

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 $(x_i \leq 0.5)$, then $x_i \in \text{Class1}$, else $x_i \in \text{Class1}$

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],
```

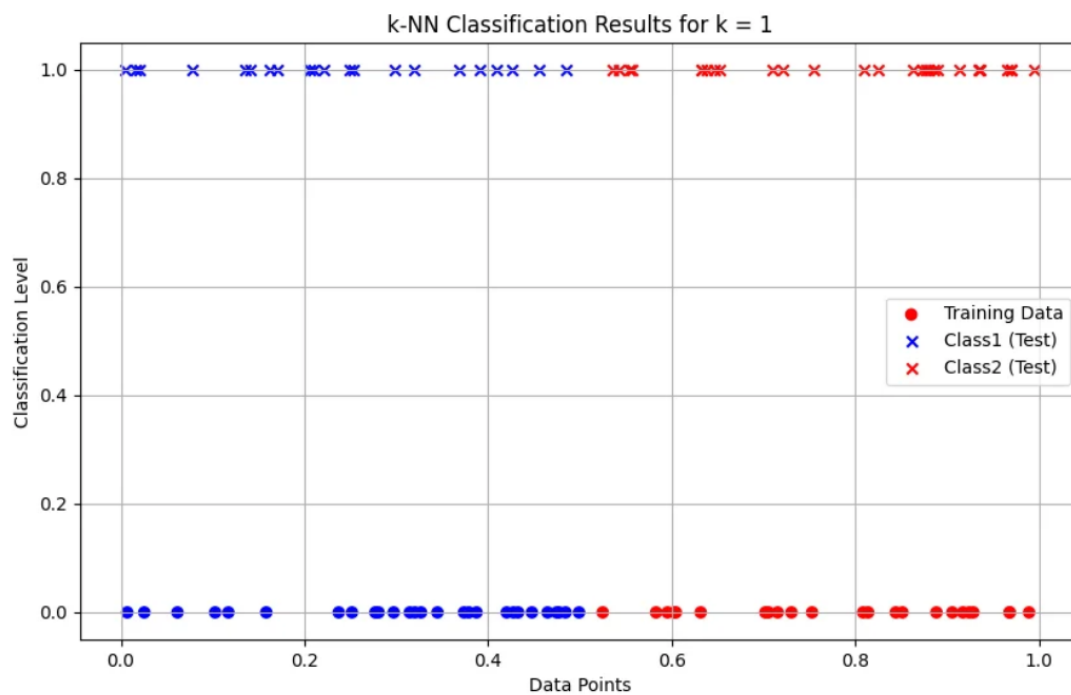
```
            label="Training Data", marker="o")
```

```
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 ($x \leq 0.5 \rightarrow \text{Class1}$, $x > 0.5 \rightarrow \text{Class2}$)

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.