0.84 116

1 0.63 0.68 0.65 126

2 0.63 0.70 0.66 135

3 0.87 0.78 0.82 123

accuracy 0.74 500

macro avg 0.75 0.74 0.74 500

weighted avg 0.75 0.74 0.74 500

Accuracy: 0.736

=== KNN with n\_neighbors = 2 ===

Confusion Matrix:

[[91 23 2 0]

[55 48 22 1]

[22 55 48 10]

[ 3 35 58 27]]

Classification Report:

precision recall f1-score support

0 0.53 0.78 0.63 116

1 0.30 0.38 0.33 126

2 0.37 0.36 0.36 135

3 0.71 0.22 0.34 123

accuracy 0.43 500

macro avg 0.48 0.44 0.42 500

weighted avg 0.47 0.43 0.41 500

Accuracy: 0.428

=== KNN with n\_neighbors = 3 ===

Confusion Matrix:

[[76 33 6 1]

[48 47 27 4]

[24 47 41 23]

[ 1 30 31 61]]

Classification Report:

precision recall f1-score support

0 0.51 0.66 0.57 116

1 0.30 0.37 0.33 126

2 0.39 0.30 0.34 135

3 0.69 0.50 0.58 123

accuracy 0.45 500

macro avg 0.47 0.46 0.46 500

weighted avg 0.47 0.45 0.45 500

Accuracy: 0.45

=== KNN with n\_neighbors = 4 ===

Confusion Matrix:

[[84 26 6 0]

[45 46 32 3]

[17 41 56 21]

[ 0 16 50 57]]

Classification Report:

precision recall f1-score support

0 0.58 0.72 0.64 116

1 0.36 0.37 0.36 126

2 0.39 0.41 0.40 135

3 0.70 0.46 0.56 123

accuracy 0.49 500

macro avg 0.51 0.49 0.49 500

weighted avg 0.50 0.49 0.49 500

Accuracy: 0.486

=== KNN with n\_neighbors = 6 ===

Confusion Matrix:

[[89 25 2 0]

[50 45 29 2]

[17 41 57 20]

[ 0 18 48 57]]

Classification Report:

precision recall f1-score support

0 0.57 0.77 0.65 116

1 0.35 0.36 0.35 126

2 0.42 0.42 0.42 135

3 0.72 0.46 0.56 123

accuracy 0.50 500

macro avg 0.51 0.50 0.50 500

weighted avg 0.51 0.50 0.49 500

Accuracy: 0.496

=== KNN with n\_neighbors = 8 ===

Confusion Matrix:

[[80 34 2 0]

[38 51 30 7]

[13 44 56 22]

[ 2 12 46 63]]

Classification Report:

precision recall f1-score support

0 0.60 0.69 0.64 116

1 0.36 0.40 0.38 126

2 0.42 0.41 0.42 135

3 0.68 0.51 0.59 123

accuracy 0.50 500

macro avg 0.52 0.51 0.51 500

weighted avg 0.51 0.50 0.50 500

Accuracy: 0.5

=== KNN with n\_neighbors = 10 ===

Confusion Matrix:

[[82 31 3 0]

[41 52 30 3]

[13 42 62 18]

[ 1 12 44 66]]

Classification Report:

precision recall f1-score support

0 0.60 0.71 0.65 116

1 0.38 0.41 0.40 126

2 0.45 0.46 0.45 135

3 0.76 0.54 0.63 123

accuracy 0.52 500

macro avg 0.55 0.53 0.53 500

weighted avg 0.54 0.52 0.53 500

Accuracy: 0.524

=== Decision Tree ===

Confusion Matrix:

[[103 13 0 0]

[ 7 99 20 0]

[ 0 23 97 15]

[ 0 0 9 114]]

Classification Report:

precision recall f1-score support

0 0.94 0.89 0.91 116

1 0.73 0.79 0.76 126

2 0.77 0.72 0.74 135

3 0.88 0.93 0.90 123

accuracy 0.83 500

macro avg 0.83 0.83 0.83 500

weighted avg 0.83 0.83 0.83 500

Accuracy: 0.826