In [9]:

```
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
from sklearn import datasets
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import confusion_matrix, classification_report


digits = datasets.load_digits()
X = digits.data
y = digits.target


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,
random_state=42)


k_values = [3, 5, 7]
results = {}

for k in k_values:

    knn = KNeighborsClassifier(n_neighbors=k)
    knn.fit(X_train, y_train)


    y_pred = knn.predict(X_test)


    results[k] = {
        "report": classification_report(y_test, y_pred, output_dict=True),
        "confusion_matrix": confusion_matrix(y_test, y_pred)
    }


for k, result in results.items():
    print("K=",k)
    print("Classification Report:")

    print(result["report"])
    print("Confusion Matrix:")
    print(result["confusion_matrix"])
    print("\n")
```

```
K= 3
Classification Report:
{'0': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 53.0},
'1': {'precision': 0.9803921568627451, 'recall': 1.0, 'f1-score':
```

0.99009900990099, 'support': 50.0}, '2': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 47.0}, '3': {'precision': 0.9818181818181818, 'recall': 1.0, 'f1-score': 0.9908256880733944, 'support': 54.0}, '4': {'precision': 0.9836065573770492, 'recall': 1.0, 'f1-score': 0.9917355371900827, 'support': 60.0}, '5': {'precision': 0.9850746268656716, 'recall': 1.0, 'f1-score': 0.9924812030075187, 'support': 66.0}, '6': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 53.0}, '7': {'precision': 1.0, 'recall': 0.9818181818181818, 'f1-score': 0.9908256880733944, 'support': 55.0}, '8': {'precision': 0.9767441860465116, 'recall': 0.9767441860465116, 'f1-score': 0.9767441860465116, 'support': 43.0}, '9': {'precision': 0.9821428571428571, 'recall': 0.9322033898305084, 'f1-score': 0.9565217391304348, 'support': 59.0}, 'accuracy': 0.9888888888888889, 'macro avg': {'precision': 0.9889778566113018, 'recall': 0.9890765757695202, 'f1-score': 0.9889233051422327, 'support': 540.0}, 'weighted avg': {'precision': 0.988917661200935, 'recall': 0.9888888888888889, 'f1-score': 0.9887918976549006, 'support': 540.0}}
Confusion Matrix:
```
[[53  0  0  0  0  0  0  0  0  0]
 [ 0 50  0  0  0  0  0  0  0  0]
 [ 0  0 47  0  0  0  0  0  0  0]
 [ 0  0  0 54  0  0  0  0  0  0]
 [ 0  0  0  0 60  0  0  0  0  0]
 [ 0  0  0  0  0 66  0  0  0  0]
 [ 0  0  0  0  0  0 53  0  0  0]
 [ 0  0  0  0  0  0  0 54  0  1]
 [ 0  1  0  0  0  0  0  0 42  0]
 [ 0  0  0  1  1  1  0  0  1 55]]
```

K= 5
Classification Report:
{'0': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 53.0}, '1': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 50.0}, '2': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 47.0}, '3': {'precision': 0.9818181818181818, 'recall': 1.0, 'f1-score': 0.9908256880733944, 'support': 54.0}, '4': {'precision': 0.9836065573770492, 'recall': 1.0, 'f1-score': 0.9917355371900827, 'support': 60.0}, '5': {'precision': 0.9848484848484849, 'recall': 0.9848484848484849, 'f1-score': 0.9848484848484849, 'support': 66.0}, '6': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 53.0}, '7': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 55.0}, '8': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 43.0}, '9': {'precision': 0.9824561403508771, 'recall': 0.9491525423728814, 'f1-score': 0.9655172413793103, 'support': 59.0}, 'accuracy': 0.9925925925925926, 'macro avg': {'precision': 0.9932729364394592, 'recall': 0.9934001027221365, 'f1-score': 0.9932926951491272, 'support': 540.0}, 'weighted avg': {'precision': 0.9925916435953825, 'recall': 0.9925925925925926, 'f1-score': 0.9925448826458289, 'support': 540.0}}

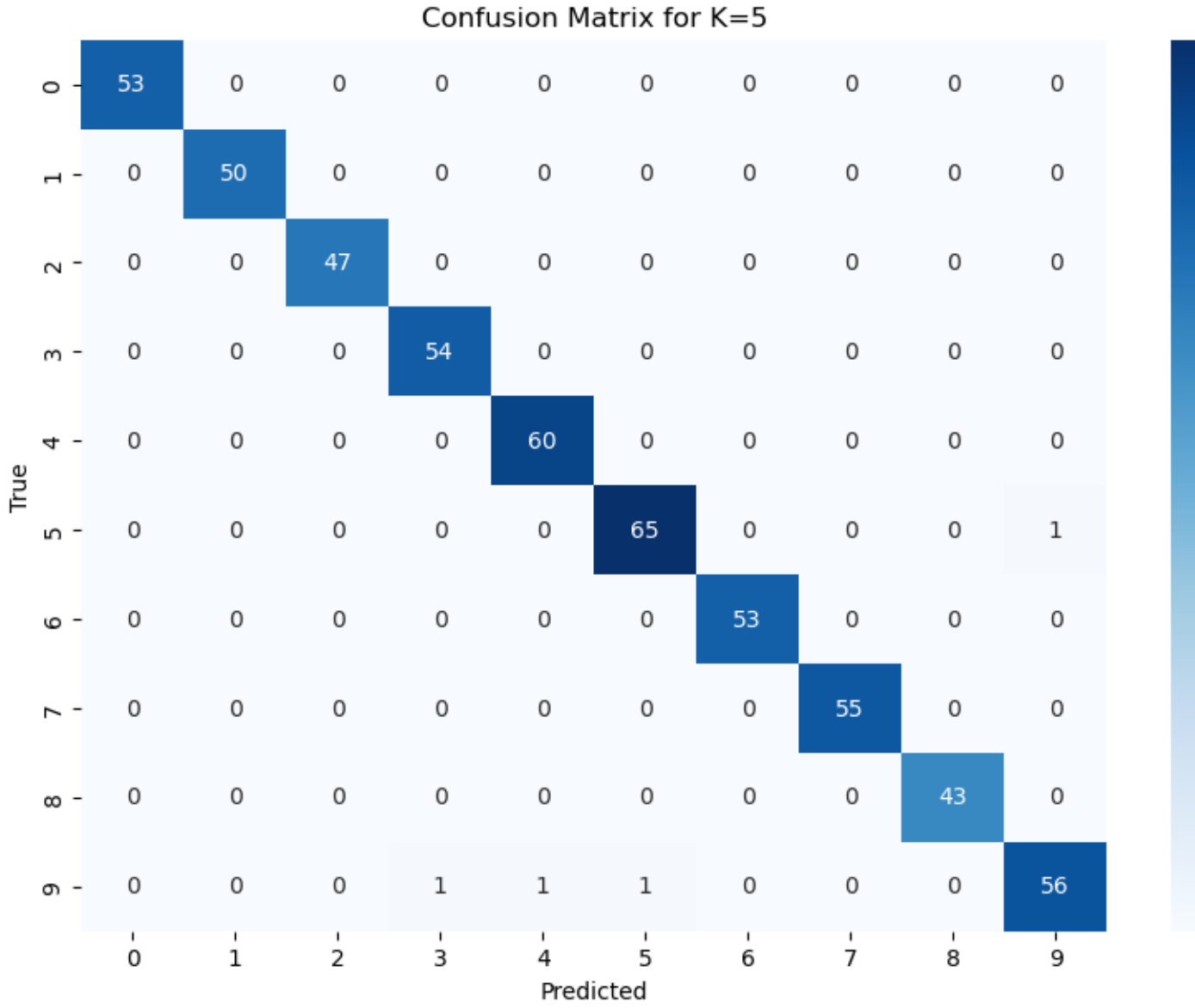
```
Confusion Matrix:
[[53  0  0  0  0  0  0  0  0  0]
 [ 0 50  0  0  0  0  0  0  0  0]
 [ 0  0 47  0  0  0  0  0  0  0]
 [ 0  0  0 54  0  0  0  0  0  0]
 [ 0  0  0  0 60  0  0  0  0  0]
 [ 0  0  0  0  0 65  0  0  0  1]
 [ 0  0  0  0  0  0 53  0  0  0]
 [ 0  0  0  0  0  0  0 55  0  0]
 [ 0  0  0  0  0  0  0  0 43  0]
 [ 0  0  0  1  1  1  0  0  0 56]]


K= 7
Classification Report:
{'0': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 53.0},
'1': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 50.0},
'2': {'precision': 1.0, 'recall': 1.0, 'f1-score': 1.0, 'support': 47.0},
'3': {'precision': 0.9818181818181818, 'recall': 1.0, 'f1-score':
0.9908256880733944, 'support': 54.0}, '4': {'precision':
0.9836065573770492, 'recall': 1.0, 'f1-score': 0.9917355371900827,
'support': 60.0}, '5': {'precision': 0.9846153846153847, 'recall':
0.9696969696969697, 'f1-score': 0.9770992366412214, 'support': 66.0}, '6':
{'precision': 0.9814814814814815, 'recall': 1.0, 'f1-score':
0.9906542056074767, 'support': 53.0}, '7': {'precision': 1.0, 'recall':
1.0, 'f1-score': 1.0, 'support': 55.0}, '8': {'precision': 1.0, 'recall':
1.0, 'f1-score': 1.0, 'support': 43.0}, '9': {'precision':
0.9824561403508771, 'recall': 0.9491525423728814, 'f1-score':
0.9655172413793103, 'support': 59.0}, 'accuracy': 0.9907407407407407,
'macro avg': {'precision': 0.9913977745642975, 'recall':
0.9918849512069849, 'f1-score': 0.9915831908891486, 'support': 540.0},
'weighted avg': {'precision': 0.9907455952678527, 'recall':
0.9907407407407407, 'f1-score': 0.9906804798967861, 'support': 540.0}}
Confusion Matrix:
[[53  0  0  0  0  0  0  0  0  0]
 [ 0 50  0  0  0  0  0  0  0  0]
 [ 0  0 47  0  0  0  0  0  0  0]
 [ 0  0  0 54  0  0  0  0  0  0]
 [ 0  0  0  0 60  0  0  0  0  0]
 [ 0  0  0  0  0 64  1  0  0  1]
 [ 0  0  0  0  0  0 53  0  0  0]
 [ 0  0  0  0  0  0  0 55  0  0]
 [ 0  0  0  0  0  0  0  0 43  0]
 [ 0  0  0  1  1  1  0  0  0 56]]
```

In [10]:

```
best_k = max(results, key=lambda k: results[k]["report"]["accuracy"])
best_cm = results[best_k]["confusion_matrix"]
```

```
## confusion matrix
plt.figure(figsize=(10, 7))
sns.heatmap(best_cm, annot=True, fmt="d", cmap="Blues",
xticklabels=digits.target_names, yticklabels=digits.target_names)
plt.xlabel("Predicted")
plt.ylabel("True")
plt.title(f"Confusion Matrix for K={best_k}")
plt.show()
```



In [11]:

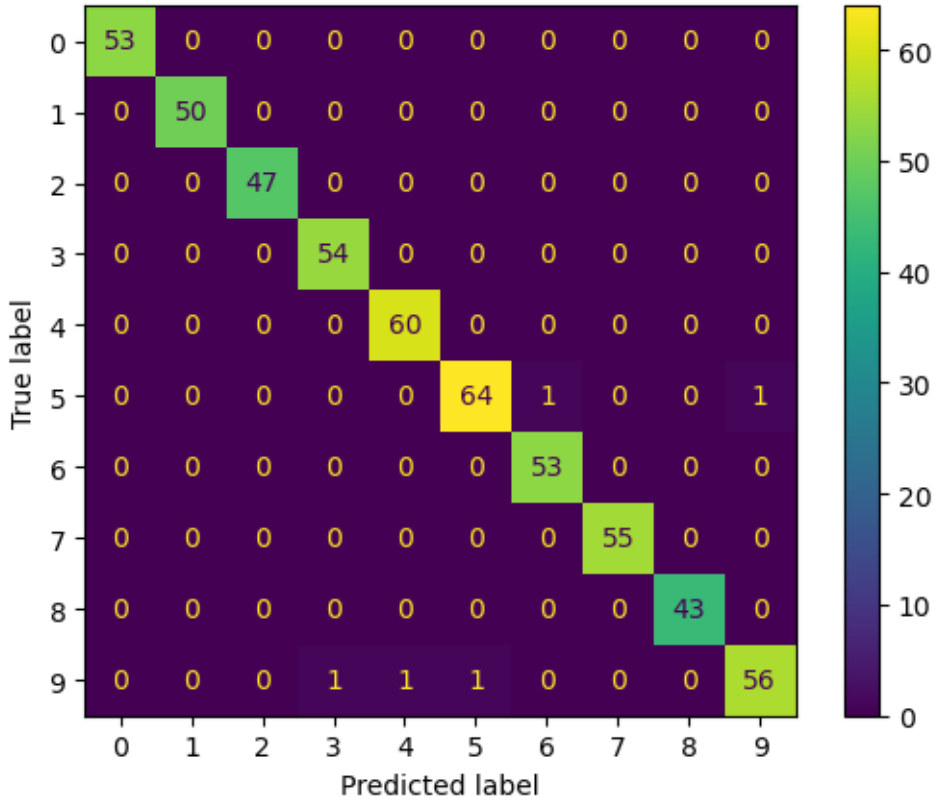
```
#plot
from sklearn.metrics import ConfusionMatrixDisplay, classification_report

report = classification_report(y_test, y_pred)
print(report)

labels = np.unique(y_test)
cm = confusion_matrix(y_test, y_pred, labels=labels)
```

```
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=labels)
disp.plot()
plt.show()
```

	precision	recall	f1-score	support
0	1.00	1.00	1.00	53
1	1.00	1.00	1.00	50
2	1.00	1.00	1.00	47
3	0.98	1.00	0.99	54
4	0.98	1.00	0.99	60
5	0.98	0.97	0.98	66
6	0.98	1.00	0.99	53
7	1.00	1.00	1.00	55
8	1.00	1.00	1.00	43
9	0.98	0.95	0.97	59
accuracy			0.99	540
macro avg	0.99	0.99	0.99	540
weighted avg	0.99	0.99	0.99	540



In [ ]: