**PROGRAM 5 :** Develop a program to implement k-Nearest Neighbour algorithm to classify the randomly generated 100 values of x in the range of [0,1]. Perform the following based on dataset generated.  
**a)**Label the first 50 points {x1,……,x50} as follows: if (xi ≤ 0.5), then xi ∊ Class1, else xi ∊ Class1  
**b)** Classify the remaining points, x51,……,x100 using KNN. Perform this for k=1,2,3,4,5,20,30

import numpy as np

import matplotlib.pyplot as plt

from collections import Counter

data = np.random.rand(100)

labels = ["Class1" if x <= 0.5 else "Class2" for x in data[:50]]

def euclidean\_distance(x1, x2):

    return abs(x1 - x2)

def knn\_classifier(train\_data, train\_labels, test\_point, k):

    distances = [(euclidean\_distance(test\_point, train\_data[i]), train\_labels[i]) for i in range(len(train\_data))]

    distances.sort(key=lambda x: x[0])

    k\_nearest\_neighbors = distances[:k]

    k\_nearest\_labels = [label for \_, label in k\_nearest\_neighbors]

    return Counter(k\_nearest\_labels).most\_common(1)[0][0]

train\_data = data[:50]

train\_labels = labels

test\_data = data[50:]

k\_values = [1, 2, 3, 4, 5, 20, 30]

print("--- k-Nearest Neighbors Classification ---")

print("Training dataset: First 50 points labeled based on the rule (x <= 0.5 -> Class1, x > 0.5 -> Class2)")

print("Testing dataset: Remaining 50 points to be classified\n")

results = {}

for k in k\_values:

    print(f"Results for k = {k}:")

    classified\_labels = [knn\_classifier(train\_data, train\_labels, test\_point, k) for test\_point in test\_data]

    results[k] = classified\_labels

    for i, label in enumerate(classified\_labels, start=51):

        print(f"Point x{i} (value: {test\_data[i - 51]:.4f}) is classified as {label}")

    print("\n")

print("Classification complete.\n")

for k in k\_values:

    classified\_labels = results[k]

    class1\_points = [test\_data[i] for i in range(len(test\_data)) if classified\_labels[i] == "Class1"]

    class2\_points = [test\_data[i] for i in range(len(test\_data)) if classified\_labels[i] == "Class2"]

    plt.figure(figsize=(10, 6))

    plt.scatter(train\_data, [0] \* len(train\_data), c=["blue" if label == "Class1" else "red" for label in train\_labels],

                label="Training Data", marker="o")

    plt.scatter(class1\_points, [1] \* len(class1\_points), c="blue", label="Class1 (Test)", marker="x")

    plt.scatter(class2\_points, [1] \* len(class2\_points), c="red", label="Class2 (Test)", marker="x")

    plt.title(f"k-NN Classification Results for k = {k}")

    plt.xlabel("Data Points")

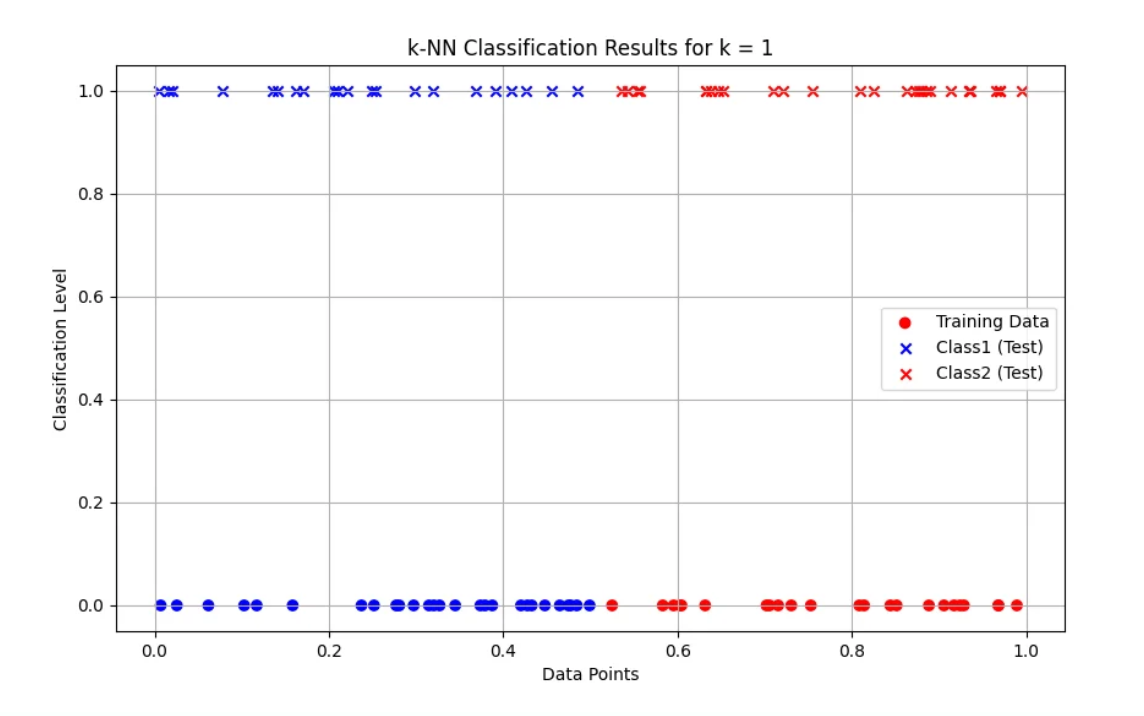
    plt.ylabel("Classification Level")

    plt.legend()

    plt.grid(True)

    plt.show()

Output :



--- k-Nearest Neighbors Classification ---

Training dataset: First 50 points labeled based on the rule (x <= 0.5 -> Class1, x > 0.5 -> Class2)

Testing dataset: Remaining 50 points to be classified

Results *for* k = 1:

Point x51 (value: 0.2059) is classified *as* Class1

Point x52 (value: 0.2535) is classified *as* Class1

Point x53 (value: 0.4856) is classified *as* Class1

Point x54 (value: 0.9651) is classified *as* Class2

Point x55 (value: 0.3906) is classified *as* Class1

Point x56 (value: 0.8903) is classified *as* Class2

Point x57 (value: 0.9695) is classified *as* Class2

Point x58 (value: 0.2206) is classified *as* Class1

Point x59 (value: 0.0203) is classified *as* Class1

Point x60 (value: 0.1619) is classified *as* Class1

Point x61 (value: 0.6461) is classified *as* Class2

Point x62 (value: 0.6523) is classified *as* Class2

Point x63 (value: 0.8728) is classified *as* Class2

Point x64 (value: 0.5435) is classified *as* Class2

Point x65 (value: 0.8246) is classified *as* Class2

Point x66 (value: 0.9347) is classified *as* Class2

Point x67 (value: 0.5361) is classified *as* Class2

Point x68 (value: 0.7215) is classified *as* Class2

Point x69 (value: 0.9703) is classified *as* Class2

Point x70 (value: 0.8764) is classified *as* Class2

Point x71 (value: 0.7543) is classified *as* Class2

Point x72 (value: 0.1406) is classified *as* Class1

Point x73 (value: 0.1349) is classified *as* Class1

Point x74 (value: 0.9705) is classified *as* Class2

Point x75 (value: 0.2985) is classified *as* Class1

Point x76 (value: 0.9948) is classified *as* Class2

Point x77 (value: 0.4551) is classified *as* Class1

Point x78 (value: 0.2101) is classified *as* Class1

Point x79 (value: 0.5542) is classified *as* Class2

Point x80 (value: 0.3202) is classified *as* Class1

Point x81 (value: 0.6325) is classified *as* Class2

Point x82 (value: 0.9345) is classified *as* Class2

Point x83 (value: 0.0156) is classified *as* Class1

Point x84 (value: 0.8859) is classified *as* Class2

Point x85 (value: 0.2495) is classified *as* Class1

Point x86 (value: 0.6380) is classified *as* Class2

Point x87 (value: 0.7095) is classified *as* Class2

Point x88 (value: 0.4259) is classified *as* Class1

Point x89 (value: 0.0052) is classified *as* Class1

Point x90 (value: 0.6322) is classified *as* Class2

Point x91 (value: 0.1701) is classified *as* Class1

Point x92 (value: 0.3693) is classified *as* Class1

Point x93 (value: 0.4087) is classified *as* Class1

Point x94 (value: 0.8103) is classified *as* Class2

Point x95 (value: 0.0773) is classified *as* Class1

Point x96 (value: 0.8792) is classified *as* Class2

Point x97 (value: 0.9138) is classified *as* Class2

Point x98 (value: 0.5567) is classified *as* Class2

Point x99 (value: 0.8625) is classified *as* Class2

Point x100 (value: 0.9363) is classified *as* Class2

Results *for* k = 2:

Point x51 (value: 0.2059) is classified *as* Class1

Point x52 (value: 0.2535) is classified *as* Class1

Point x53 (value: 0.4856) is classified *as* Class1

Point x54 (value: 0.9651) is classified *as* Class2

Point x55 (value: 0.3906) is classified *as* Class1

Point x56 (value: 0.8903) is classified *as* Class2

Point x57 (value: 0.9695) is classified *as* Class2

Point x58 (value: 0.2206) is classified *as* Class1

Point x59 (value: 0.0203) is classified *as* Class1

Point x60 (value: 0.1619) is classified *as* Class1

Point x61 (value: 0.6461) is classified *as* Class2

Point x62 (value: 0.6523) is classified *as* Class2

Point x63 (value: 0.8728) is classified *as* Class2

Point x64 (value: 0.5435) is classified *as* Class2

Point x65 (value: 0.8246) is classified *as* Class2

Point x66 (value: 0.9347) is classified *as* Class2

Point x67 (value: 0.5361) is classified *as* Class2

Point x68 (value: 0.7215) is classified *as* Class2

Point x69 (value: 0.9703) is classified *as* Class2

Point x70 (value: 0.8764) is classified *as* Class2

Point x71 (value: 0.7543) is classified *as* Class2

Point x72 (value: 0.1406) is classified *as* Class1

Point x73 (value: 0.1349) is classified *as* Class1

Point x74 (value: 0.9705) is classified *as* Class2

Point x75 (value: 0.2985) is classified *as* Class1

Point x76 (value: 0.9948) is classified *as* Class2

Point x77 (value: 0.4551) is classified *as* Class1

Point x78 (value: 0.2101) is classified *as* Class1

Point x79 (value: 0.5542) is classified *as* Class2

Point x80 (value: 0.3202) is classified *as* Class1

Point x81 (value: 0.6325) is classified *as* Class2

Point x82 (value: 0.9345) is classified *as* Class2

Point x83 (value: 0.0156) is classified *as* Class1

Point x84 (value: 0.8859) is classified *as* Class2

Point x85 (value: 0.2495) is classified *as* Class1

Point x86 (value: 0.6380) is classified *as* Class2

Point x87 (value: 0.7095) is classified *as* Class2

Point x88 (value: 0.4259) is classified *as* Class1

Point x89 (value: 0.0052) is classified *as* Class1

Point x90 (value: 0.6322) is classified *as* Class2

Point x91 (value: 0.1701) is classified *as* Class1

Point x92 (value: 0.3693) is classified *as* Class1

Point x93 (value: 0.4087) is classified *as* Class1

Point x94 (value: 0.8103) is classified *as* Class2

Point x95 (value: 0.0773) is classified *as* Class1

Point x96 (value: 0.8792) is classified *as* Class2

Point x97 (value: 0.9138) is classified *as* Class2

Point x98 (value: 0.5567) is classified *as* Class2

Point x99 (value: 0.8625) is classified *as* Class2

Point x100 (value: 0.9363) is classified *as* Class2

Results *for* k = 3:

Point x51 (value: 0.2059) is classified *as* Class1

Point x52 (value: 0.2535) is classified *as* Class1

Point x53 (value: 0.4856) is classified *as* Class1

Point x54 (value: 0.9651) is classified *as* Class2

Point x55 (value: 0.3906) is classified *as* Class1

Point x56 (value: 0.8903) is classified *as* Class2

Point x57 (value: 0.9695) is classified *as* Class2

Point x58 (value: 0.2206) is classified *as* Class1

Point x59 (value: 0.0203) is classified *as* Class1

Point x60 (value: 0.1619) is classified *as* Class1

Point x61 (value: 0.6461) is classified *as* Class2

Point x62 (value: 0.6523) is classified *as* Class2

Point x63 (value: 0.8728) is classified *as* Class2

Point x64 (value: 0.5435) is classified *as* Class2

Point x65 (value: 0.8246) is classified *as* Class2

Point x66 (value: 0.9347) is classified *as* Class2

Point x67 (value: 0.5361) is classified *as* Class2

Point x68 (value: 0.7215) is classified *as* Class2

Point x69 (value: 0.9703) is classified *as* Class2

Point x70 (value: 0.8764) is classified *as* Class2

Point x71 (value: 0.7543) is classified *as* Class2

Point x72 (value: 0.1406) is classified *as* Class1

Point x73 (value: 0.1349) is classified *as* Class1

Point x74 (value: 0.9705) is classified *as* Class2

Point x75 (value: 0.2985) is classified *as* Class1

Point x76 (value: 0.9948) is classified *as* Class2

Point x77 (value: 0.4551) is classified *as* Class1

Point x78 (value: 0.2101) is classified *as* Class1

Point x79 (value: 0.5542) is classified *as* Class2

Point x80 (value: 0.3202) is classified *as* Class1

Point x81 (value: 0.6325) is classified *as* Class2

Point x82 (value: 0.9345) is classified *as* Class2

Point x83 (value: 0.0156) is classified *as* Class1

Point x84 (value: 0.8859) is classified *as* Class2

Point x85 (value: 0.2495) is classified *as* Class1

Point x86 (value: 0.6380) is classified *as* Class2

Point x87 (value: 0.7095) is classified *as* Class2

Point x88 (value: 0.4259) is classified *as* Class1

Point x89 (value: 0.0052) is classified *as* Class1

Point x90 (value: 0.6322) is classified *as* Class2

Point x91 (value: 0.1701) is classified *as* Class1

Point x92 (value: 0.3693) is classified *as* Class1

Point x93 (value: 0.4087) is classified *as* Class1

Point x94 (value: 0.8103) is classified *as* Class2

Point x95 (value: 0.0773) is classified *as* Class1

Point x96 (value: 0.8792) is classified *as* Class2

Point x97 (value: 0.9138) is classified *as* Class2

Point x98 (value: 0.5567) is classified *as* Class2

Point x99 (value: 0.8625) is classified *as* Class2

Point x100 (value: 0.9363) is classified *as* Class2

Results *for* k = 4:

Point x51 (value: 0.2059) is classified *as* Class1

Point x52 (value: 0.2535) is classified *as* Class1

Point x53 (value: 0.4856) is classified *as* Class1

Point x54 (value: 0.9651) is classified *as* Class2

Point x55 (value: 0.3906) is classified *as* Class1

Point x56 (value: 0.8903) is classified *as* Class2

Point x57 (value: 0.9695) is classified *as* Class2

Point x58 (value: 0.2206) is classified *as* Class1

Point x59 (value: 0.0203) is classified *as* Class1

Point x60 (value: 0.1619) is classified *as* Class1

Point x61 (value: 0.6461) is classified *as* Class2

Point x62 (value: 0.6523) is classified *as* Class2

Point x63 (value: 0.8728) is classified *as* Class2

Point x64 (value: 0.5435) is classified *as* Class2

Point x65 (value: 0.8246) is classified *as* Class2

Point x66 (value: 0.9347) is classified *as* Class2

Point x67 (value: 0.5361) is classified *as* Class2

Point x68 (value: 0.7215) is classified *as* Class2

Point x69 (value: 0.9703) is classified *as* Class2

Point x70 (value: 0.8764) is classified *as* Class2

Point x71 (value: 0.7543) is classified *as* Class2

Point x72 (value: 0.1406) is classified *as* Class1

Point x73 (value: 0.1349) is classified *as* Class1

Point x74 (value: 0.9705) is classified *as* Class2

Point x75 (value: 0.2985) is classified *as* Class1

Point x76 (value: 0.9948) is classified *as* Class2

Point x77 (value: 0.4551) is classified *as* Class1

Point x78 (value: 0.2101) is classified *as* Class1

Point x79 (value: 0.5542) is classified *as* Class2

Point x80 (value: 0.3202) is classified *as* Class1

Point x81 (value: 0.6325) is classified *as* Class2

Point x82 (value: 0.9345) is classified *as* Class2

Point x83 (value: 0.0156) is classified *as* Class1

Point x84 (value: 0.8859) is classified *as* Class2

Point x85 (value: 0.2495) is classified *as* Class1

Point x86 (value: 0.6380) is classified *as* Class2

Point x87 (value: 0.7095) is classified *as* Class2

Point x88 (value: 0.4259) is classified *as* Class1

Point x89 (value: 0.0052) is classified *as* Class1

Point x90 (value: 0.6322) is classified *as* Class2

Point x91 (value: 0.1701) is classified *as* Class1

Point x92 (value: 0.3693) is classified *as* Class1

Point x93 (value: 0.4087) is classified *as* Class1

Point x94 (value: 0.8103) is classified *as* Class2

Point x95 (value: 0.0773) is classified *as* Class1

Point x96 (value: 0.8792) is classified *as* Class2

Point x97 (value: 0.9138) is classified *as* Class2

Point x98 (value: 0.5567) is classified *as* Class2

Point x99 (value: 0.8625) is classified *as* Class2

Point x100 (value: 0.9363) is classified *as* Class2

Results *for* k = 5:

Point x51 (value: 0.2059) is classified *as* Class1

Point x52 (value: 0.2535) is classified *as* Class1

Point x53 (value: 0.4856) is classified *as* Class1

Point x54 (value: 0.9651) is classified *as* Class2

Point x55 (value: 0.3906) is classified *as* Class1

Point x56 (value: 0.8903) is classified *as* Class2

Point x57 (value: 0.9695) is classified *as* Class2

Point x58 (value: 0.2206) is classified *as* Class1

Point x59 (value: 0.0203) is classified *as* Class1

Point x60 (value: 0.1619) is classified *as* Class1

Point x61 (value: 0.6461) is classified *as* Class2

Point x62 (value: 0.6523) is classified *as* Class2

Point x63 (value: 0.8728) is classified *as* Class2

Point x64 (value: 0.5435) is classified *as* Class2

Point x65 (value: 0.8246) is classified *as* Class2

Point x66 (value: 0.9347) is classified *as* Class2

Point x67 (value: 0.5361) is classified *as* Class1

Point x68 (value: 0.7215) is classified *as* Class2

Point x69 (value: 0.9703) is classified *as* Class2

Point x70 (value: 0.8764) is classified *as* Class2

Point x71 (value: 0.7543) is classified *as* Class2

Point x72 (value: 0.1406) is classified *as* Class1

Point x73 (value: 0.1349) is classified *as* Class1

Point x74 (value: 0.9705) is classified *as* Class2

Point x75 (value: 0.2985) is classified *as* Class1

Point x76 (value: 0.9948) is classified *as* Class2

Point x77 (value: 0.4551) is classified *as* Class1

Point x78 (value: 0.2101) is classified *as* Class1

Point x79 (value: 0.5542) is classified *as* Class2

Point x80 (value: 0.3202) is classified *as* Class1

Point x81 (value: 0.6325) is classified *as* Class2

Point x82 (value: 0.9345) is classified *as* Class2

Point x83 (value: 0.0156) is classified *as* Class1

Point x84 (value: 0.8859) is classified *as* Class2

Point x85 (value: 0.2495) is classified *as* Class1

Point x86 (value: 0.6380) is classified *as* Class2

Point x87 (value: 0.7095) is classified *as* Class2

Point x88 (value: 0.4259) is classified *as* Class1

Point x89 (value: 0.0052) is classified *as* Class1

Point x90 (value: 0.6322) is classified *as* Class2

Point x91 (value: 0.1701) is classified *as* Class1

Point x92 (value: 0.3693) is classified *as* Class1

Point x93 (value: 0.4087) is classified *as* Class1

Point x94 (value: 0.8103) is classified *as* Class2

Point x95 (value: 0.0773) is classified *as* Class1

Point x96 (value: 0.8792) is classified *as* Class2

Point x97 (value: 0.9138) is classified *as* Class2

Point x98 (value: 0.5567) is classified *as* Class2

Point x99 (value: 0.8625) is classified *as* Class2

Point x100 (value: 0.9363) is classified *as* Class2

Results *for* k = 20:

Point x51 (value: 0.2059) is classified *as* Class1

Point x52 (value: 0.2535) is classified *as* Class1

Point x53 (value: 0.4856) is classified *as* Class1

Point x54 (value: 0.9651) is classified *as* Class2

Point x55 (value: 0.3906) is classified *as* Class1

Point x56 (value: 0.8903) is classified *as* Class2

Point x57 (value: 0.9695) is classified *as* Class2

Point x58 (value: 0.2206) is classified *as* Class1

Point x59 (value: 0.0203) is classified *as* Class1

Point x60 (value: 0.1619) is classified *as* Class1

Point x61 (value: 0.6461) is classified *as* Class2

Point x62 (value: 0.6523) is classified *as* Class2

Point x63 (value: 0.8728) is classified *as* Class2

Point x64 (value: 0.5435) is classified *as* Class1

Point x65 (value: 0.8246) is classified *as* Class2

Point x66 (value: 0.9347) is classified *as* Class2

Point x67 (value: 0.5361) is classified *as* Class1

Point x68 (value: 0.7215) is classified *as* Class2

Point x69 (value: 0.9703) is classified *as* Class2

Point x70 (value: 0.8764) is classified *as* Class2

Point x71 (value: 0.7543) is classified *as* Class2

Point x72 (value: 0.1406) is classified *as* Class1

Point x73 (value: 0.1349) is classified *as* Class1

Point x74 (value: 0.9705) is classified *as* Class2

Point x75 (value: 0.2985) is classified *as* Class1

Point x76 (value: 0.9948) is classified *as* Class2

Point x77 (value: 0.4551) is classified *as* Class1

Point x78 (value: 0.2101) is classified *as* Class1

Point x79 (value: 0.5542) is classified *as* Class1

Point x80 (value: 0.3202) is classified *as* Class1

Point x81 (value: 0.6325) is classified *as* Class2

Point x82 (value: 0.9345) is classified *as* Class2

Point x83 (value: 0.0156) is classified *as* Class1

Point x84 (value: 0.8859) is classified *as* Class2

Point x85 (value: 0.2495) is classified *as* Class1

Point x86 (value: 0.6380) is classified *as* Class2

Point x87 (value: 0.7095) is classified *as* Class2

Point x88 (value: 0.4259) is classified *as* Class1

Point x89 (value: 0.0052) is classified *as* Class1

Point x90 (value: 0.6322) is classified *as* Class2

Point x91 (value: 0.1701) is classified *as* Class1

Point x92 (value: 0.3693) is classified *as* Class1

Point x93 (value: 0.4087) is classified *as* Class1

Point x94 (value: 0.8103) is classified *as* Class2

Point x95 (value: 0.0773) is classified *as* Class1

Point x96 (value: 0.8792) is classified *as* Class2

Point x97 (value: 0.9138) is classified *as* Class2

Point x98 (value: 0.5567) is classified *as* Class2

Point x99 (value: 0.8625) is classified *as* Class2

Point x100 (value: 0.9363) is classified *as* Class2

Results *for* k = 30:

Point x51 (value: 0.2059) is classified *as* Class1

Point x52 (value: 0.2535) is classified *as* Class1

Point x53 (value: 0.4856) is classified *as* Class1

Point x54 (value: 0.9651) is classified *as* Class2

Point x55 (value: 0.3906) is classified *as* Class1

Point x56 (value: 0.8903) is classified *as* Class2

Point x57 (value: 0.9695) is classified *as* Class2

Point x58 (value: 0.2206) is classified *as* Class1

Point x59 (value: 0.0203) is classified *as* Class1

Point x60 (value: 0.1619) is classified *as* Class1

Point x61 (value: 0.6461) is classified *as* Class2

Point x62 (value: 0.6523) is classified *as* Class2

Point x63 (value: 0.8728) is classified *as* Class2

Point x64 (value: 0.5435) is classified *as* Class1

Point x65 (value: 0.8246) is classified *as* Class2

Point x66 (value: 0.9347) is classified *as* Class2

Point x67 (value: 0.5361) is classified *as* Class1

Point x68 (value: 0.7215) is classified *as* Class2

Point x69 (value: 0.9703) is classified *as* Class2

Point x70 (value: 0.8764) is classified *as* Class2

Point x71 (value: 0.7543) is classified *as* Class2

Point x72 (value: 0.1406) is classified *as* Class1

Point x73 (value: 0.1349) is classified *as* Class1

Point x74 (value: 0.9705) is classified *as* Class2

Point x75 (value: 0.2985) is classified *as* Class1

Point x76 (value: 0.9948) is classified *as* Class2

Point x77 (value: 0.4551) is classified *as* Class1

Point x78 (value: 0.2101) is classified *as* Class1

Point x79 (value: 0.5542) is classified *as* Class1

Point x80 (value: 0.3202) is classified *as* Class1

Point x81 (value: 0.6325) is classified *as* Class2

Point x82 (value: 0.9345) is classified *as* Class2

Point x83 (value: 0.0156) is classified *as* Class1

Point x84 (value: 0.8859) is classified *as* Class2

Point x85 (value: 0.2495) is classified *as* Class1

Point x86 (value: 0.6380) is classified *as* Class2

Point x87 (value: 0.7095) is classified *as* Class2

Point x88 (value: 0.4259) is classified *as* Class1

Point x89 (value: 0.0052) is classified *as* Class1

Point x90 (value: 0.6322) is classified *as* Class2

Point x91 (value: 0.1701) is classified *as* Class1

Point x92 (value: 0.3693) is classified *as* Class1

Point x93 (value: 0.4087) is classified *as* Class1

Point x94 (value: 0.8103) is classified *as* Class2

Point x95 (value: 0.0773) is classified *as* Class1

Point x96 (value: 0.8792) is classified *as* Class2

Point x97 (value: 0.9138) is classified *as* Class2

Point x98 (value: 0.5567) is classified *as* Class1

Point x99 (value: 0.8625) is classified *as* Class2

Point x100 (value: 0.9363) is classified *as* Class2

Classification complete.