KNN_Classification

November 27, 2025

[2]:
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# -*- coding: utf-8 -*-
"""
Stage 2 - Binary Classification (Grid Search, KNN from scratch) using PyTorch
Comparison models: 1R (decision stump), Decision Tree, Random Forest, SVM
Binary labels: quality >= 7 -> 1 else 0
Experiments: 80/20 and 70/30 stratified splits
Distance metrics: euclidean, manhattan, minkowski (p=3)
Grid Search over odd k in [1, 3, 5, ..., 49]
5-fold Stratified CV, tuning metric: average F1
Saves results to stage2_results_grid_allmodels.csv and confusion matrices:
 - cm_best_80_grid_allmodels.png
 - cm_best_70_grid_allmodels.png
"""

import numpy as np
import pandas as pd
import torch
import csv
import time
import random
import matplotlib
matplotlib.use("Agg")
import matplotlib.pyplot as plt

from sklearn.model_selection import train_test_split, StratifiedKFold
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import (
    accuracy_score, precision_score, recall_score,
    f1_score, roc_auc_score, confusion_matrix
)
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC

from ucimlrepo import fetch_ucirepo
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```
# Device selection for PyTorch KNN
device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
print("Device:", device)
print("Stage 2 Classification (Grid Search) with model comparisons")
print("Starting...\n")

# ------------------------
# Distance functions
# ------------------------
def compute_distances(x, X_train, metric="euclidean", p=3):
    if metric == "euclidean":
        return torch.norm(X_train - x, dim=1)
    elif metric == "manhattan":
        return torch.sum(torch.abs(X_train - x), dim=1)
    elif metric == "minkowski":
        return torch.sum(torch.abs(X_train - x) ** p, dim=1) ** (1.0 / p)
    else:
        raise ValueError("Unknown metric: {}".format(metric))

# ------------------------
# KNN Classifier (PyTorch)
# ------------------------
class KNNClassifierTorch:
    def __init__(self, k=5, distance="euclidean", weights="uniform", p=3,␣
 ↪print_freq=100):
        self.k = int(k)
        self.distance = distance
        self.weights = weights
        self.p = p
        self.print_freq = max(1, int(print_freq))

    def fit(self, X, y):
        # X: numpy array (N, D), y: array-like (N,)
        print("   Fit KNN: k={}, distance={}, weights={}".format(self.k, self.
 ↪distance, self.weights))
        self.X_train = torch.tensor(X, dtype=torch.float32).to(device)
        y_arr = np.array(y)
        self.y_train = torch.tensor(y_arr.astype(np.int64), dtype=torch.
 ↪float32).to(device)

    def predict_proba(self, X):
        X_t = torch.tensor(X, dtype=torch.float32).to(device)
        n = X_t.shape[0]
        probs = []
        for idx in range(n):
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            if idx % self.print_freq == 0:
                print("      Predicting sample {}/{}".format(idx, n))
            x = X_t[idx]
            dists = compute_distances(x, self.X_train, metric=self.distance,␣
 ↪p=self.p)
            knn_idx = torch.topk(dists, self.k, largest=False).indices
            knn_labels = self.y_train[knn_idx]
            if self.weights == "uniform":
                prob1 = torch.mean(knn_labels)
            else:
                eps = 1e-8
                weights = 1.0 / (dists[knn_idx] + eps)
                prob1 = (weights * knn_labels).sum() / weights.sum()
            probs.append(prob1.item())
        return np.array(probs)

    def predict(self, X, threshold=0.5):
        probs = self.predict_proba(X)
        return (probs >= threshold).astype(int)

# ------------------------
# Grid search over provided k grid
# ------------------------
def grid_search_knn(X, y, k_grid, distance, p=3, print_freq=100):
    """
    X: numpy array (N, D) - training data used for CV
    y: array-like (N,)
    k_grid: list of odd k values to evaluate
    Returns: dict {k: avg_f1}
    """
    results = {}
    skf = StratifiedKFold(n_splits=5, shuffle=True, random_state=42)
    y_np = y if isinstance(y, np.ndarray) else y.values
    X_np = X

    print("Grid search for distance:", distance)
    for k in k_grid:
        print("  Testing k =", k)
        fold_scores = []
        fold_num = 1
        for train_idx, val_idx in skf.split(X_np, y_np):
            print("    Fold {}/5".format(fold_num))
            clf = KNNClassifierTorch(k=k, distance=distance, weights="uniform",␣
 ↪p=p, print_freq=print_freq)
            clf.fit(X_np[train_idx], y_np[train_idx])
            y_val_pred = clf.predict(X_np[val_idx])
            f1 = f1_score(y_np[val_idx], y_val_pred, zero_division=0)
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            fold_scores.append(f1)
            print("      Fold F1 =", f1)
            fold_num += 1
        avg_f1 = np.mean(fold_scores)
        results[k] = avg_f1
        print("  -> Avg F1 for k {} = {:.4f}\n".format(k, avg_f1))
    print("Grid search complete for distance:", distance)
    return results

# ------------------------
# Confusion matrix plot/save
# ------------------------
def save_confusion_matrix(y_true, y_pred, filename, title=None):
    cm = confusion_matrix(y_true, y_pred)
    print("Confusion matrix (array):")
    print(cm)
    plt.figure(figsize=(5, 4))
    plt.imshow(cm, interpolation="nearest", cmap=plt.cm.Blues)
    plt.title(title if title else "Confusion Matrix")
    plt.colorbar()
    ticks = np.arange(2)
    plt.xticks(ticks, ["0", "1"])
    plt.yticks(ticks, ["0", "1"])
    plt.xlabel("Predicted label")
    plt.ylabel("True label")
    thresh = cm.max() / 2.0 if cm.max() > 0 else 1
    for i in range(cm.shape[0]):
        for j in range(cm.shape[1]):
            plt.text(j, i, format(cm[i, j], 'd'),
                     horizontalalignment="center",
                     color="white" if cm[i, j] > thresh else "black")
    plt.tight_layout()
    plt.savefig(filename)
    plt.close()
    print("Saved confusion matrix to:", filename)

# ------------------------
# Evaluate library baseline models (1R via decision stump, decision tree, RF,␣
 ↪SVM)
# ------------------------
def train_and_evaluate_baselines(X_train, y_train, X_test, y_test):
    results = {}

    # 1R as decision stump: DecisionTreeClassifier(max_depth=1)
    print(" Training 1R (decision stump)...")
    stump = DecisionTreeClassifier(max_depth=1, random_state=42)
    stump.fit(X_train, y_train)
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    y_prob_stump = stump.predict_proba(X_test)[:, 1] if hasattr(stump,␣
↪"predict_proba") else None
    y_pred_stump = stump.predict(X_test)
    results["1R"] = compute_metrics_and_store(y_test, y_pred_stump,␣
↪y_prob_stump)

    # Decision Tree
    print(" Training Decision Tree...")
    dt = DecisionTreeClassifier(random_state=42)
    dt.fit(X_train, y_train)
    y_prob_dt = dt.predict_proba(X_test)[:, 1]
    y_pred_dt = dt.predict(X_test)
    results["DecisionTree"] = compute_metrics_and_store(y_test, y_pred_dt,␣
↪y_prob_dt)

    # Random Forest
    print(" Training Random Forest...")
    rf = RandomForestClassifier(n_estimators=100, random_state=42)
    rf.fit(X_train, y_train)
    y_prob_rf = rf.predict_proba(X_test)[:, 1]
    y_pred_rf = rf.predict(X_test)
    results["RandomForest"] = compute_metrics_and_store(y_test, y_pred_rf,␣
↪y_prob_rf)

    # SVM
    print(" Training SVM (probability=True)...")
    svm = SVC(probability=True, random_state=42)
    svm.fit(X_train, y_train)
    y_prob_svm = svm.predict_proba(X_test)[:, 1]
    y_pred_svm = svm.predict(X_test)
    results["SVM"] = compute_metrics_and_store(y_test, y_pred_svm, y_prob_svm)

    return results

def compute_metrics_and_store(y_true, y_pred, y_prob=None):
    acc = accuracy_score(y_true, y_pred)
    prec = precision_score(y_true, y_pred, zero_division=0)
    rec = recall_score(y_true, y_pred, zero_division=0)
    f1 = f1_score(y_true, y_pred, zero_division=0)
    if y_prob is None:
        rocauc = None
    else:
        try:
            rocauc = roc_auc_score(y_true, y_prob)
        except Exception:
            rocauc = None
    return {
```

```
        "accuracy": float(acc),
        "precision": float(prec),
        "recall": float(rec),
        "f1": float(f1),
        "roc_auc": float(rocauc) if rocauc is not None else None,
        "y_pred": np.array(y_pred),
        "y_test": np.array(y_true)
    }

# ------------------------
# Experiment runner using grid search plus baselines
# ------------------------
def run_classification_experiment_full_grid(X_scaled, y_binary, test_size,␣
 ↪k_grid, print_freq=100):
    print("\nRunning experiment with test_size =", test_size)
    X_train, X_test, y_train, y_test = train_test_split(
        X_scaled, y_binary, test_size=test_size, random_state=42,␣
 ↪stratify=y_binary
    )
    print(" Data split done. Train size:", X_train.shape[0], "Test size:",␣
 ↪X_test.shape[0])

    all_results = {}
    all_evals = {}

    # KNN models for each metric
    for metric in ["euclidean", "manhattan", "minkowski"]:
        print("\nKNN - Distance metric:", metric)
        cv_results = grid_search_knn(X_train, y_train, k_grid, distance=metric,␣
 ↪p=3, print_freq=print_freq)
        best_k = sorted(cv_results.items(), key=lambda kv: (-kv[1],␣
 ↪kv[0]))[0][0]
        print(" Best k selected for", metric, "=", best_k)

        knn = KNNClassifierTorch(k=best_k, distance=metric, weights="uniform",␣
 ↪p=3, print_freq=print_freq)
        knn.fit(X_train, y_train)
        y_prob_knn = knn.predict_proba(X_test)
        y_pred_knn = (y_prob_knn >= 0.5).astype(int)

        acc = accuracy_score(y_test, y_pred_knn)
        prec = precision_score(y_test, y_pred_knn, zero_division=0)
        rec = recall_score(y_test, y_pred_knn, zero_division=0)
        f1 = f1_score(y_test, y_pred_knn, zero_division=0)
        try:
            rocauc = roc_auc_score(y_test, y_prob_knn)
```

```
        except Exception:
            rocauc = None

        all_results["KNN_{}".format(metric)] = {
            "best_k": best_k,
            "accuracy": float(acc),
            "precision": float(prec),
            "recall": float(rec),
            "f1": float(f1),
            "roc_auc": float(rocauc) if rocauc is not None else None
        }
        all_evals["KNN_{}".format(metric)] = {"y_test": np.array(y_test),␣
↪"y_pred": np.array(y_pred_knn), "f1": f1}

        print(" Test results for KNN ({}) - k={}:".format(metric, best_k))
        print("   Accuracy: {:.4f}".format(acc))
        print("   Precision: {:.4f}".format(prec))
        print("   Recall: {:.4f}".format(rec))
        print("   F1-score: {:.4f}".format(f1))
        print("   ROC-AUC: {}".format(rocauc if rocauc is not None else "NA"))

    # Library baselines
    print("\nTraining and evaluating baseline library classifiers...")
    baseline_results = train_and_evaluate_baselines(X_train, y_train, X_test,␣
↪y_test)
    for name, res in baseline_results.items():
        all_results[name] = {
            "accuracy": res["accuracy"],
            "precision": res["precision"],
            "recall": res["recall"],
            "f1": res["f1"],
            "roc_auc": res["roc_auc"]
        }
        all_evals[name] = {"y_test": res["y_test"], "y_pred": res["y_pred"],␣
↪"f1": res["f1"]}

    # pick best model by test F1 among all
    best_model_name = None
    best_f1 = -1.0
    for name, evalinfo in all_evals.items():
        if evalinfo["f1"] > best_f1:
            best_f1 = evalinfo["f1"]
            best_model_name = name

    print("\nBest model on test set for this split is:", best_model_name, "with␣
↪F1 =", best_f1)
```

```
    # save confusion matrix for the best model
    cm_filename = "cm_best_80_grid_allmodels.png" if test_size == 0.2 else␣
 ↪"cm_best_70_grid_allmodels.png"
    best_eval = all_evals[best_model_name]
    save_confusion_matrix(best_eval["y_test"], best_eval["y_pred"], cm_filename,
                          title="Confusion Matrix - Best Model ({})".
 ↪format(best_model_name))

    return all_results

# ------------------------
# Main
# ------------------------
print("Loading Wine Quality dataset...")
wine_quality = fetch_ucirepo(id=186)
X = wine_quality.data.features
y = wine_quality.data.targets

print("Converting to binary labels: quality >= 7 -> 1 else 0")
y_binary = (y >= 7).astype(int)

print("Scaling features...")
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
print("Scaling completed.\n")

# grid of odd k values from 1 to 49
k_grid = list(range(1, 50, 2))  # [1,3,5,...,49]
print("k grid:", k_grid)

# grid search parameters
print_freq = 100
seed = 42

start_time = time.time()
# Run for 80/20
results_80 = run_classification_experiment_full_grid(X_scaled, y_binary,␣
 ↪test_size=0.2, k_grid=k_grid, print_freq=print_freq)
# Run for 70/30
results_70 = run_classification_experiment_full_grid(X_scaled, y_binary,␣
 ↪test_size=0.3, k_grid=k_grid, print_freq=print_freq)
end_time = time.time()
print("\nTotal runtime: {:.2f} seconds".format(end_time - start_time))

# ------------------------
# Save results to CSV
# ------------------------
```

```
out_csv = "stage2_results_grid_allmodels.csv"
print("Saving results to", out_csv)
with open(out_csv, "w", newline="") as f:
    writer = csv.writer(f)
    writer.writerow(["Split", "Model", "Distance_or_Name", "Best_k_or_NA",␣
 ↪"Accuracy", "Precision", "Recall", "F1", "ROC_AUC"])

    # 80/20
    for key, val in results_80.items():
        if key.startswith("KNN_"):
            metric = key.split("_", 1)[1]
            writer.writerow(["80/20", "KNN", metric, val.get("best_k"), val.
 ↪get("accuracy"), val.get("precision"), val.get("recall"), val.get("f1"), val.
 ↪get("roc_auc")])
        else:
            writer.writerow(["80/20", key, "NA", "NA", val.get("accuracy"), val.
 ↪get("precision"), val.get("recall"), val.get("f1"), val.get("roc_auc")])

    # 70/30
    for key, val in results_70.items():
        if key.startswith("KNN_"):
            metric = key.split("_", 1)[1]
            writer.writerow(["70/30", "KNN", metric, val.get("best_k"), val.
 ↪get("accuracy"), val.get("precision"), val.get("recall"), val.get("f1"), val.
 ↪get("roc_auc")])
        else:
            writer.writerow(["70/30", key, "NA", "NA", val.get("accuracy"), val.
 ↪get("precision"), val.get("recall"), val.get("f1"), val.get("roc_auc")])

print("Saved", out_csv)
print("Done.")
```

```
Device: cuda
Stage 2 Classification (Grid Search) with model comparisons
Starting…

Loading Wine Quality dataset…
Converting to binary labels: quality >= 7 -> 1 else 0
Scaling features…
Scaling completed.

k grid: [1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37,
39, 41, 43, 45, 47, 49]

Running experiment with test_size = 0.2
 Data split done. Train size: 5197 Test size: 1300
```

```
KNN - Distance metric: euclidean
Grid search for distance: euclidean
  Testing k = 1
    Fold 1/5
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/1040
      Predicting sample 100/1040
      Predicting sample 200/1040
      Predicting sample 300/1040
      Predicting sample 400/1040
      Predicting sample 500/1040
      Predicting sample 600/1040
      Predicting sample 700/1040
      Predicting sample 800/1040
      Predicting sample 900/1040
      Predicting sample 1000/1040
      Fold F1 = 0.6463700234192038
    Fold 2/5
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/1040
      Predicting sample 100/1040
      Predicting sample 200/1040
      Predicting sample 300/1040
      Predicting sample 400/1040
      Predicting sample 500/1040
      Predicting sample 600/1040
      Predicting sample 700/1040
      Predicting sample 800/1040
      Predicting sample 900/1040
      Predicting sample 1000/1040
      Fold F1 = 0.6258823529411764
    Fold 3/5
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/1039
      Predicting sample 100/1039
      Predicting sample 200/1039
      Predicting sample 300/1039
      Predicting sample 400/1039
      Predicting sample 500/1039
      Predicting sample 600/1039
      Predicting sample 700/1039
      Predicting sample 800/1039
      Predicting sample 900/1039
      Predicting sample 1000/1039
      Fold F1 = 0.5797101449275363
    Fold 4/5
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/1039
```

```
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.6161137440758294
  Fold 5/5
 Fit KNN: k=1, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.555
-> Avg F1 for k 1 = 0.6046

Testing k = 3
  Fold 1/5
 Fit KNN: k=3, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5774278215223098
  Fold 2/5
 Fit KNN: k=3, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
```

```
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.575682382133995
 Fold 3/5
Fit KNN: k=3, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.556390977443609
 Fold 4/5
Fit KNN: k=3, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5822784810126582
 Fold 5/5
Fit KNN: k=3, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
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```
    Predicting sample 1000/1039
    Fold F1 = 0.5152354570637119
-> Avg F1 for k 3 = 0.5614

Testing k = 5
  Fold 1/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5894736842105263
  Fold 2/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5848563968668408
  Fold 3/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.543010752688172
  Fold 4/5
```

```
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.6077922077922078
  Fold 5/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5297297297297298
-> Avg F1 for k 5 = 0.5710

Testing k = 7
  Fold 1/5
 Fit KNN: k=7, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5543478260869565
  Fold 2/5
 Fit KNN: k=7, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
```

```
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5647668393782384
 Fold 3/5
Fit KNN: k=7, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4932249322493225
 Fold 4/5
Fit KNN: k=7, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5506493506493506
 Fold 5/5
Fit KNN: k=7, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
```

```
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5114942528735632
-> Avg F1 for k 7 = 0.5349

Testing k = 9
  Fold 1/5
 Fit KNN: k=9, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5231607629427792
  Fold 2/5
 Fit KNN: k=9, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5661375661375662
  Fold 3/5
 Fit KNN: k=9, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
```

```
    Fold F1 = 0.5068119891008175
  Fold 4/5
 Fit KNN: k=9, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5226666666666666
  Fold 5/5
 Fit KNN: k=9, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4885057471264368
-> Avg F1 for k 9 = 0.5215

Testing k = 11
  Fold 1/5
 Fit KNN: k=11, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5205479452054794
  Fold 2/5
 Fit KNN: k=11, distance=euclidean, weights=uniform
```

```
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5898123324396782
 Fold 3/5
Fit KNN: k=11, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4745762711864407
 Fold 4/5
Fit KNN: k=11, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5291005291005291
 Fold 5/5
Fit KNN: k=11, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
```

```
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.47953216374269003
-> Avg F1 for k 11 = 0.5187

Testing k = 13
  Fold 1/5
 Fit KNN: k=13, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5277777777777778
  Fold 2/5
 Fit KNN: k=13, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.554945054945055
  Fold 3/5
 Fit KNN: k=13, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
```

```
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.44108761329305135
  Fold 4/5
 Fit KNN: k=13, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5081081081081081
  Fold 5/5
 Fit KNN: k=13, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4647058823529412
-> Avg F1 for k 13 = 0.4993

Testing k = 15
  Fold 1/5
 Fit KNN: k=15, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5028571428571429
```

```
 Fold 2/5
Fit KNN: k=15, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5515320334261838
 Fold 3/5
Fit KNN: k=15, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4773413897280967
 Fold 4/5
Fit KNN: k=15, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.512396694214876
 Fold 5/5
Fit KNN: k=15, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
```

```
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.44242424242424244
-> Avg F1 for k 15 = 0.4973

Testing k = 17
  Fold 1/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.47674418604651164
  Fold 2/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5227272727272727
  Fold 3/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
```

```
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.47416413373860183
  Fold 4/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5207756232686981
  Fold 5/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4369230769230769
-> Avg F1 for k 17 = 0.4863

Testing k = 19
  Fold 1/5
 Fit KNN: k=19, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
```

```
   Predicting sample 1000/1040
   Fold F1 = 0.4896755162241888
 Fold 2/5
Fit KNN: k=19, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5302593659942363
 Fold 3/5
Fit KNN: k=19, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4492307692307692
 Fold 4/5
Fit KNN: k=19, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5183098591549296
 Fold 5/5
Fit KNN: k=19, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
```

```
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4140127388535032
-> Avg F1 for k 19 = 0.4803

Testing k = 21
  Fold 1/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.46987951807228917
  Fold 2/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5174418604651163
  Fold 3/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
```

```
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.46060606060606063
  Fold 4/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5202312138728323
  Fold 5/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.425
-> Avg F1 for k 21 = 0.4786

Testing k = 23
  Fold 1/5
 Fit KNN: k=23, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
```

```
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.46846846846846846
 Fold 2/5
Fit KNN: k=23, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5014925373134328
 Fold 3/5
Fit KNN: k=23, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.45592705167173253
 Fold 4/5
Fit KNN: k=23, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.49710982658959535
 Fold 5/5
Fit KNN: k=23, distance=euclidean, weights=uniform
```

```
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4140127388535032
-> Avg F1 for k 23 = 0.4674

Testing k = 25
  Fold 1/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.46200607902735563
  Fold 2/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5014925373134328
  Fold 3/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
```

```
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45482866043613707
  Fold 4/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5117647058823529
  Fold 5/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.43174603174603177
-> Avg F1 for k 25 = 0.4724

Testing k = 27
  Fold 1/5
 Fit KNN: k=27, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
```

```
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4709480122324159
 Fold 2/5
Fit KNN: k=27, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4984984984984985
 Fold 3/5
Fit KNN: k=27, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.46439628482972134
 Fold 4/5
Fit KNN: k=27, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4778761061946903
```

```
  Fold 5/5
 Fit KNN: k=27, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4281150159744409
-> Avg F1 for k 27 = 0.4680

Testing k = 29
  Fold 1/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4634146341463415
  Fold 2/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5
  Fold 3/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/1039
```

```
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45962732919254656
  Fold 4/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.49853372434017595
  Fold 5/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4258064516129032
-> Avg F1 for k 29 = 0.4695

Testing k = 31
  Fold 1/5
 Fit KNN: k=31, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
```

```
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4492307692307692
 Fold 2/5
Fit KNN: k=31, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.48
 Fold 3/5
Fit KNN: k=31, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4658385093167702
 Fold 4/5
Fit KNN: k=31, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
```

```
    Predicting sample 1000/1039
    Fold F1 = 0.5159420289855072
  Fold 5/5
 Fit KNN: k=31, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.42718446601941745
-> Avg F1 for k 31 = 0.4676

Testing k = 33
  Fold 1/5
 Fit KNN: k=33, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.44036697247706424
  Fold 2/5
 Fit KNN: k=33, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4735202492211838
  Fold 3/5
```

```
 Fit KNN: k=33, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45962732919254656
  Fold 4/5
 Fit KNN: k=33, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.48520710059171596
  Fold 5/5
 Fit KNN: k=33, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3973509933774834
-> Avg F1 for k 33 = 0.4512

Testing k = 35
  Fold 1/5
 Fit KNN: k=35, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
```

```
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.45121951219512196
 Fold 2/5
Fit KNN: k=35, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4782608695652174
 Fold 3/5
Fit KNN: k=35, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.46394984326018807
 Fold 4/5
Fit KNN: k=35, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
```

```
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4652567975830816
  Fold 5/5
 Fit KNN: k=35, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.42105263157894735
-> Avg F1 for k 35 = 0.4559

Testing k = 37
  Fold 1/5
 Fit KNN: k=37, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4506172839506173
  Fold 2/5
 Fit KNN: k=37, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
```

```
    Fold F1 = 0.4876543209876543
  Fold 3/5
 Fit KNN: k=37, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4416403785488959
  Fold 4/5
 Fit KNN: k=37, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.48338368580060426
  Fold 5/5
 Fit KNN: k=37, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.39603960396039606
-> Avg F1 for k 37 = 0.4519

Testing k = 39
  Fold 1/5
 Fit KNN: k=39, distance=euclidean, weights=uniform
```

```
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4303030303030303
 Fold 2/5
Fit KNN: k=39, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.48297213622291024
 Fold 3/5
Fit KNN: k=39, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4267515923566879
 Fold 4/5
Fit KNN: k=39, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
```

```
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.46060606060606063
  Fold 5/5
 Fit KNN: k=39, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4
-> Avg F1 for k 39 = 0.4401

Testing k = 41
  Fold 1/5
 Fit KNN: k=41, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.43558282208588955
  Fold 2/5
 Fit KNN: k=41, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
```

```
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4702194357366771
  Fold 3/5
 Fit KNN: k=41, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4281150159744409
  Fold 4/5
 Fit KNN: k=41, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45592705167173253
  Fold 5/5
 Fit KNN: k=41, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3879598662207358
-> Avg F1 for k 41 = 0.4356

Testing k = 43
```

```
 Fold 1/5
Fit KNN: k=43, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.44375
 Fold 2/5
Fit KNN: k=43, distance=euclidean, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4873417721518987
 Fold 3/5
Fit KNN: k=43, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.41423948220064727
 Fold 4/5
Fit KNN: k=43, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
```

```
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45121951219512196
  Fold 5/5
 Fit KNN: k=43, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3973509933774834
-> Avg F1 for k 43 = 0.4388

Testing k = 45
  Fold 1/5
 Fit KNN: k=45, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.438871473354232
  Fold 2/5
 Fit KNN: k=45, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
```

```
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.47318611987381703
 Fold 3/5
Fit KNN: k=45, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4
 Fold 4/5
Fit KNN: k=45, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4492307692307692
 Fold 5/5
Fit KNN: k=45, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.3879598662207358
-> Avg F1 for k 45 = 0.4298
```

```
Testing k = 47
  Fold 1/5
 Fit KNN: k=47, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4437299035369775
  Fold 2/5
 Fit KNN: k=47, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4551282051282051
  Fold 3/5
 Fit KNN: k=47, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4080267558528428
  Fold 4/5
 Fit KNN: k=47, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
```

```
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.43962848297213625
  Fold 5/5
 Fit KNN: k=47, distance=euclidean, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3716216216216216
-> Avg F1 for k 47 = 0.4236

Testing k = 49
  Fold 1/5
 Fit KNN: k=49, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4423076923076923
  Fold 2/5
 Fit KNN: k=49, distance=euclidean, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
```

```
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.43729903536977494
 Fold 3/5
Fit KNN: k=49, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.40268456375838924
 Fold 4/5
Fit KNN: k=49, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.42902208201892744
 Fold 5/5
Fit KNN: k=49, distance=euclidean, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
```

```
      Fold F1 = 0.38095238095238093
  -> Avg F1 for k 49 = 0.4185

Grid search complete for distance: euclidean
 Best k selected for euclidean = 1
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/1300
      Predicting sample 100/1300
      Predicting sample 200/1300
      Predicting sample 300/1300
      Predicting sample 400/1300
      Predicting sample 500/1300
      Predicting sample 600/1300
      Predicting sample 700/1300
      Predicting sample 800/1300
      Predicting sample 900/1300
      Predicting sample 1000/1300
      Predicting sample 1100/1300
      Predicting sample 1200/1300
 Test results for KNN (euclidean) - k=1:
   Accuracy: 0.8577
   Precision: 0.6426
   Recall: 0.6250
   F1-score: 0.6337
   ROC-AUC: 0.7698754789272031

KNN - Distance metric: manhattan
Grid search for distance: manhattan
  Testing k = 1
    Fold 1/5
   Fit KNN: k=1, distance=manhattan, weights=uniform
      Predicting sample 0/1040
      Predicting sample 100/1040
      Predicting sample 200/1040
      Predicting sample 300/1040
      Predicting sample 400/1040
      Predicting sample 500/1040
      Predicting sample 600/1040
      Predicting sample 700/1040
      Predicting sample 800/1040
      Predicting sample 900/1040
      Predicting sample 1000/1040
      Fold F1 = 0.6651270207852193
    Fold 2/5
   Fit KNN: k=1, distance=manhattan, weights=uniform
      Predicting sample 0/1040
      Predicting sample 100/1040
      Predicting sample 200/1040
```

```
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.6681818181818182
 Fold 3/5
Fit KNN: k=1, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.6014669926650367
 Fold 4/5
Fit KNN: k=1, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.6390243902439025
 Fold 5/5
Fit KNN: k=1, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
```

```
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.56
-> Avg F1 for k 1 = 0.6268

Testing k = 3
  Fold 1/5
 Fit KNN: k=3, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.59846547314578
  Fold 2/5
 Fit KNN: k=3, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.553921568627451
  Fold 3/5
 Fit KNN: k=3, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5597964376590331
```

```
  Fold 4/5
 Fit KNN: k=3, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5483028720626631
  Fold 5/5
 Fit KNN: k=3, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5067385444743935
-> Avg F1 for k 3 = 0.5534

Testing k = 5
  Fold 1/5
 Fit KNN: k=5, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5677749360613811
  Fold 2/5
 Fit KNN: k=5, distance=manhattan, weights=uniform
    Predicting sample 0/1040
```

```
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5882352941176471
 Fold 3/5
Fit KNN: k=5, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5614973262032086
 Fold 4/5
Fit KNN: k=5, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5639686684073107
 Fold 5/5
Fit KNN: k=5, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
```

```
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5013623978201635
-> Avg F1 for k 5 = 0.5566

Testing k = 7
  Fold 1/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5572916666666666
  Fold 2/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5931758530183727
  Fold 3/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
```

```
    Predicting sample 1000/1039
    Fold F1 = 0.5277044854881267
  Fold 4/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.518918918918919
  Fold 5/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5207756232686981
-> Avg F1 for k 7 = 0.5436

Testing k = 9
  Fold 1/5
 Fit KNN: k=9, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5509641873278237
  Fold 2/5
```

```
Fit KNN: k=9, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5806451612903226
 Fold 3/5
Fit KNN: k=9, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5683646112600537
 Fold 4/5
Fit KNN: k=9, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4972677595628415
 Fold 5/5
Fit KNN: k=9, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
```

```
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5084745762711864
-> Avg F1 for k 9 = 0.5411

Testing k = 11
  Fold 1/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5224719101123596
  Fold 2/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5534246575342465
  Fold 3/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
```

```
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5100286532951289
  Fold 4/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5191256830601093
  Fold 5/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5157593123209169
-> Avg F1 for k 11 = 0.5242

Testing k = 13
  Fold 1/5
 Fit KNN: k=13, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
```

```
   Fold F1 = 0.509915014164306
 Fold 2/5
Fit KNN: k=13, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5564738292011019
 Fold 3/5
Fit KNN: k=13, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5117647058823529
 Fold 4/5
Fit KNN: k=13, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5055555555555555
 Fold 5/5
Fit KNN: k=13, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
```

```
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4819277108433735
-> Avg F1 for k 13 = 0.5131

Testing k = 15
  Fold 1/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4942528735632184
  Fold 2/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5356125356125356
  Fold 3/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
```

```
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4896755162241888
  Fold 4/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5028248587570622
  Fold 5/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.47706422018348627
-> Avg F1 for k 15 = 0.4999

Testing k = 17
  Fold 1/5
 Fit KNN: k=17, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
```

```
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4764705882352941
 Fold 2/5
Fit KNN: k=17, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5314285714285715
 Fold 3/5
Fit KNN: k=17, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4773413897280967
 Fold 4/5
Fit KNN: k=17, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5098039215686274
 Fold 5/5
Fit KNN: k=17, distance=manhattan, weights=uniform
   Predicting sample 0/1039
```

```
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.48148148148148145
-> Avg F1 for k 17 = 0.4953

Testing k = 19
  Fold 1/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.47477744807121663
  Fold 2/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5470085470085471
  Fold 3/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
```

```
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.49696969696969695
  Fold 4/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5072046109510087
  Fold 5/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45569620253164556
-> Avg F1 for k 19 = 0.4963

Testing k = 21
  Fold 1/5
 Fit KNN: k=21, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
```

```
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.44642857142857145
 Fold 2/5
Fit KNN: k=21, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5229885057471264
 Fold 3/5
Fit KNN: k=21, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4817073170731707
 Fold 4/5
Fit KNN: k=21, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5161290322580645
 Fold 5/5
```

```
 Fit KNN: k=21, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4472843450479233
-> Avg F1 for k 21 = 0.4829

Testing k = 23
  Fold 1/5
 Fit KNN: k=23, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.42201834862385323
  Fold 2/5
 Fit KNN: k=23, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5161290322580645
  Fold 3/5
 Fit KNN: k=23, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
```

```
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.46808510638297873
  Fold 4/5
 Fit KNN: k=23, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5058823529411764
  Fold 5/5
 Fit KNN: k=23, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4281150159744409
-> Avg F1 for k 23 = 0.4680

Testing k = 25
  Fold 1/5
 Fit KNN: k=25, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
```

```
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4369230769230769
 Fold 2/5
Fit KNN: k=25, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.514792899408284
 Fold 3/5
Fit KNN: k=25, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4662576687116564
 Fold 4/5
Fit KNN: k=25, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
```

```
    Fold F1 = 0.5
  Fold 5/5
 Fit KNN: k=25, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4166666666666667
-> Avg F1 for k 25 = 0.4669

Testing k = 27
  Fold 1/5
 Fit KNN: k=27, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.43558282208588955
  Fold 2/5
 Fit KNN: k=27, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5
  Fold 3/5
 Fit KNN: k=27, distance=manhattan, weights=uniform
```

```
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4507936507936508
  Fold 4/5
 Fit KNN: k=27, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4939759036144578
  Fold 5/5
 Fit KNN: k=27, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.40634920634920635
-> Avg F1 for k 27 = 0.4573

Testing k = 29
  Fold 1/5
 Fit KNN: k=29, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
```

```
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4350453172205438
 Fold 2/5
Fit KNN: k=29, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4648318042813456
 Fold 3/5
Fit KNN: k=29, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4779874213836478
 Fold 4/5
Fit KNN: k=29, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
```

```
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4773413897280967
  Fold 5/5
 Fit KNN: k=29, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4025974025974026
-> Avg F1 for k 29 = 0.4516

Testing k = 31
  Fold 1/5
 Fit KNN: k=31, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4471299093655589
  Fold 2/5
 Fit KNN: k=31, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.45482866043613707
```

```
  Fold 3/5
 Fit KNN: k=31, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4794952681388013
  Fold 4/5
 Fit KNN: k=31, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.48632218844984804
  Fold 5/5
 Fit KNN: k=31, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4155844155844156
-> Avg F1 for k 31 = 0.4567

Testing k = 33
  Fold 1/5
 Fit KNN: k=33, distance=manhattan, weights=uniform
    Predicting sample 0/1040
```

```
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.43902439024390244
 Fold 2/5
Fit KNN: k=33, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4430379746835443
 Fold 3/5
Fit KNN: k=33, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4713375796178344
 Fold 4/5
Fit KNN: k=33, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
```

```
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4567901234567901
  Fold 5/5
 Fit KNN: k=33, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4025974025974026
-> Avg F1 for k 33 = 0.4426

Testing k = 35
  Fold 1/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.44171779141104295
  Fold 2/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
```

```
    Predicting sample 1000/1040
    Fold F1 = 0.4430379746835443
  Fold 3/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.46794871794871795
  Fold 4/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4831804281345566
  Fold 5/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.39072847682119205
-> Avg F1 for k 35 = 0.4453

Testing k = 37
  Fold 1/5
```

```
Fit KNN: k=37, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4240506329113924
 Fold 2/5
Fit KNN: k=37, distance=manhattan, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4782608695652174
 Fold 3/5
Fit KNN: k=37, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4645161290322581
 Fold 4/5
Fit KNN: k=37, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
```

```
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.453416149068323
  Fold 5/5
 Fit KNN: k=37, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4090909090909091
-> Avg F1 for k 37 = 0.4459

Testing k = 39
  Fold 1/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4276729559748428
  Fold 2/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
```

```
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4591194968553459
  Fold 3/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45454545454545453
  Fold 4/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45482866043613707
  Fold 5/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.37966101694915255
-> Avg F1 for k 39 = 0.4352
```

```
Testing k = 41
  Fold 1/5
 Fit KNN: k=41, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4281150159744409
  Fold 2/5
 Fit KNN: k=41, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.46394984326018807
  Fold 3/5
 Fit KNN: k=41, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4565916398713826
  Fold 4/5
 Fit KNN: k=41, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
```

```
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4591194968553459
  Fold 5/5
 Fit KNN: k=41, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3728813559322034
-> Avg F1 for k 41 = 0.4361

Testing k = 43
  Fold 1/5
 Fit KNN: k=43, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.43450479233226835
  Fold 2/5
 Fit KNN: k=43, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
```

```
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.46984126984126984
 Fold 3/5
Fit KNN: k=43, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.43934426229508194
 Fold 4/5
Fit KNN: k=43, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.46439628482972134
 Fold 5/5
Fit KNN: k=43, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.3698630136986301
```

```
-> Avg F1 for k 43 = 0.4356

Testing k = 45
  Fold 1/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.42948717948717946
  Fold 2/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.47468354430379744
  Fold 3/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.42105263157894735
  Fold 4/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/1039
```

```
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4553846153846154
  Fold 5/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.35789473684210527
-> Avg F1 for k 45 = 0.4277

Testing k = 47
  Fold 1/5
 Fit KNN: k=47, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.38943894389438943
  Fold 2/5
 Fit KNN: k=47, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
```

```
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.48253968253968255
 Fold 3/5
Fit KNN: k=47, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.423841059602649
 Fold 4/5
Fit KNN: k=47, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.44171779141104295
 Fold 5/5
Fit KNN: k=47, distance=manhattan, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
```

```
    Predicting sample 1000/1039
    Fold F1 = 0.3554006968641115
-> Avg F1 for k 47 = 0.4186

Testing k = 49
  Fold 1/5
 Fit KNN: k=49, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.3881578947368421
  Fold 2/5
 Fit KNN: k=49, distance=manhattan, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.47096774193548385
  Fold 3/5
 Fit KNN: k=49, distance=manhattan, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4214046822742475
  Fold 4/5
```

```
   Fit KNN: k=49, distance=manhattan, weights=uniform
      Predicting sample 0/1039
      Predicting sample 100/1039
      Predicting sample 200/1039
      Predicting sample 300/1039
      Predicting sample 400/1039
      Predicting sample 500/1039
      Predicting sample 600/1039
      Predicting sample 700/1039
      Predicting sample 800/1039
      Predicting sample 900/1039
      Predicting sample 1000/1039
      Fold F1 = 0.43260188087774293
    Fold 5/5
   Fit KNN: k=49, distance=manhattan, weights=uniform
      Predicting sample 0/1039
      Predicting sample 100/1039
      Predicting sample 200/1039
      Predicting sample 300/1039
      Predicting sample 400/1039
      Predicting sample 500/1039
      Predicting sample 600/1039
      Predicting sample 700/1039
      Predicting sample 800/1039
      Predicting sample 900/1039
      Predicting sample 1000/1039
      Fold F1 = 0.35294117647058826
  -> Avg F1 for k 49 = 0.4132

Grid search complete for distance: manhattan
 Best k selected for manhattan = 1
   Fit KNN: k=1, distance=manhattan, weights=uniform
      Predicting sample 0/1300
      Predicting sample 100/1300
      Predicting sample 200/1300
      Predicting sample 300/1300
      Predicting sample 400/1300
      Predicting sample 500/1300
      Predicting sample 600/1300
      Predicting sample 700/1300
      Predicting sample 800/1300
      Predicting sample 900/1300
      Predicting sample 1000/1300
      Predicting sample 1100/1300
      Predicting sample 1200/1300
 Test results for KNN (manhattan) - k=1:
   Accuracy: 0.8631
   Precision: 0.6535
```

```
   Recall: 0.6484
   F1-score: 0.6510
   ROC-AUC: 0.7820731561302682

KNN - Distance metric: minkowski
Grid search for distance: minkowski
  Testing k = 1
    Fold 1/5
   Fit KNN: k=1, distance=minkowski, weights=uniform
      Predicting sample 0/1040
      Predicting sample 100/1040
      Predicting sample 200/1040
      Predicting sample 300/1040
      Predicting sample 400/1040
      Predicting sample 500/1040
      Predicting sample 600/1040
      Predicting sample 700/1040
      Predicting sample 800/1040
      Predicting sample 900/1040
      Predicting sample 1000/1040
      Fold F1 = 0.6666666666666666
    Fold 2/5
   Fit KNN: k=1, distance=minkowski, weights=uniform
      Predicting sample 0/1040
      Predicting sample 100/1040
      Predicting sample 200/1040
      Predicting sample 300/1040
      Predicting sample 400/1040
      Predicting sample 500/1040
      Predicting sample 600/1040
      Predicting sample 700/1040
      Predicting sample 800/1040
      Predicting sample 900/1040
      Predicting sample 1000/1040
      Fold F1 = 0.630071599045346
    Fold 3/5
   Fit KNN: k=1, distance=minkowski, weights=uniform
      Predicting sample 0/1039
      Predicting sample 100/1039
      Predicting sample 200/1039
      Predicting sample 300/1039
      Predicting sample 400/1039
      Predicting sample 500/1039
      Predicting sample 600/1039
      Predicting sample 700/1039
      Predicting sample 800/1039
      Predicting sample 900/1039
      Predicting sample 1000/1039
```

```
    Fold F1 = 0.5761904761904761
  Fold 4/5
 Fit KNN: k=1, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.6220095693779905
  Fold 5/5
 Fit KNN: k=1, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5806451612903226
-> Avg F1 for k 1 = 0.6151

Testing k = 3
  Fold 1/5
 Fit KNN: k=3, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5685279187817259
  Fold 2/5
 Fit KNN: k=3, distance=minkowski, weights=uniform
```

```
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5670886075949367
 Fold 3/5
Fit KNN: k=3, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5431472081218274
 Fold 4/5
Fit KNN: k=3, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.57356608478803
 Fold 5/5
Fit KNN: k=3, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
```

```
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5095890410958904
-> Avg F1 for k 3 = 0.5524

Testing k = 5
  Fold 1/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.575197889182058
  Fold 2/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5839793281653747
  Fold 3/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
```

```
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.521505376344086
  Fold 4/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.585
  Fold 5/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5096952908587258
-> Avg F1 for k 5 = 0.5551

Testing k = 7
  Fold 1/5
 Fit KNN: k=7, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5623342175066313
```

```
 Fold 2/5
Fit KNN: k=7, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5879265091863517
 Fold 3/5
Fit KNN: k=7, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4972375690607735
 Fold 4/5
Fit KNN: k=7, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5569620253164557
 Fold 5/5
Fit KNN: k=7, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
```

```
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.49283667621776506
-> Avg F1 for k 7 = 0.5395

Testing k = 9
  Fold 1/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.512396694214876
  Fold 2/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.56
  Fold 3/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
```

```
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4722222222222222
  Fold 4/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5406824146981627
  Fold 5/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4956772334293948
-> Avg F1 for k 9 = 0.5162

Testing k = 11
  Fold 1/5
 Fit KNN: k=11, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
```

```
   Predicting sample 1000/1040
   Fold F1 = 0.5069637883008357
 Fold 2/5
Fit KNN: k=11, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5498652291105122
 Fold 3/5
Fit KNN: k=11, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4507042253521127
 Fold 4/5
Fit KNN: k=11, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5333333333333333
 Fold 5/5
Fit KNN: k=11, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
```

```
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.47262247838616717
-> Avg F1 for k 11 = 0.5027

Testing k = 13
  Fold 1/5
 Fit KNN: k=13, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.49714285714285716
  Fold 2/5
 Fit KNN: k=13, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5384615384615384
  Fold 3/5
 Fit KNN: k=13, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
```

```
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.436046511627907
  Fold 4/5
 Fit KNN: k=13, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.528
  Fold 5/5
 Fit KNN: k=13, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4633431085043988
-> Avg F1 for k 13 = 0.4926

Testing k = 15
  Fold 1/5
 Fit KNN: k=15, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
```

```
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.498567335243553
 Fold 2/5
Fit KNN: k=15, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5382436260623229
 Fold 3/5
Fit KNN: k=15, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4303030303030303
 Fold 4/5
Fit KNN: k=15, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5095890410958904
 Fold 5/5
Fit KNN: k=15, distance=minkowski, weights=uniform
```

```
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4088050314465409
-> Avg F1 for k 15 = 0.4771

Testing k = 17
  Fold 1/5
 Fit KNN: k=17, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.49853372434017595
  Fold 2/5
 Fit KNN: k=17, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5260115606936416
  Fold 3/5
 Fit KNN: k=17, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
```

```
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.45317220543806647
  Fold 4/5
 Fit KNN: k=17, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5177111716621253
  Fold 5/5
 Fit KNN: k=17, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4263322884012539
-> Avg F1 for k 17 = 0.4844

Testing k = 19
  Fold 1/5
 Fit KNN: k=19, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
```

```
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.486646884272997
 Fold 2/5
Fit KNN: k=19, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.5014577259475219
 Fold 3/5
Fit KNN: k=19, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.43558282208588955
 Fold 4/5
Fit KNN: k=19, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.5014084507042254
```

```
  Fold 5/5
 Fit KNN: k=19, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.41509433962264153
-> Avg F1 for k 19 = 0.4680

Testing k = 21
  Fold 1/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.47619047619047616
  Fold 2/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5
  Fold 3/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/1039
```

```
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.42724458204334365
  Fold 4/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5114942528735632
  Fold 5/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.402555910543131
-> Avg F1 for k 21 = 0.4635

Testing k = 23
  Fold 1/5
 Fit KNN: k=23, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
```

```
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.47305389221556887
 Fold 2/5
Fit KNN: k=23, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.48466257668711654
 Fold 3/5
Fit KNN: k=23, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4307692307692308
 Fold 4/5
Fit KNN: k=23, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
```

```
    Predicting sample 1000/1039
    Fold F1 = 0.5072886297376094
  Fold 5/5
 Fit KNN: k=23, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4140127388535032
-> Avg F1 for k 23 = 0.4620

Testing k = 25
  Fold 1/5
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.46987951807228917
  Fold 2/5
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4954128440366973
  Fold 3/5
```

```
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.43558282208588955
  Fold 4/5
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.5146198830409356
  Fold 5/5
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.391025641025641
-> Avg F1 for k 25 = 0.4613

Testing k = 27
  Fold 1/5
 Fit KNN: k=27, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
```

```
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.46987951807228917
 Fold 2/5
Fit KNN: k=27, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.48466257668711654
 Fold 3/5
Fit KNN: k=27, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4227129337539432
 Fold 4/5
Fit KNN: k=27, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
```

```
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.49258160237388726
  Fold 5/5
 Fit KNN: k=27, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.391025641025641
-> Avg F1 for k 27 = 0.4522

Testing k = 29
  Fold 1/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.46987951807228917
  Fold 2/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
```

```
    Fold F1 = 0.47678018575851394
  Fold 3/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.43037974683544306
  Fold 4/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4823529411764706
  Fold 5/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3737704918032787
-> Avg F1 for k 29 = 0.4466

Testing k = 31
  Fold 1/5
 Fit KNN: k=31, distance=minkowski, weights=uniform
```

```
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4716417910447761
 Fold 2/5
Fit KNN: k=31, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.47678018575851394
 Fold 3/5
Fit KNN: k=31, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4394904458598726
 Fold 4/5
Fit KNN: k=31, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
```

```
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.471976401179941
  Fold 5/5
 Fit KNN: k=31, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3818770226537217
-> Avg F1 for k 31 = 0.4484

Testing k = 33
  Fold 1/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4652567975830816
  Fold 2/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
```

```
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4953560371517028
  Fold 3/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.445859872611465
  Fold 4/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.47904191616766467
  Fold 5/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.38562091503267976
-> Avg F1 for k 33 = 0.4542

Testing k = 35
```

```
 Fold 1/5
Fit KNN: k=35, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.45317220543806647
 Fold 2/5
Fit KNN: k=35, distance=minkowski, weights=uniform
   Predicting sample 0/1040
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4952978056426332
 Fold 3/5
Fit KNN: k=35, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.43086816720257237
 Fold 4/5
Fit KNN: k=35, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
```

```
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.48338368580060426
  Fold 5/5
 Fit KNN: k=35, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.39473684210526316
-> Avg F1 for k 35 = 0.4515

Testing k = 37
  Fold 1/5
 Fit KNN: k=37, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.45121951219512196
  Fold 2/5
 Fit KNN: k=37, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
```

```
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.49221183800623053
  Fold 3/5
 Fit KNN: k=37, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.43086816720257237
  Fold 4/5
 Fit KNN: k=37, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4878048780487805
  Fold 5/5
 Fit KNN: k=37, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3783783783783784
-> Avg F1 for k 37 = 0.4481
```

```
Testing k = 39
  Fold 1/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4484848484848485
  Fold 2/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.5123456790123457
  Fold 3/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4169381107491857
  Fold 4/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
```

```
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4691358024691358
  Fold 5/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3581081081081081
-> Avg F1 for k 39 = 0.4410

Testing k = 41
  Fold 1/5
 Fit KNN: k=41, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4458204334365325
  Fold 2/5
 Fit KNN: k=41, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
```

```
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.47619047619047616
 Fold 3/5
Fit KNN: k=41, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.4155844155844156
 Fold 4/5
Fit KNN: k=41, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.46439628482972134
 Fold 5/5
Fit KNN: k=41, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
```

```
    Fold F1 = 0.35494880546075086
-> Avg F1 for k 41 = 0.4314

Testing k = 43
  Fold 1/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.43125
  Fold 2/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.4728434504792332
  Fold 3/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.432258064516129
  Fold 4/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
```

```
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4676923076923077
  Fold 5/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3525423728813559
-> Avg F1 for k 43 = 0.4313

Testing k = 45
  Fold 1/5
 Fit KNN: k=45, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.43312101910828027
  Fold 2/5
 Fit KNN: k=45, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
```

```
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.4565916398713826
 Fold 3/5
Fit KNN: k=45, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.40268456375838924
 Fold 4/5
Fit KNN: k=45, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.46296296296296297
 Fold 5/5
Fit KNN: k=45, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
```

```
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.36177474402730375
-> Avg F1 for k 45 = 0.4234

Testing k = 47
  Fold 1/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.43729903536977494
  Fold 2/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.45098039215686275
  Fold 3/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4053156146179402
```

```
  Fold 4/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.4423676012461059
  Fold 5/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/1039
    Predicting sample 100/1039
    Predicting sample 200/1039
    Predicting sample 300/1039
    Predicting sample 400/1039
    Predicting sample 500/1039
    Predicting sample 600/1039
    Predicting sample 700/1039
    Predicting sample 800/1039
    Predicting sample 900/1039
    Predicting sample 1000/1039
    Fold F1 = 0.3698630136986301
-> Avg F1 for k 47 = 0.4212

Testing k = 49
  Fold 1/5
 Fit KNN: k=49, distance=minkowski, weights=uniform
    Predicting sample 0/1040
    Predicting sample 100/1040
    Predicting sample 200/1040
    Predicting sample 300/1040
    Predicting sample 400/1040
    Predicting sample 500/1040
    Predicting sample 600/1040
    Predicting sample 700/1040
    Predicting sample 800/1040
    Predicting sample 900/1040
    Predicting sample 1000/1040
    Fold F1 = 0.43506493506493504
  Fold 2/5
 Fit KNN: k=49, distance=minkowski, weights=uniform
    Predicting sample 0/1040
```

```
   Predicting sample 100/1040
   Predicting sample 200/1040
   Predicting sample 300/1040
   Predicting sample 400/1040
   Predicting sample 500/1040
   Predicting sample 600/1040
   Predicting sample 700/1040
   Predicting sample 800/1040
   Predicting sample 900/1040
   Predicting sample 1000/1040
   Fold F1 = 0.44299674267100975
 Fold 3/5
Fit KNN: k=49, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.3918918918918919
 Fold 4/5
Fit KNN: k=49, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
   Predicting sample 700/1039
   Predicting sample 800/1039
   Predicting sample 900/1039
   Predicting sample 1000/1039
   Fold F1 = 0.42038216560509556
 Fold 5/5
Fit KNN: k=49, distance=minkowski, weights=uniform
   Predicting sample 0/1039
   Predicting sample 100/1039
   Predicting sample 200/1039
   Predicting sample 300/1039
   Predicting sample 400/1039
   Predicting sample 500/1039
   Predicting sample 600/1039
```

```
      Predicting sample 700/1039
      Predicting sample 800/1039
      Predicting sample 900/1039
      Predicting sample 1000/1039
      Fold F1 = 0.363013698630137
  -> Avg F1 for k 49 = 0.4107

Grid search complete for distance: minkowski
 Best k selected for minkowski = 1
   Fit KNN: k=1, distance=minkowski, weights=uniform
      Predicting sample 0/1300
      Predicting sample 100/1300
      Predicting sample 200/1300
      Predicting sample 300/1300
      Predicting sample 400/1300
      Predicting sample 500/1300
      Predicting sample 600/1300
      Predicting sample 700/1300
      Predicting sample 800/1300
      Predicting sample 900/1300
      Predicting sample 1000/1300
      Predicting sample 1100/1300
      Predicting sample 1200/1300
 Test results for KNN (minkowski) - k=1:
   Accuracy: 0.8577
   Precision: 0.6426
   Recall: 0.6250
   F1-score: 0.6337
   ROC-AUC: 0.7698754789272031

Training and evaluating baseline library classifiers…
 Training 1R (decision stump)…
 Training Decision Tree…
 Training Random Forest…

/root/miniconda3/envs/py3.10/lib/python3.10/site-packages/sklearn/base.py:1365:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples,), for example using
ravel().
  return fit_method(estimator, *args, **kwargs)

 Training SVM (probability=True)…

/root/miniconda3/envs/py3.10/lib/python3.10/site-
packages/sklearn/utils/validation.py:1406: DataConversionWarning: A column-
vector y was passed when a 1d array was expected. Please change the shape of y
to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

```
Best model on test set for this split is: KNN_manhattan with F1 =
0.6509803921568628
Confusion matrix (array):
[[956  88]
 [ 90 166]]
Saved confusion matrix to: cm_best_80_grid_allmodels.png

Running experiment with test_size = 0.3
 Data split done. Train size: 4547 Test size: 1950

KNN - Distance metric: euclidean
Grid search for distance: euclidean
  Testing k = 1
    Fold 1/5
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/910
      Predicting sample 100/910
      Predicting sample 200/910
      Predicting sample 300/910
      Predicting sample 400/910
      Predicting sample 500/910
      Predicting sample 600/910
      Predicting sample 700/910
      Predicting sample 800/910
      Predicting sample 900/910
      Fold F1 = 0.6312997347480106
    Fold 2/5
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/910
      Predicting sample 100/910
      Predicting sample 200/910
      Predicting sample 300/910
      Predicting sample 400/910
      Predicting sample 500/910
      Predicting sample 600/910
      Predicting sample 700/910
      Predicting sample 800/910
      Predicting sample 900/910
      Fold F1 = 0.6043956043956044
    Fold 3/5
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
```

```
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5652173913043478
  Fold 4/5
 Fit KNN: k=1, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5674931129476584
  Fold 5/5
 Fit KNN: k=1, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.6306818181818182
-> Avg F1 for k 1 = 0.5998

Testing k = 3
  Fold 1/5
 Fit KNN: k=3, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.6453488372093024
  Fold 2/5
 Fit KNN: k=3, distance=euclidean, weights=uniform
```

```
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5747126436781609
 Fold 3/5
Fit KNN: k=3, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.5439093484419264
 Fold 4/5
Fit KNN: k=3, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.5044510385756676
 Fold 5/5
Fit KNN: k=3, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
```

```
    Predicting sample 900/909
    Fold F1 = 0.5705705705705706
-> Avg F1 for k 3 = 0.5678

Testing k = 5
  Fold 1/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.6149253731343284
  Fold 2/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5833333333333334
  Fold 3/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5227272727272727
  Fold 4/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
```

```
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4984984984984985
  Fold 5/5
 Fit KNN: k=5, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5558912386706949
-> Avg F1 for k 5 = 0.5551

Testing k = 7
  Fold 1/5
 Fit KNN: k=7, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5903614457831325
  Fold 2/5
 Fit KNN: k=7, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
```

```
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.55625
  Fold 3/5
 Fit KNN: k=7, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5325443786982249
  Fold 4/5
 Fit KNN: k=7, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46153846153846156
  Fold 5/5
 Fit KNN: k=7, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5370370370370371
-> Avg F1 for k 7 = 0.5355

Testing k = 9
  Fold 1/5
 Fit KNN: k=9, distance=euclidean, weights=uniform
    Predicting sample 0/910
```

```
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5871559633027523
 Fold 2/5
Fit KNN: k=9, distance=euclidean, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5256410256410257
 Fold 3/5
Fit KNN: k=9, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.5094339622641509
 Fold 4/5
Fit KNN: k=9, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
```

```
    Fold F1 = 0.48484848484848486
  Fold 5/5
 Fit KNN: k=9, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5253164556962026
-> Avg F1 for k 9 = 0.5265

Testing k = 11
  Fold 1/5
 Fit KNN: k=11, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5584415584415584
  Fold 2/5
 Fit KNN: k=11, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4934210526315789
  Fold 3/5
 Fit KNN: k=11, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
```

```
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5
  Fold 4/5
 Fit KNN: k=11, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4735202492211838
  Fold 5/5
 Fit KNN: k=11, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5324675324675324
-> Avg F1 for k 11 = 0.5116

Testing k = 13
  Fold 1/5
 Fit KNN: k=13, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
```

```
   Predicting sample 900/910
   Fold F1 = 0.5612903225806452
 Fold 2/5
Fit KNN: k=13, distance=euclidean, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5050505050505051
 Fold 3/5
Fit KNN: k=13, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.47249190938511326
 Fold 4/5
Fit KNN: k=13, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.48427672955974843
 Fold 5/5
Fit KNN: k=13, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
```

```
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5116279069767442
-> Avg F1 for k 13 = 0.5069

Testing k = 15
  Fold 1/5
 Fit KNN: k=15, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5346534653465347
  Fold 2/5
 Fit KNN: k=15, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4857142857142857
  Fold 3/5
 Fit KNN: k=15, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46905537459283386
```

```
  Fold 4/5
 Fit KNN: k=15, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.47770700636942676
  Fold 5/5
 Fit KNN: k=15, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5034013605442177
-> Avg F1 for k 15 = 0.4941

Testing k = 17
  Fold 1/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5298013245033113
  Fold 2/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
```

```
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5035460992907801
  Fold 3/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4406779661016949
  Fold 4/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46601941747572817
  Fold 5/5
 Fit KNN: k=17, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.47586206896551725
-> Avg F1 for k 17 = 0.4832
```

```
Testing k = 19
  Fold 1/5
 Fit KNN: k=19, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5424836601307189
  Fold 2/5
 Fit KNN: k=19, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5071428571428571
  Fold 3/5
 Fit KNN: k=19, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4315068493150685
  Fold 4/5
 Fit KNN: k=19, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
```

```
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46153846153846156
  Fold 5/5
 Fit KNN: k=19, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4329896907216495
-> Avg F1 for k 19 = 0.4751

Testing k = 21
  Fold 1/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.531986531986532
  Fold 2/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.49264705882352944
  Fold 3/5
```

```
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4315068493150685
  Fold 4/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4666666666666667
  Fold 5/5
 Fit KNN: k=21, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4359861591695502
-> Avg F1 for k 21 = 0.4718

Testing k = 23
  Fold 1/5
 Fit KNN: k=23, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
```

```
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.535593220338983
 Fold 2/5
Fit KNN: k=23, distance=euclidean, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.509090909090909
 Fold 3/5
Fit KNN: k=23, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4178082191780822
 Fold 4/5
Fit KNN: k=23, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4752475247524752
 Fold 5/5
Fit KNN: k=23, distance=euclidean, weights=uniform
   Predicting sample 0/909
```

```
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4383561643835616
-> Avg F1 for k 23 = 0.4752

Testing k = 25
  Fold 1/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5351170568561873
  Fold 2/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5163636363636364
  Fold 3/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
```

```
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4098939929328622
  Fold 4/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46308724832214765
  Fold 5/5
 Fit KNN: k=25, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.43986254295532645
-> Avg F1 for k 25 = 0.4729

Testing k = 27
  Fold 1/5
 Fit KNN: k=27, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5220338983050847
  Fold 2/5
 Fit KNN: k=27, distance=euclidean, weights=uniform
```

```
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5018450184501845
 Fold 3/5
Fit KNN: k=27, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.39568345323741005
 Fold 4/5
Fit KNN: k=27, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4794520547945205
 Fold 5/5
Fit KNN: k=27, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
```

```
    Predicting sample 900/909
    Fold F1 = 0.43205574912891986
-> Avg F1 for k 27 = 0.4662

Testing k = 29
  Fold 1/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5068493150684932
  Fold 2/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5092250922509225
  Fold 3/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4098939929328622
  Fold 4/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
```

```
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4726027397260274
  Fold 5/5
 Fit KNN: k=29, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.43508771929824563
-> Avg F1 for k 29 = 0.4667

Testing k = 31
  Fold 1/5
 Fit KNN: k=31, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4948453608247423
  Fold 2/5
 Fit KNN: k=31, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
```

```
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.48872180451127817
  Fold 3/5
 Fit KNN: k=31, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4157706093189964
  Fold 4/5
 Fit KNN: k=31, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4444444444444444
  Fold 5/5
 Fit KNN: k=31, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4397163120567376
-> Avg F1 for k 31 = 0.4567

Testing k = 33
  Fold 1/5
 Fit KNN: k=33, distance=euclidean, weights=uniform
    Predicting sample 0/910
```

```
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.503448275862069
 Fold 2/5
Fit KNN: k=33, distance=euclidean, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.4701492537313433
 Fold 3/5
Fit KNN: k=33, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.40569395017793597
 Fold 4/5
Fit KNN: k=33, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
```

```
    Fold F1 = 0.4357142857142857
  Fold 5/5
 Fit KNN: k=33, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4357142857142857
-> Avg F1 for k 33 = 0.4501

Testing k = 35
  Fold 1/5
 Fit KNN: k=35, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5017667844522968
  Fold 2/5
 Fit KNN: k=35, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4626865671641791
  Fold 3/5
 Fit KNN: k=35, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
```

```
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4128113879003559
  Fold 4/5
 Fit KNN: k=35, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4555160142348754
  Fold 5/5
 Fit KNN: k=35, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4244604316546763
-> Avg F1 for k 35 = 0.4514

Testing k = 37
  Fold 1/5
 Fit KNN: k=37, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
```

```
   Predicting sample 900/910
   Fold F1 = 0.48398576512455516
 Fold 2/5
Fit KNN: k=37, distance=euclidean, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.4701492537313433
 Fold 3/5
Fit KNN: k=37, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.42142857142857143
 Fold 4/5
Fit KNN: k=37, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4397163120567376
 Fold 5/5
Fit KNN: k=37, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
```

```
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.43416370106761565
-> Avg F1 for k 37 = 0.4499

Testing k = 39
  Fold 1/5
 Fit KNN: k=39, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4785714285714286
  Fold 2/5
 Fit KNN: k=39, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.47191011235955055
  Fold 3/5
 Fit KNN: k=39, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4157706093189964
```

```
  Fold 4/5
 Fit KNN: k=39, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4357142857142857
  Fold 5/5
 Fit KNN: k=39, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.43884892086330934
-> Avg F1 for k 39 = 0.4482

Testing k = 41
  Fold 1/5
 Fit KNN: k=41, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.475177304964539
  Fold 2/5
 Fit KNN: k=41, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
```

```
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.45864661654135336
 Fold 3/5
Fit KNN: k=41, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4249084249084249
 Fold 4/5
Fit KNN: k=41, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.41454545454545455
 Fold 5/5
Fit KNN: k=41, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4059040590405904
-> Avg F1 for k 41 = 0.4358
```

```
Testing k = 43
  Fold 1/5
 Fit KNN: k=43, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4581818181818182
  Fold 2/5
 Fit KNN: k=43, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.44274809160305345
  Fold 3/5
 Fit KNN: k=43, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4059040590405904
  Fold 4/5
 Fit KNN: k=43, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
```

```
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4175824175824176
  Fold 5/5
 Fit KNN: k=43, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.41454545454545455
-> Avg F1 for k 43 = 0.4278

Testing k = 45
  Fold 1/5
 Fit KNN: k=45, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4509090909090909
  Fold 2/5
 Fit KNN: k=45, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.46037735849056605
  Fold 3/5
```

```
 Fit KNN: k=45, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.40441176470588236
  Fold 4/5
 Fit KNN: k=45, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4117647058823529
  Fold 5/5
 Fit KNN: k=45, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.41304347826086957
-> Avg F1 for k 45 = 0.4281

Testing k = 47
  Fold 1/5
 Fit KNN: k=47, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
```

```
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.4620938628158845
 Fold 2/5
Fit KNN: k=47, distance=euclidean, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.45038167938931295
 Fold 3/5
Fit KNN: k=47, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.42066420664206644
 Fold 4/5
Fit KNN: k=47, distance=euclidean, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.3985239852398524
 Fold 5/5
Fit KNN: k=47, distance=euclidean, weights=uniform
   Predicting sample 0/909
```

```
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.39114391143911437
-> Avg F1 for k 47 = 0.4246

Testing k = 49
  Fold 1/5
 Fit KNN: k=49, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4312267657992565
  Fold 2/5
 Fit KNN: k=49, distance=euclidean, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4186046511627907
  Fold 3/5
 Fit KNN: k=49, distance=euclidean, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
```

```
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.4148148148148148
    Fold 4/5
   Fit KNN: k=49, distance=euclidean, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.3925925925925926
    Fold 5/5
   Fit KNN: k=49, distance=euclidean, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.3880597014925373
  -> Avg F1 for k 49 = 0.4091

Grid search complete for distance: euclidean
 Best k selected for euclidean = 1
   Fit KNN: k=1, distance=euclidean, weights=uniform
      Predicting sample 0/1950
      Predicting sample 100/1950
      Predicting sample 200/1950
      Predicting sample 300/1950
      Predicting sample 400/1950
      Predicting sample 500/1950
      Predicting sample 600/1950
      Predicting sample 700/1950
      Predicting sample 800/1950
      Predicting sample 900/1950
      Predicting sample 1000/1950
      Predicting sample 1100/1950
      Predicting sample 1200/1950
```

```
      Predicting sample 1300/1950
      Predicting sample 1400/1950
      Predicting sample 1500/1950
      Predicting sample 1600/1950
      Predicting sample 1700/1950
      Predicting sample 1800/1950
      Predicting sample 1900/1950
 Test results for KNN (euclidean) - k=1:
   Accuracy: 0.8600
   Precision: 0.6447
   Recall: 0.6397
   F1-score: 0.6422
   ROC-AUC: 0.7767674007474661

KNN - Distance metric: manhattan
Grid search for distance: manhattan
  Testing k = 1
    Fold 1/5
   Fit KNN: k=1, distance=manhattan, weights=uniform
      Predicting sample 0/910
      Predicting sample 100/910
      Predicting sample 200/910
      Predicting sample 300/910
      Predicting sample 400/910
      Predicting sample 500/910
      Predicting sample 600/910
      Predicting sample 700/910
      Predicting sample 800/910
      Predicting sample 900/910
      Fold F1 = 0.6437994722955145
    Fold 2/5
   Fit KNN: k=1, distance=manhattan, weights=uniform
      Predicting sample 0/910
      Predicting sample 100/910
      Predicting sample 200/910
      Predicting sample 300/910
      Predicting sample 400/910
      Predicting sample 500/910
      Predicting sample 600/910
      Predicting sample 700/910
      Predicting sample 800/910
      Predicting sample 900/910
      Fold F1 = 0.636604774535809
    Fold 3/5
   Fit KNN: k=1, distance=manhattan, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
```

```
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.6016260162601627
  Fold 4/5
 Fit KNN: k=1, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5519125683060109
  Fold 5/5
 Fit KNN: k=1, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.6069364161849711
-> Avg F1 for k 1 = 0.6082

Testing k = 3
  Fold 1/5
 Fit KNN: k=3, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
```

```
   Predicting sample 900/910
   Fold F1 = 0.6552706552706553
 Fold 2/5
Fit KNN: k=3, distance=manhattan, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5382436260623229
 Fold 3/5
Fit KNN: k=3, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.5408450704225352
 Fold 4/5
Fit KNN: k=3, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.5087719298245614
 Fold 5/5
Fit KNN: k=3, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
```

```
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5377643504531722
-> Avg F1 for k 3 = 0.5562

Testing k = 5
  Fold 1/5
 Fit KNN: k=5, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.6184971098265896
  Fold 2/5
 Fit KNN: k=5, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5427728613569321
  Fold 3/5
 Fit KNN: k=5, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5449275362318841
```

```
  Fold 4/5
 Fit KNN: k=5, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5
  Fold 5/5
 Fit KNN: k=5, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5304878048780488
-> Avg F1 for k 5 = 0.5473

Testing k = 7
  Fold 1/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5802469135802469
  Fold 2/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
```

```
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5572755417956656
  Fold 3/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5167173252279635
  Fold 4/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4723926380368098
  Fold 5/5
 Fit KNN: k=7, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5653495440729484
-> Avg F1 for k 7 = 0.5384
```

```
Testing k = 9
  Fold 1/5
 Fit KNN: k=9, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5653495440729484
  Fold 2/5
 Fit KNN: k=9, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.525974025974026
  Fold 3/5
 Fit KNN: k=9, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.48297213622291024
  Fold 4/5
 Fit KNN: k=9, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
```

```
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4620253164556962
  Fold 5/5
 Fit KNN: k=9, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5523809523809524
-> Avg F1 for k 9 = 0.5177

Testing k = 11
  Fold 1/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5768025078369906
  Fold 2/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4983388704318937
  Fold 3/5
```

```
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4728434504792332
  Fold 4/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4713375796178344
  Fold 5/5
 Fit KNN: k=11, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.536741214057508
-> Avg F1 for k 11 = 0.5112

Testing k = 13
  Fold 1/5
 Fit KNN: k=13, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
```

```
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5612903225806452
 Fold 2/5
Fit KNN: k=13, distance=manhattan, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5288135593220339
 Fold 3/5
Fit KNN: k=13, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4605263157894737
 Fold 4/5
Fit KNN: k=13, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4276315789473684
 Fold 5/5
Fit KNN: k=13, distance=manhattan, weights=uniform
   Predicting sample 0/909
```

```
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5131578947368421
-> Avg F1 for k 13 = 0.4983

Testing k = 15
  Fold 1/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5631067961165048
  Fold 2/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5238095238095238
  Fold 3/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
```

```
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4816053511705686
  Fold 4/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.45901639344262296
  Fold 5/5
 Fit KNN: k=15, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5050505050505051
-> Avg F1 for k 15 = 0.5065

Testing k = 17
  Fold 1/5
 Fit KNN: k=17, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5478547854785478
  Fold 2/5
 Fit KNN: k=17, distance=manhattan, weights=uniform
```

```
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5035460992907801
 Fold 3/5
Fit KNN: k=17, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4778156996587031
 Fold 4/5
Fit KNN: k=17, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.45695364238410596
 Fold 5/5
Fit KNN: k=17, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
```

```
    Predicting sample 900/909
    Fold F1 = 0.4897959183673469
-> Avg F1 for k 17 = 0.4952

Testing k = 19
  Fold 1/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5412541254125413
  Fold 2/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4928571428571429
  Fold 3/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4482758620689655
  Fold 4/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
```

```
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46710526315789475
  Fold 5/5
 Fit KNN: k=19, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4882943143812709
-> Avg F1 for k 19 = 0.4876

Testing k = 21
  Fold 1/5
 Fit KNN: k=21, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5418060200668896
  Fold 2/5
 Fit KNN: k=21, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
```

```
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.48398576512455516
  Fold 3/5
 Fit KNN: k=21, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.45517241379310347
  Fold 4/5
 Fit KNN: k=21, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46511627906976744
  Fold 5/5
 Fit KNN: k=21, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.49324324324324326
-> Avg F1 for k 21 = 0.4879

Testing k = 23
  Fold 1/5
 Fit KNN: k=23, distance=manhattan, weights=uniform
    Predicting sample 0/910
```

```
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5405405405405406
 Fold 2/5
Fit KNN: k=23, distance=manhattan, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.4727272727272727
 Fold 3/5
Fit KNN: k=23, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4375
 Fold 4/5
Fit KNN: k=23, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
```

```
    Fold F1 = 0.4563758389261745
  Fold 5/5
 Fit KNN: k=23, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4717607973421927
-> Avg F1 for k 23 = 0.4758

Testing k = 25
  Fold 1/5
 Fit KNN: k=25, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5387205387205387
  Fold 2/5
 Fit KNN: k=25, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.46886446886446886
  Fold 3/5
 Fit KNN: k=25, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
```

```
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3986013986013986
  Fold 4/5
 Fit KNN: k=25, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.45544554455445546
  Fold 5/5
 Fit KNN: k=25, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.45733788395904434
-> Avg F1 for k 25 = 0.4638

Testing k = 27
  Fold 1/5
 Fit KNN: k=27, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
```

```
   Predicting sample 900/910
   Fold F1 = 0.531986531986532
 Fold 2/5
Fit KNN: k=27, distance=manhattan, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.46096654275092935
 Fold 3/5
Fit KNN: k=27, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.3898916967509025
 Fold 4/5
Fit KNN: k=27, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.46621621621621623
 Fold 5/5
Fit KNN: k=27, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
```

```
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4610169491525424
-> Avg F1 for k 27 = 0.4620

Testing k = 29
  Fold 1/5
 Fit KNN: k=29, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.531986531986532
  Fold 2/5
 Fit KNN: k=29, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.46494464944649444
  Fold 3/5
 Fit KNN: k=29, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4
```

```
  Fold 4/5
 Fit KNN: k=29, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4383561643835616
  Fold 5/5
 Fit KNN: k=29, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4520547945205479
-> Avg F1 for k 29 = 0.4575

Testing k = 31
  Fold 1/5
 Fit KNN: k=31, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4982698961937716
  Fold 2/5
 Fit KNN: k=31, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
```

```
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.4693140794223827
 Fold 3/5
Fit KNN: k=31, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.3898916967509025
 Fold 4/5
Fit KNN: k=31, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.46048109965635736
 Fold 5/5
Fit KNN: k=31, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4444444444444444
-> Avg F1 for k 31 = 0.4525
```

```
Testing k = 33
  Fold 1/5
 Fit KNN: k=33, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5034965034965035
  Fold 2/5
 Fit KNN: k=33, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4542124542124542
  Fold 3/5
 Fit KNN: k=33, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3927272727272727
  Fold 4/5
 Fit KNN: k=33, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
```

```
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4405594405594406
  Fold 5/5
 Fit KNN: k=33, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.45614035087719296
-> Avg F1 for k 33 = 0.4494

Testing k = 35
  Fold 1/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5087108013937283
  Fold 2/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.45985401459854014
  Fold 3/5
```

```
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.41025641025641024
  Fold 4/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4157706093189964
  Fold 5/5
 Fit KNN: k=35, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4397163120567376
-> Avg F1 for k 35 = 0.4469

Testing k = 37
  Fold 1/5
 Fit KNN: k=37, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
```

```
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.48226950354609927
 Fold 2/5
Fit KNN: k=37, distance=manhattan, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.44696969696969696
 Fold 3/5
Fit KNN: k=37, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.39097744360902253
 Fold 4/5
Fit KNN: k=37, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4259927797833935
 Fold 5/5
Fit KNN: k=37, distance=manhattan, weights=uniform
   Predicting sample 0/909
```

```
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4647887323943662
-> Avg F1 for k 37 = 0.4422

Testing k = 39
  Fold 1/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4874551971326165
  Fold 2/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4444444444444444
  Fold 3/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
```

```
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3970037453183521
  Fold 4/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4316546762589928
  Fold 5/5
 Fit KNN: k=39, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.45936395759717313
-> Avg F1 for k 39 = 0.4440

Testing k = 41
  Fold 1/5
 Fit KNN: k=41, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4734982332155477
  Fold 2/5
 Fit KNN: k=41, distance=manhattan, weights=uniform
```

```
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.43243243243243246
 Fold 3/5
Fit KNN: k=41, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.3925925925925926
 Fold 4/5
Fit KNN: k=41, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.40875912408759124
 Fold 5/5
Fit KNN: k=41, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
```

```
    Predicting sample 900/909
    Fold F1 = 0.4626334519572954
-> Avg F1 for k 41 = 0.4340

Testing k = 43
  Fold 1/5
 Fit KNN: k=43, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.48226950354609927
  Fold 2/5
 Fit KNN: k=43, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.42023346303501946
  Fold 3/5
 Fit KNN: k=43, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3805970149253731
  Fold 4/5
 Fit KNN: k=43, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
```

```
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.39705882352941174
  Fold 5/5
 Fit KNN: k=43, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.475177304964539
-> Avg F1 for k 43 = 0.4311

Testing k = 45
  Fold 1/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.46545454545454545
  Fold 2/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
```

```
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.43410852713178294
  Fold 3/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.39552238805970147
  Fold 4/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.373134328358209
  Fold 5/5
 Fit KNN: k=45, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46099290780141844
-> Avg F1 for k 45 = 0.4258

Testing k = 47
  Fold 1/5
 Fit KNN: k=47, distance=manhattan, weights=uniform
    Predicting sample 0/910
```

```
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.45588235294117646
 Fold 2/5
Fit KNN: k=47, distance=manhattan, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.4268774703557312
 Fold 3/5
Fit KNN: k=47, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.40601503759398494
 Fold 4/5
Fit KNN: k=47, distance=manhattan, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
```

```
    Fold F1 = 0.38661710037174724
  Fold 5/5
 Fit KNN: k=47, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.44765342960288806
-> Avg F1 for k 47 = 0.4246

Testing k = 49
  Fold 1/5
 Fit KNN: k=49, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.44609665427509293
  Fold 2/5
 Fit KNN: k=49, distance=manhattan, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.40476190476190477
  Fold 3/5
 Fit KNN: k=49, distance=manhattan, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
```

```
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.3939393939393939
    Fold 4/5
   Fit KNN: k=49, distance=manhattan, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.36015325670498083
    Fold 5/5
   Fit KNN: k=49, distance=manhattan, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.44285714285714284
  -> Avg F1 for k 49 = 0.4096

Grid search complete for distance: manhattan
 Best k selected for manhattan = 1
   Fit KNN: k=1, distance=manhattan, weights=uniform
      Predicting sample 0/1950
      Predicting sample 100/1950
      Predicting sample 200/1950
      Predicting sample 300/1950
      Predicting sample 400/1950
      Predicting sample 500/1950
      Predicting sample 600/1950
      Predicting sample 700/1950
      Predicting sample 800/1950
```

```
      Predicting sample 900/1950
      Predicting sample 1000/1950
      Predicting sample 1100/1950
      Predicting sample 1200/1950
      Predicting sample 1300/1950
      Predicting sample 1400/1950
      Predicting sample 1500/1950
      Predicting sample 1600/1950
      Predicting sample 1700/1950
      Predicting sample 1800/1950
      Predicting sample 1900/1950
 Test results for KNN (manhattan) - k=1:
   Accuracy: 0.8595
   Precision: 0.6416
   Recall: 0.6449
   F1-score: 0.6432
   ROC-AUC: 0.7784211236651499

KNN - Distance metric: minkowski
Grid search for distance: minkowski
  Testing k = 1
    Fold 1/5
   Fit KNN: k=1, distance=minkowski, weights=uniform
      Predicting sample 0/910
      Predicting sample 100/910
      Predicting sample 200/910
      Predicting sample 300/910
      Predicting sample 400/910
      Predicting sample 500/910
      Predicting sample 600/910
      Predicting sample 700/910
      Predicting sample 800/910
      Predicting sample 900/910
      Fold F1 = 0.633245382585752
    Fold 2/5
   Fit KNN: k=1, distance=minkowski, weights=uniform
      Predicting sample 0/910
      Predicting sample 100/910
      Predicting sample 200/910
      Predicting sample 300/910
      Predicting sample 400/910
      Predicting sample 500/910
      Predicting sample 600/910
      Predicting sample 700/910
      Predicting sample 800/910
      Predicting sample 900/910
      Fold F1 = 0.6055555555555555
    Fold 3/5
```

```
 Fit KNN: k=1, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5831062670299727
  Fold 4/5
 Fit KNN: k=1, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5571030640668524
  Fold 5/5
 Fit KNN: k=1, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.6379310344827587
-> Avg F1 for k 1 = 0.6034

Testing k = 3
  Fold 1/5
 Fit KNN: k=3, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
```

```
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.6260869565217392
 Fold 2/5
Fit KNN: k=3, distance=minkowski, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5595238095238095
 Fold 3/5
Fit KNN: k=3, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.5625
 Fold 4/5
Fit KNN: k=3, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.5015105740181269
 Fold 5/5
Fit KNN: k=3, distance=minkowski, weights=uniform
   Predicting sample 0/909
```

```
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5688622754491018
-> Avg F1 for k 3 = 0.5637

Testing k = 5
  Fold 1/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5964912280701754
  Fold 2/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5482866043613707
  Fold 3/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
```

```
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5527065527065527
  Fold 4/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5146198830409356
  Fold 5/5
 Fit KNN: k=5, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5558912386706949
-> Avg F1 for k 5 = 0.5536

Testing k = 7
  Fold 1/5
 Fit KNN: k=7, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5792682926829268
  Fold 2/5
 Fit KNN: k=7, distance=minkowski, weights=uniform
```

```
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5359477124183006
 Fold 3/5
Fit KNN: k=7, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.5269461077844312
 Fold 4/5
Fit KNN: k=7, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.48024316109422494
 Fold 5/5
Fit KNN: k=7, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
```

```
    Predicting sample 900/909
    Fold F1 = 0.5425867507886435
-> Avg F1 for k 7 = 0.5330

Testing k = 9
  Fold 1/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5477707006369427
  Fold 2/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5263157894736842
  Fold 3/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4890282131661442
  Fold 4/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
```

```
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46540880503144655
  Fold 5/5
 Fit KNN: k=9, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5295950155763239
-> Avg F1 for k 9 = 0.5116

Testing k = 11
  Fold 1/5
 Fit KNN: k=11, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5501618122977346
  Fold 2/5
 Fit KNN: k=11, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
```

```
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4931506849315068
  Fold 3/5
 Fit KNN: k=11, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.44805194805194803
  Fold 4/5
 Fit KNN: k=11, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46794871794871795
  Fold 5/5
 Fit KNN: k=11, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.5015873015873016
-> Avg F1 for k 11 = 0.4922

Testing k = 13
  Fold 1/5
 Fit KNN: k=13, distance=minkowski, weights=uniform
    Predicting sample 0/910
```

```
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5537459283387622
 Fold 2/5
Fit KNN: k=13, distance=minkowski, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5119453924914675
 Fold 3/5
Fit KNN: k=13, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4888888888888889
 Fold 4/5
Fit KNN: k=13, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
```

```
    Fold F1 = 0.4666666666666667
  Fold 5/5
 Fit KNN: k=13, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.47058823529411764
-> Avg F1 for k 13 = 0.4984

Testing k = 15
  Fold 1/5
 Fit KNN: k=15, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5620915032679739
  Fold 2/5
 Fit KNN: k=15, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4982456140350877
  Fold 3/5
 Fit KNN: k=15, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
```

```
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4645161290322581
  Fold 4/5
 Fit KNN: k=15, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46
  Fold 5/5
 Fit KNN: k=15, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4752475247524752
-> Avg F1 for k 15 = 0.4920

Testing k = 17
  Fold 1/5
 Fit KNN: k=17, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
```

```
   Predicting sample 900/910
   Fold F1 = 0.5333333333333333
 Fold 2/5
Fit KNN: k=17, distance=minkowski, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.49097472924187724
 Fold 3/5
Fit KNN: k=17, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4342105263157895
 Fold 4/5
Fit KNN: k=17, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4533333333333333
 Fold 5/5
Fit KNN: k=17, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
```

```
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4536082474226804
-> Avg F1 for k 17 = 0.4731

Testing k = 19
  Fold 1/5
 Fit KNN: k=19, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5284280936454849
  Fold 2/5
 Fit KNN: k=19, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4870848708487085
  Fold 3/5
 Fit KNN: k=19, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.45901639344262296
```

```
  Fold 4/5
 Fit KNN: k=19, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4666666666666667
  Fold 5/5
 Fit KNN: k=19, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4513888888888889
-> Avg F1 for k 19 = 0.4785

Testing k = 21
  Fold 1/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4983164983164983
  Fold 2/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
```

```
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5
  Fold 3/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4563758389261745
  Fold 4/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4489795918367347
  Fold 5/5
 Fit KNN: k=21, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4375
-> Avg F1 for k 21 = 0.4682
```

```
Testing k = 23
  Fold 1/5
 Fit KNN: k=23, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5187713310580204
  Fold 2/5
 Fit KNN: k=23, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5106382978723404
  Fold 3/5
 Fit KNN: k=23, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4489795918367347
  Fold 4/5
 Fit KNN: k=23, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
```

```
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46511627906976744
  Fold 5/5
 Fit KNN: k=23, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4181184668989547
-> Avg F1 for k 23 = 0.4723

Testing k = 25
  Fold 1/5
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5068493150684932
  Fold 2/5
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5142857142857142
  Fold 3/5
```

```
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4329896907216495
  Fold 4/5
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.46153846153846156
  Fold 5/5
 Fit KNN: k=25, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4206896551724138
-> Avg F1 for k 25 = 0.4673

Testing k = 27
  Fold 1/5
 Fit KNN: k=27, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
```

```
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.5121107266435986
 Fold 2/5
Fit KNN: k=27, distance=minkowski, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.4855072463768116
 Fold 3/5
Fit KNN: k=27, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.42105263157894735
 Fold 4/5
Fit KNN: k=27, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.46779661016949153
 Fold 5/5
Fit KNN: k=27, distance=minkowski, weights=uniform
   Predicting sample 0/909
```

```
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4070175438596491
-> Avg F1 for k 27 = 0.4587

Testing k = 29
  Fold 1/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.5069444444444444
  Fold 2/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4740740740740741
  Fold 3/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
```

```
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3942652329749104
  Fold 4/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.45517241379310347
  Fold 5/5
 Fit KNN: k=29, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4295774647887324
-> Avg F1 for k 29 = 0.4520

Testing k = 31
  Fold 1/5
 Fit KNN: k=31, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4982456140350877
  Fold 2/5
 Fit KNN: k=31, distance=minkowski, weights=uniform
```

```
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.4908424908424908
 Fold 3/5
Fit KNN: k=31, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.425531914893617
 Fold 4/5
Fit KNN: k=31, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4583333333333333
 Fold 5/5
Fit KNN: k=31, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
```

```
    Predicting sample 900/909
    Fold F1 = 0.4128113879003559
-> Avg F1 for k 31 = 0.4572

Testing k = 33
  Fold 1/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4859154929577465
  Fold 2/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4626865671641791
  Fold 3/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4142857142857143
  Fold 4/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
```

```
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.43661971830985913
  Fold 5/5
 Fit KNN: k=33, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.40714285714285714
-> Avg F1 for k 33 = 0.4413

Testing k = 35
  Fold 1/5
 Fit KNN: k=35, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.49469964664310956
  Fold 2/5
 Fit KNN: k=35, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
```

```
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.46616541353383456
  Fold 3/5
 Fit KNN: k=35, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.38267148014440433
  Fold 4/5
 Fit KNN: k=35, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.47017543859649125
  Fold 5/5
 Fit KNN: k=35, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.391304347826087
-> Avg F1 for k 35 = 0.4410

Testing k = 37
  Fold 1/5
 Fit KNN: k=37, distance=minkowski, weights=uniform
    Predicting sample 0/910
```

```
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.48398576512455516
 Fold 2/5
Fit KNN: k=37, distance=minkowski, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.46441947565543074
 Fold 3/5
Fit KNN: k=37, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.39114391143911437
 Fold 4/5
Fit KNN: k=37, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
```

```
    Fold F1 = 0.4381625441696113
  Fold 5/5
 Fit KNN: k=37, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3882783882783883
-> Avg F1 for k 37 = 0.4332

Testing k = 39
  Fold 1/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4748201438848921
  Fold 2/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4794007490636704
  Fold 3/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
```

```
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3985239852398524
  Fold 4/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.43010752688172044
  Fold 5/5
 Fit KNN: k=39, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4142857142857143
-> Avg F1 for k 39 = 0.4394

Testing k = 41
  Fold 1/5
 Fit KNN: k=41, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
```

```
   Predicting sample 900/910
   Fold F1 = 0.47101449275362317
 Fold 2/5
Fit KNN: k=41, distance=minkowski, weights=uniform
   Predicting sample 0/910
   Predicting sample 100/910
   Predicting sample 200/910
   Predicting sample 300/910
   Predicting sample 400/910
   Predicting sample 500/910
   Predicting sample 600/910
   Predicting sample 700/910
   Predicting sample 800/910
   Predicting sample 900/910
   Fold F1 = 0.47191011235955055
 Fold 3/5
Fit KNN: k=41, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4059040590405904
 Fold 4/5
Fit KNN: k=41, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
   Predicting sample 500/909
   Predicting sample 600/909
   Predicting sample 700/909
   Predicting sample 800/909
   Predicting sample 900/909
   Fold F1 = 0.4229390681003584
 Fold 5/5
Fit KNN: k=41, distance=minkowski, weights=uniform
   Predicting sample 0/909
   Predicting sample 100/909
   Predicting sample 200/909
   Predicting sample 300/909
   Predicting sample 400/909
```

```
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3927272727272727
-> Avg F1 for k 41 = 0.4329

Testing k = 43
  Fold 1/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.45185185185185184
  Fold 2/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.44866920152091255
  Fold 3/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3897058823529412
```

```
  Fold 4/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4199288256227758
  Fold 5/5
 Fit KNN: k=43, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3837638376383764
-> Avg F1 for k 43 = 0.4188

Testing k = 45
  Fold 1/5
 Fit KNN: k=45, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.45985401459854014
  Fold 2/5
 Fit KNN: k=45, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
```

```
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4555984555984556
  Fold 3/5
 Fit KNN: k=45, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.38661710037174724
  Fold 4/5
 Fit KNN: k=45, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.41155234657039713
  Fold 5/5
 Fit KNN: k=45, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3897058823529412
-> Avg F1 for k 45 = 0.4207
```

```
Testing k = 47
  Fold 1/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4727272727272727
  Fold 2/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.4235294117647059
  Fold 3/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.36363636363636365
  Fold 4/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
```

```
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.4175824175824176
  Fold 5/5
 Fit KNN: k=47, distance=minkowski, weights=uniform
    Predicting sample 0/909
    Predicting sample 100/909
    Predicting sample 200/909
    Predicting sample 300/909
    Predicting sample 400/909
    Predicting sample 500/909
    Predicting sample 600/909
    Predicting sample 700/909
    Predicting sample 800/909
    Predicting sample 900/909
    Fold F1 = 0.3837638376383764
-> Avg F1 for k 47 = 0.4122

Testing k = 49
  Fold 1/5
 Fit KNN: k=49, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.45925925925925926
  Fold 2/5
 Fit KNN: k=49, distance=minkowski, weights=uniform
    Predicting sample 0/910
    Predicting sample 100/910
    Predicting sample 200/910
    Predicting sample 300/910
    Predicting sample 400/910
    Predicting sample 500/910
    Predicting sample 600/910
    Predicting sample 700/910
    Predicting sample 800/910
    Predicting sample 900/910
    Fold F1 = 0.44357976653696496
  Fold 3/5
```

```
   Fit KNN: k=49, distance=minkowski, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.3560606060606061
    Fold 4/5
   Fit KNN: k=49, distance=minkowski, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.4
    Fold 5/5
   Fit KNN: k=49, distance=minkowski, weights=uniform
      Predicting sample 0/909
      Predicting sample 100/909
      Predicting sample 200/909
      Predicting sample 300/909
      Predicting sample 400/909
      Predicting sample 500/909
      Predicting sample 600/909
      Predicting sample 700/909
      Predicting sample 800/909
      Predicting sample 900/909
      Fold F1 = 0.36764705882352944
  -> Avg F1 for k 49 = 0.4053

Grid search complete for distance: minkowski
 Best k selected for minkowski = 1
   Fit KNN: k=1, distance=minkowski, weights=uniform
      Predicting sample 0/1950
      Predicting sample 100/1950
      Predicting sample 200/1950
      Predicting sample 300/1950
      Predicting sample 400/1950
```

```
      Predicting sample 500/1950
      Predicting sample 600/1950
      Predicting sample 700/1950
      Predicting sample 800/1950
      Predicting sample 900/1950
      Predicting sample 1000/1950
      Predicting sample 1100/1950
      Predicting sample 1200/1950
      Predicting sample 1300/1950
      Predicting sample 1400/1950
      Predicting sample 1500/1950
      Predicting sample 1600/1950
      Predicting sample 1700/1950
      Predicting sample 1800/1950
      Predicting sample 1900/1950
 Test results for KNN (minkowski) - k=1:
   Accuracy: 0.8533
   Precision: 0.6260
   Recall: 0.6292
   F1-score: 0.6276
   ROC-AUC: 0.7686737392133112

Training and evaluating baseline library classifiers…
 Training 1R (decision stump)…
 Training Decision Tree…
 Training Random Forest…

/root/miniconda3/envs/py3.10/lib/python3.10/site-packages/sklearn/base.py:1365:
DataConversionWarning: A column-vector y was passed when a 1d array was
expected. Please change the shape of y to (n_samples,), for example using
ravel().
  return fit_method(estimator, *args, **kwargs)

 Training SVM (probability=True)…

/root/miniconda3/envs/py3.10/lib/python3.10/site-
packages/sklearn/utils/validation.py:1406: DataConversionWarning: A column-
vector y was passed when a 1d array was expected. Please change the shape of y
to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)


Best model on test set for this split is: RandomForest with F1 =
0.6481481481481481
Confusion matrix (array):
[[1512   55]
 [ 173  210]]
Saved confusion matrix to: cm_best_70_grid_allmodels.png

Total runtime: 107.69 seconds
```

```
Saving results to stage2_results_grid_allmodels.csv
Saved stage2_results_grid_allmodels.csv
Done.
```

[ ]: