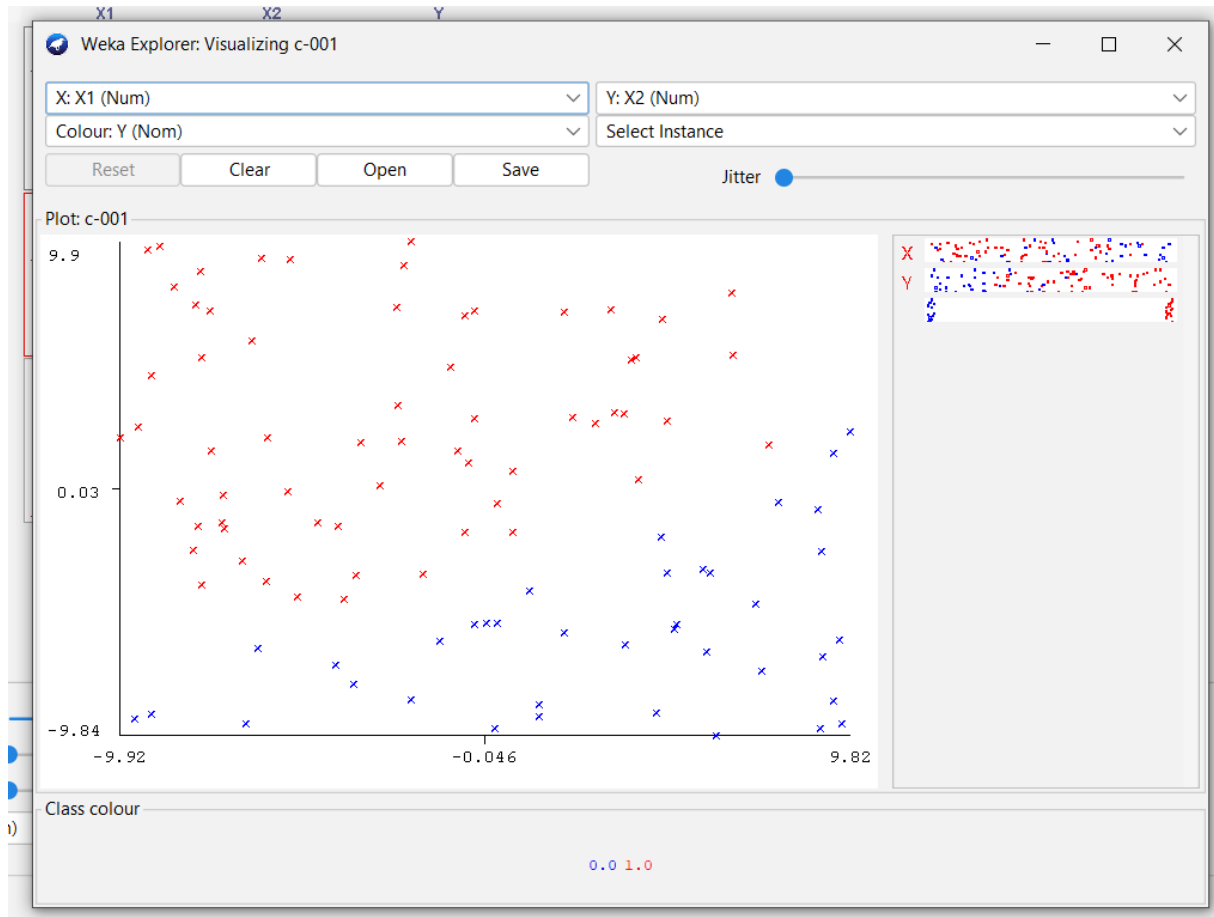


SPRAWOZDANIE – LABORATORIUM 8

Karolina Kotłowska, 26 kwietnia 2023

8.1



| No. | 1: X1 | 2: X2 | 3: Y |
|-----|-----------|-----------|---------|
| | Numeric | Numeric | Nominal |
| 1 | -2.365... | 3.3413... | 1.0 |
| 2 | 2.9650... | 2.6301... | 1.0 |
| 3 | -0.300... | -5.455... | 0.0 |
| 4 | 6.0647... | -3.373... | 0.0 |
| 5 | -0.949... | 4.85541 | 1.0 |
| 6 | -9.045... | -9.032... | 0.0 |
| 7 | -7.045... | -1.604... | 1.0 |
| 8 | 4.9214... | 2.6909... | 1.0 |
| 9 | 5.1257... | -5.620... | 0.0 |
| 10 | 9.0828... | -2.526... | 0.0 |
| 11 | 4.7954... | 6.7497... | 1.0 |
| 12 | -9.917... | 2.0548... | 1.0 |

```

private static void zad1() {
    try {
        ConverterUtils.DataSource source = new ConverterUtils.DataSource( location: "c-001.arff");
        Instances data = source.getDataSet();

        if (data.classIndex() == -1)
            data.setClassIndex(data.numAttributes() - 1);

        Classifier cls = new NaiveBayes();
        cls.buildClassifier(data);

        Instance inst = new DenseInstance( numAttributes: 3);
        inst.setDataset(data);
        inst.setValue( i: 0, v: 3.2); // wartość dla X1
        inst.setValue( i: 1, v: 4.0); // wartość dla X2

        double y = cls.classifyInstance(inst);

        double[] distrib = cls.distributionForInstance(inst);
        System.out.printf(Locale.US, s: "%d->%f %d->%f\n", ...objects: 0, distrib[0], 1, distrib[1]);
    } catch (Exception e) {
        e.printStackTrace();
    }
}

```

| | | | |
|---|----------|----------|----------|
| X | 1.1 | 2.6 | 3.2 |
| Y | 2.2 | 3.5 | 4.0 |
| 0 | 0.030374 | 0.012202 | 0.009745 |
| 1 | 0.969626 | 0.987798 | 0.990255 |

8.2

```

private static void zad2() {
    try {
        ConverterUtils.DataSource source = new ConverterUtils.DataSource( location: "c-001.arff");
        Instances data = source.getDataSet();

        if (data.classIndex() == -1)
            data.setClassIndex(data.numAttributes()-1);

        Classifier cls = new NaiveBayes();
        cls.buildClassifier(data);

        List<Attribute> atts = Arrays.asList(
            new Attribute( attributeName: "X1"),
            new Attribute( attributeName: "X2"),
            new Attribute( attributeName: "Y", Arrays.asList("tak", "nie")));

        Instances result = new Instances( name: "some-relation", new ArrayList<>(atts), capacity: 0);

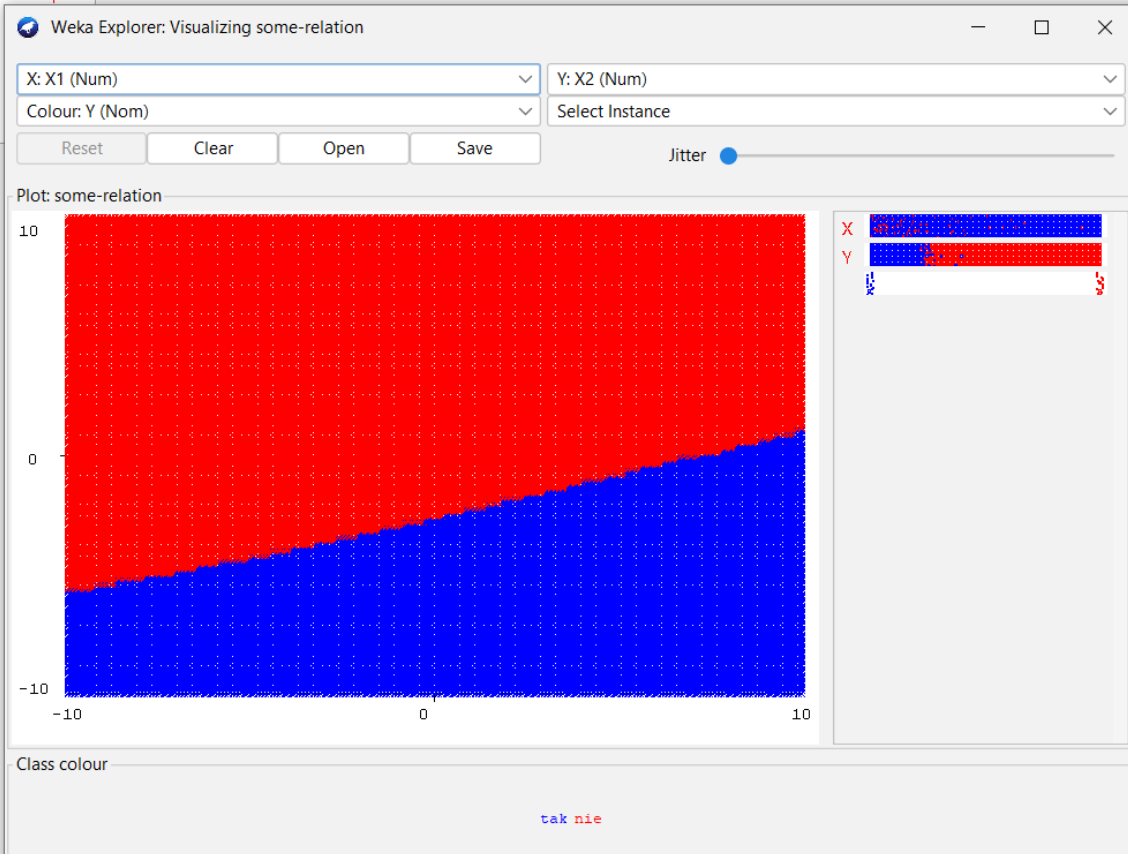
        result.setClassIndex(result.numAttributes()-1);

        for(double x1=-10;x1<=10;x1+=0.1){
            for(double x2=-10;x2<=10;x2+=0.1){
                Instance inst = new DenseInstance( numAttributes: 3);
                inst.setValue( i: 0, x1);
                inst.setValue( i: 1, x2);

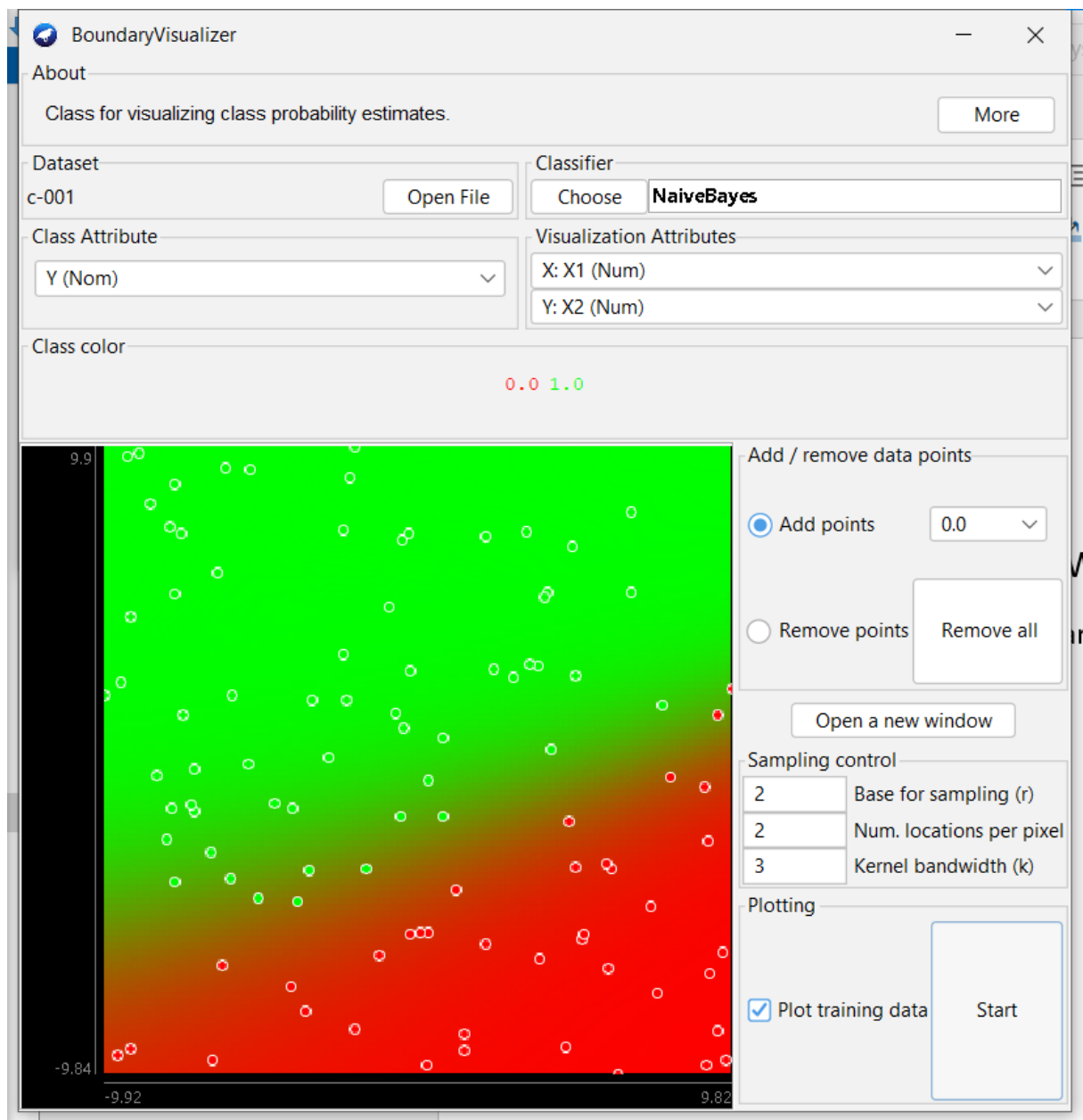
                inst.setDataset(result);
                double y = cls.classifyInstance(inst);
                inst.setClassValue(y);
                result.add(inst);
            }
        }

        ArffSaver saver = new ArffSaver();
        saver.setInstances(result);
        saver.setFile(new File( s: "c-001-result.arff"));
        saver.writeBatch();
    } catch (Exception e) {

```



8.3



8.4

```

private static void zad3() {
    try {
        ConverterUtils.DataSource source = new ConverterUtils.DataSource("c-001.arff");
        Instances data = source.getDataSet();

        if (data.classIndex() == -1)
            data.setClassIndex(data.numAttributes() - 1);

        Classifier cls;
        cls = new NaiveBayes();

        Evaluation eval = new Evaluation(data);
        eval.crossValidateModel(cls, data, numFolds: 10, new Random(1));

        System.out.println(eval.toSummaryString());
        System.out.println(eval.toMatrixString());
        System.out.printf(Locale.US,
            s: "[prec recall fmeasure]:\t%f\t%f\t%f\n",
            eval.weightedPrecision(),
            eval.weightedRecall(),
            eval.weightedFMeasure());
    } catch (Exception e) {
        e.printStackTrace();
    }
}

```

| | | | |
|----------------------------------|---------|----|---|
| Correctly Classified Instances | 97 | 97 | % |
| Incorrectly Classified Instances | 3 | 3 | % |
| Kappa statistic | 0.936 | | |
| Mean absolute error | 0.1143 | | |
| Root mean squared error | 0.1998 | | |
| Relative absolute error | 24.209 | % | |
| Root relative squared error | 41.1233 | % | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

```

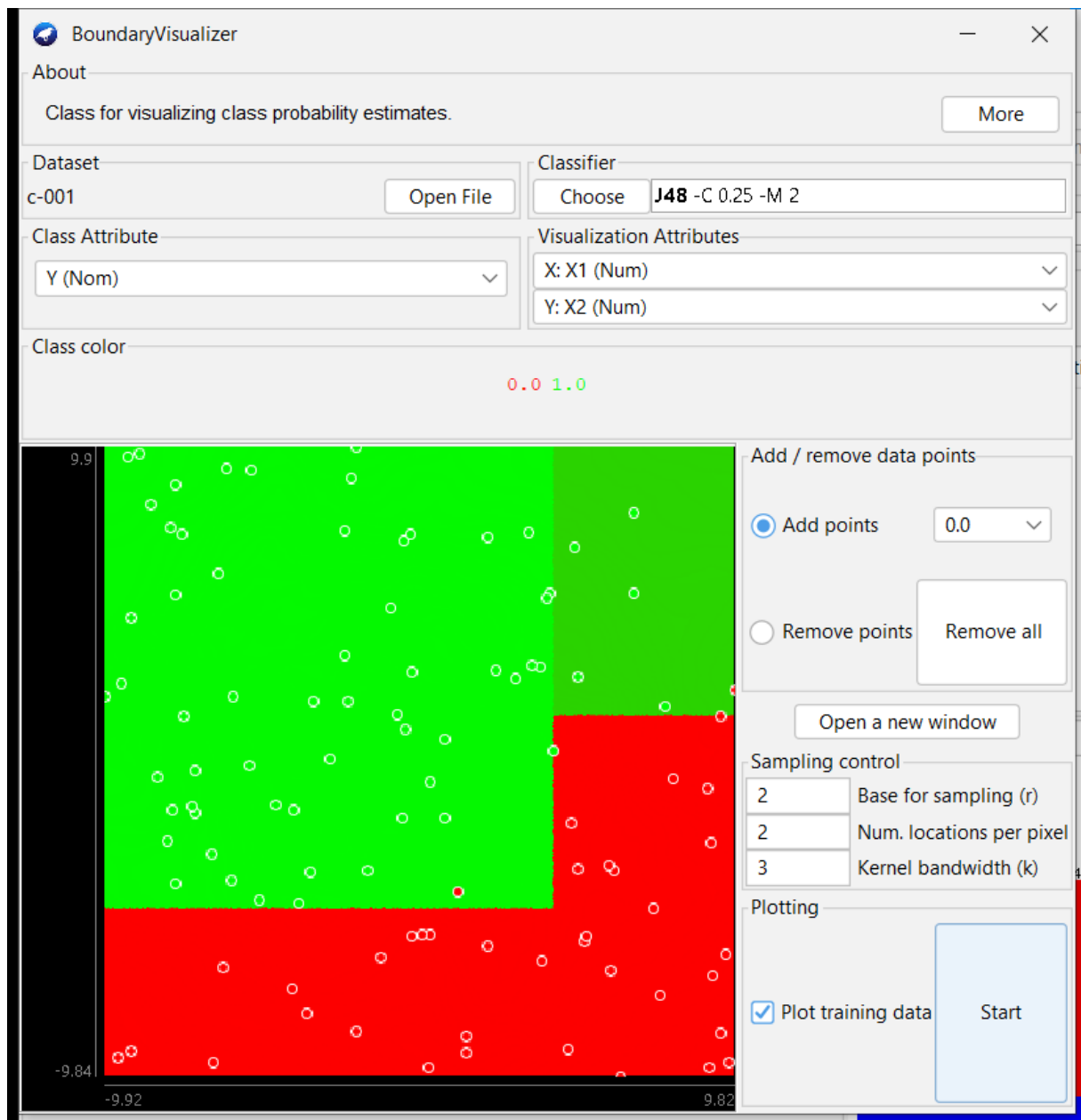
a  b  <-- classified as
36  2 |  a = 0.0
 1 61 |  b = 1.0

```

```
[prec recall fmeasure]: 0.970047    0.970000    0.969920
```

8.5

J48



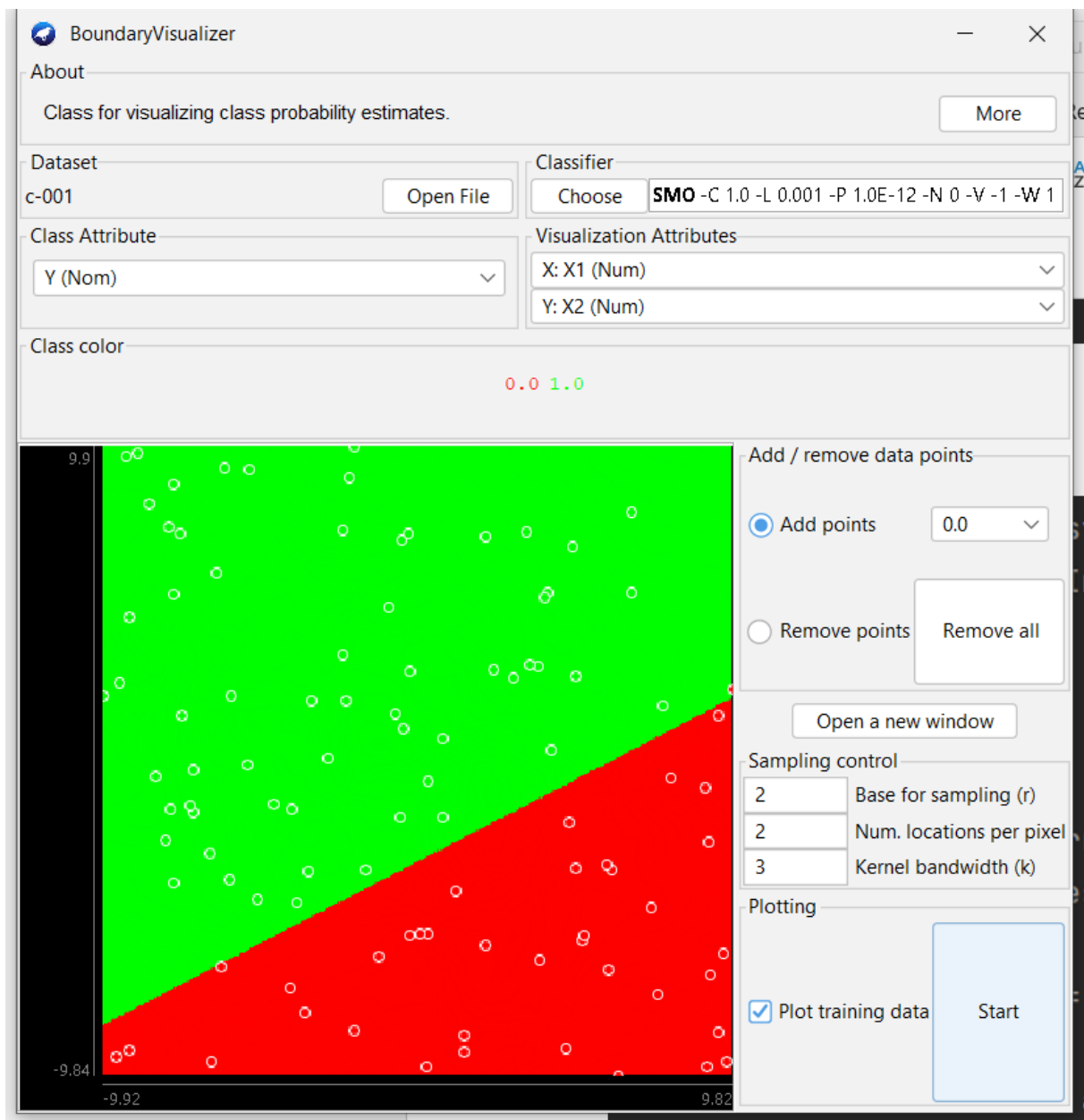
| | | | |
|----------------------------------|---------|----|---|
| Correctly Classified Instances | 95 | 95 | % |
| Incorrectly Classified Instances | 5 | 5 | % |
| Kappa statistic | 0.8922 | | |
| Mean absolute error | 0.0642 | | |
| Root mean squared error | 0.2186 | | |
| Relative absolute error | 13.5884 | % | |
| Root relative squared error | 45.0032 | % | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

| | | |
|----|----|-------------------|
| a | b | <-- classified as |
| 34 | 4 | a = 0.0 |
| 1 | 61 | b = 1.0 |

[prec recall fmeasure]: 0.950989 0.950000 0.949563

SMO



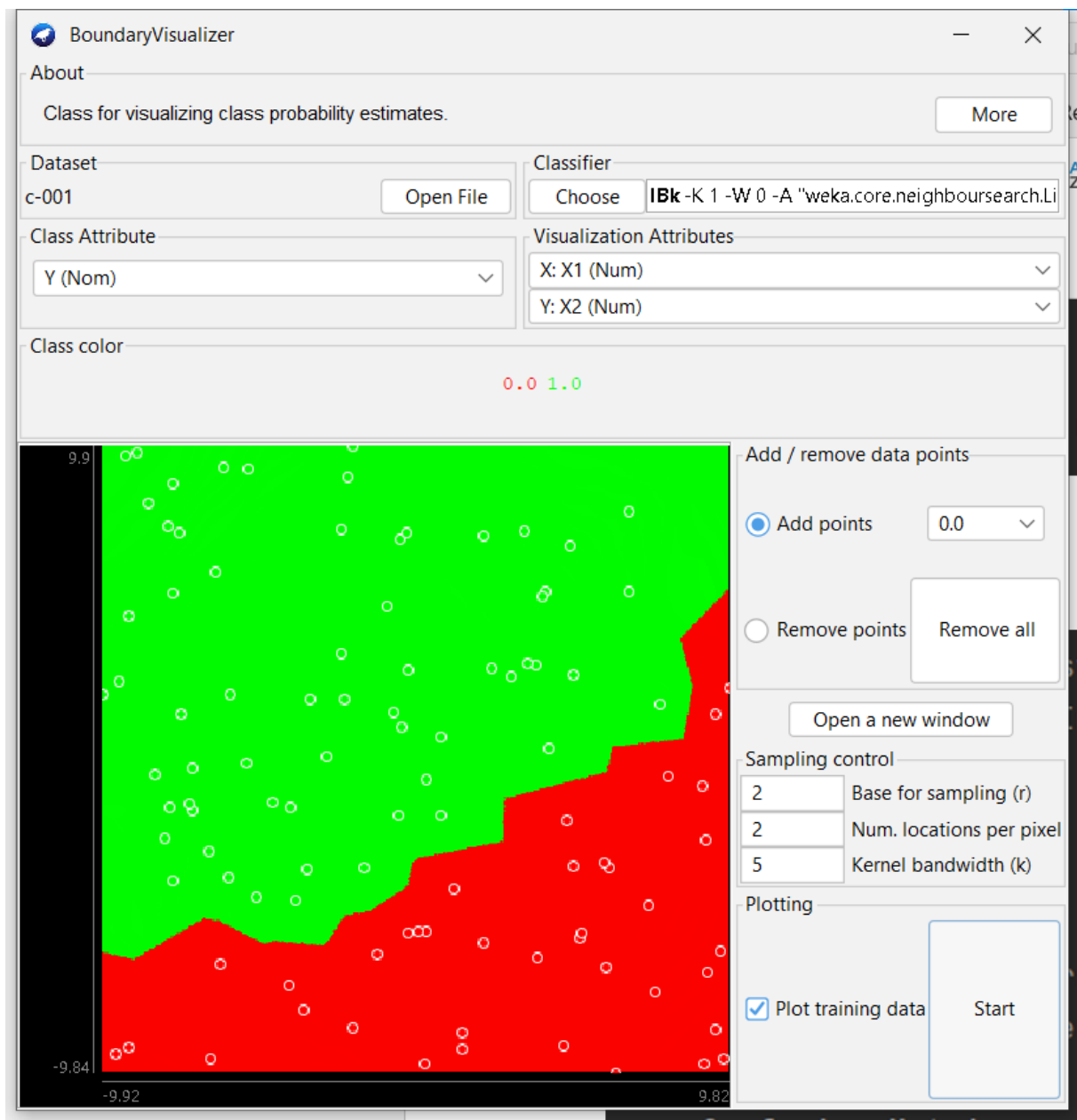
| | | | |
|----------------------------------|-----------|----|---|
| Correctly Classified Instances | 98 | 98 | % |
| Incorrectly Classified Instances | 2 | 2 | % |
| Kappa statistic | 0.9571 | | |
| Mean absolute error | 0.02 | | |
| Root mean squared error | 0.1414 | | |
| Relative absolute error | 4.2357 % | | |
| Root relative squared error | 29.1128 % | | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

```
a  b  <-- classified as
36  2 |  a = 0.0
 0 62 |  b = 1.0
```

[prec recall fmeasure]: 0.980625 0.980000 0.979888

IBk(5)



| | | | |
|----------------------------------|---------|----|---|
| Correctly Classified Instances | 99 | 99 | % |
| Incorrectly Classified Instances | 1 | 1 | % |
| Kappa statistic | 0.9789 | | |
| Mean absolute error | 0.048 | | |
| Root mean squared error | 0.1343 | | |
| Relative absolute error | 10.1676 | % | |
| Root relative squared error | 27.656 | % | |
| Total Number of Instances | 100 | | |

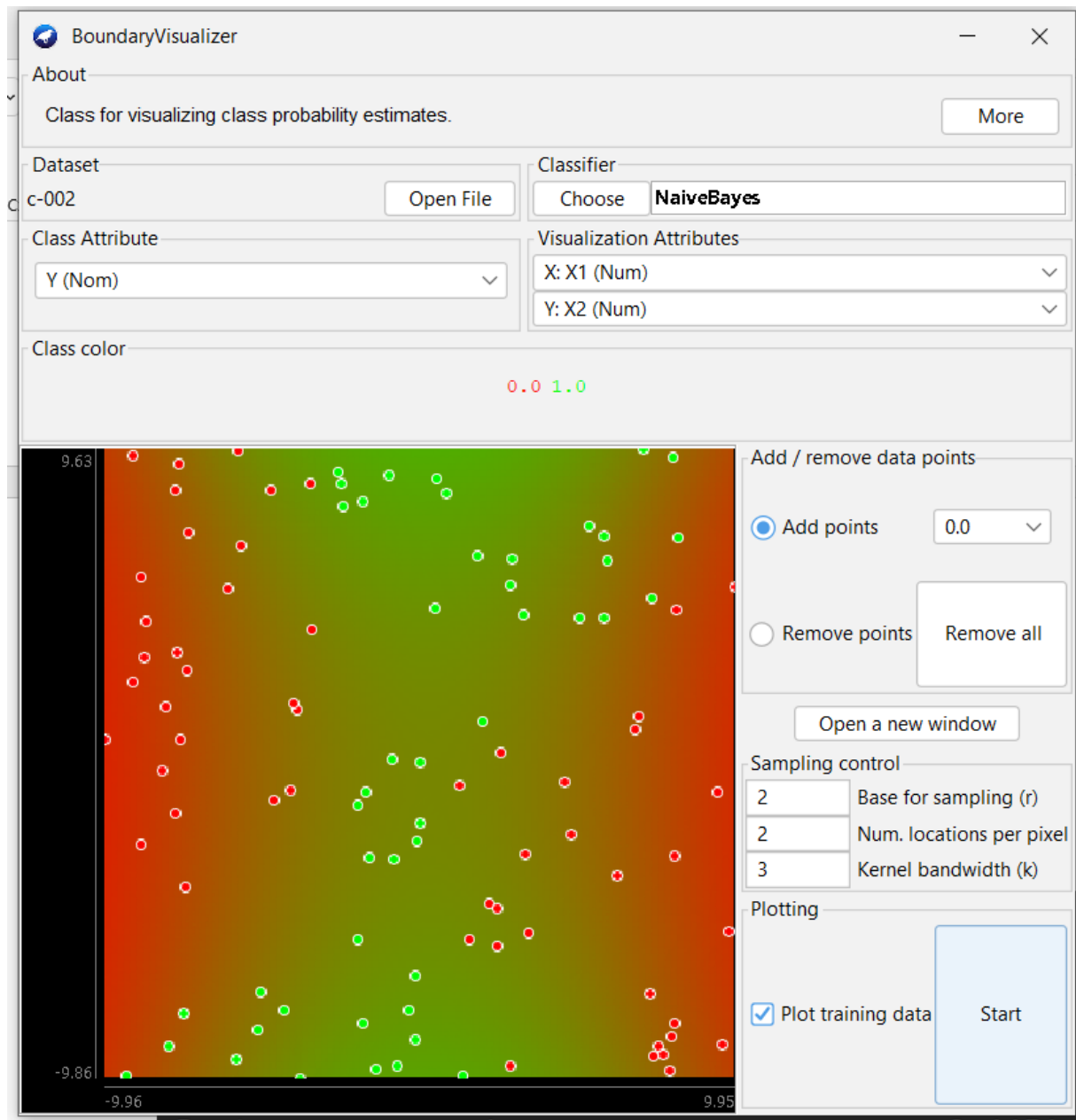
=== Confusion Matrix ===

```
a  b  <-- classified as
38  0 |  a = 0.0
1 61 |  b = 1.0
```

[prec recall fmeasure]: 0.990256 0.990000 0.990024

8.6

NaiveBayes

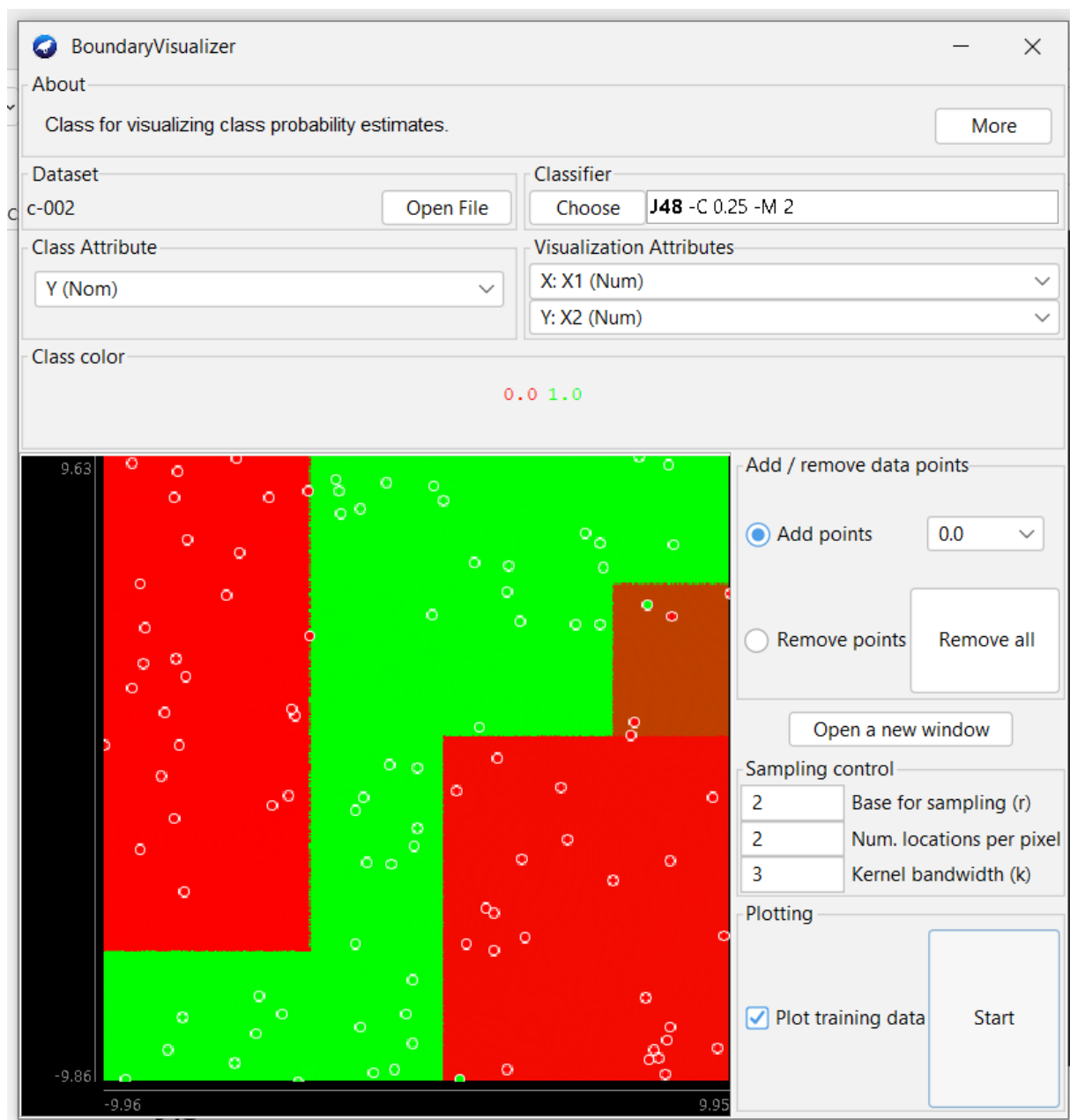


| | | | |
|----------------------------------|-----------|----|---|
| Correctly Classified Instances | 76 | 76 | % |
| Incorrectly Classified Instances | 24 | 24 | % |
| Kappa statistic | 0.5122 | | |
| Mean absolute error | 0.4263 | | |
| Root mean squared error | 0.4456 | | |
| Relative absolute error | 85.7031 % | | |
| Root relative squared error | 89.3157 % | | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

```
  a  b  <-- classified as
45  9 |  a = 0.0
15 31 |  b = 1.0
```

[prec recall fmeasure]: 0.761500 0.760000 0.757944



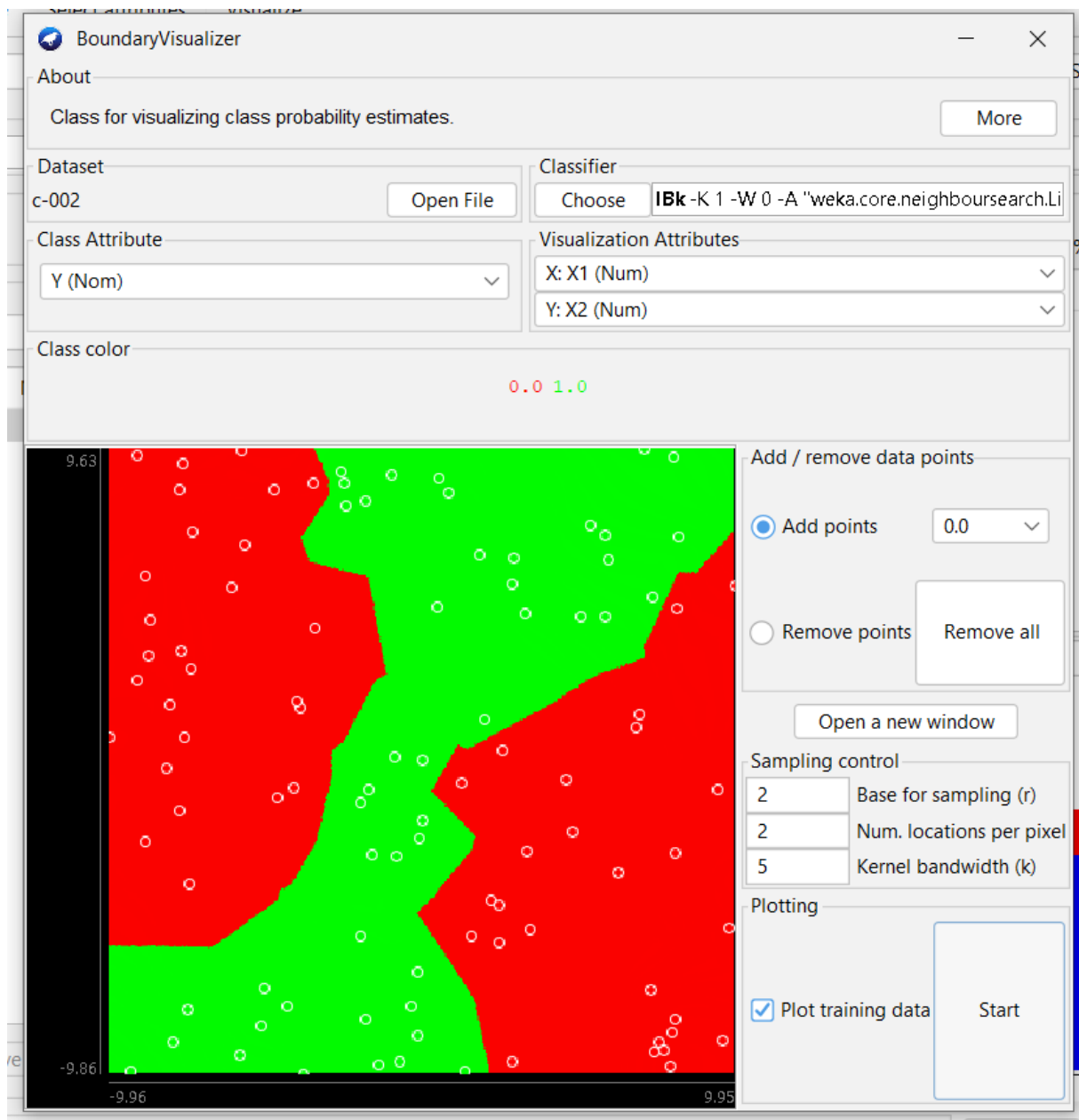
| | | | |
|----------------------------------|-----------|----|---|
| Correctly Classified Instances | 93 | 93 | % |
| Incorrectly Classified Instances | 7 | 7 | % |
| Kappa statistic | 0.8593 | | |
| Mean absolute error | 0.0886 | | |
| Root mean squared error | 0.2627 | | |
| Relative absolute error | 17.8181 % | | |
| Root relative squared error | 52.6419 % | | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

```
a  b  <-- classified as
50  4 |  a = 0.0
 3 43 |  b = 1.0
```

[prec recall fmeasure]: 0.930285 0.930000 0.930049

lbk(5)

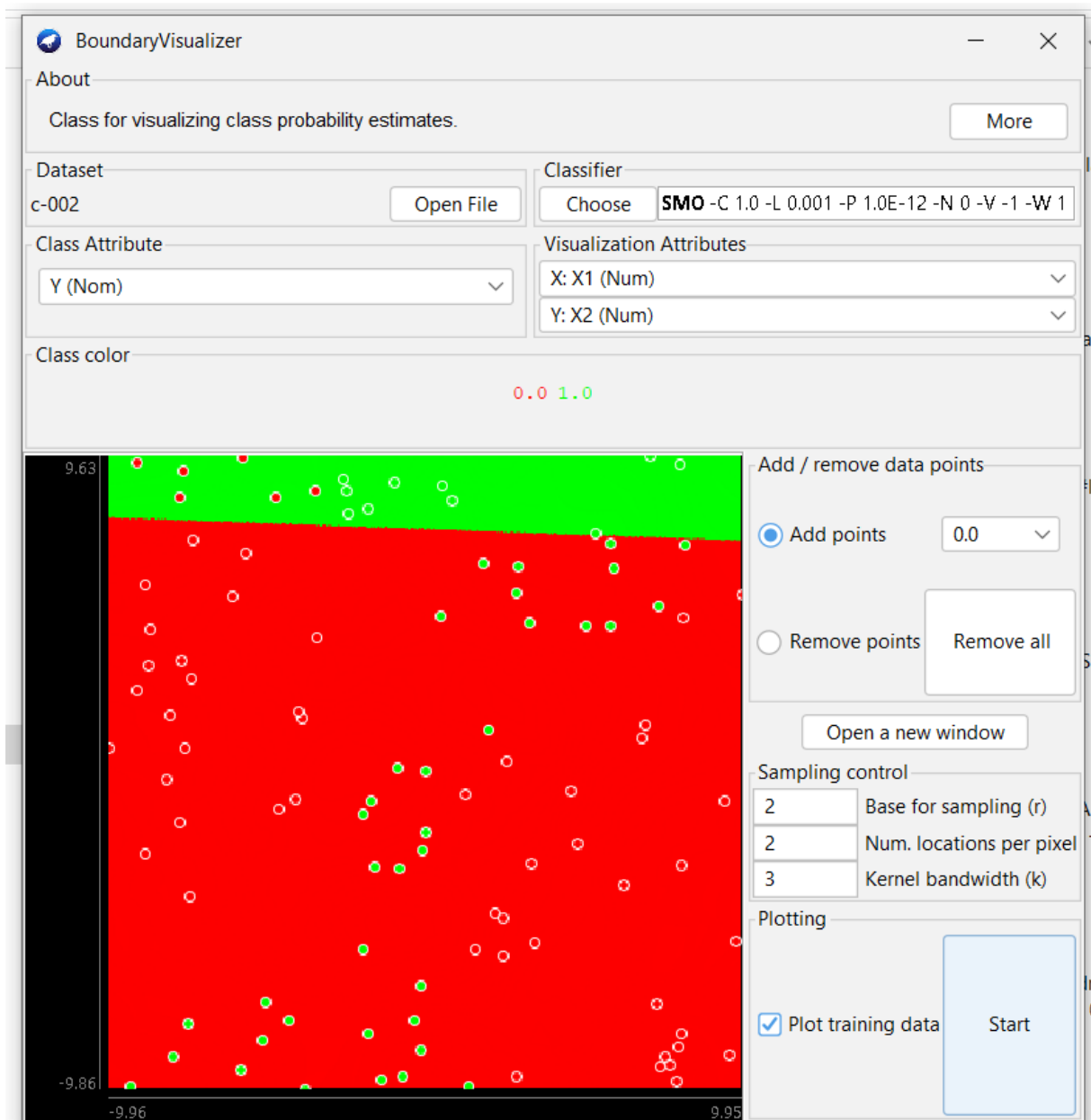


| | | | |
|----------------------------------|---------|----|---|
| Correctly Classified Instances | 93 | 93 | % |
| Incorrectly Classified Instances | 7 | 7 | % |
| Kappa statistic | 0.8602 | | |
| Mean absolute error | 0.1177 | | |
| Root mean squared error | 0.2513 | | |
| Relative absolute error | 23.6633 | % | |
| Root relative squared error | 50.3682 | % | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

```
a  b  <-- classified as
48  6 |  a = 0.0
 1 45 |  b = 1.0
```

[prec recall fmeasure]: 0.934862 0.930000 0.930105



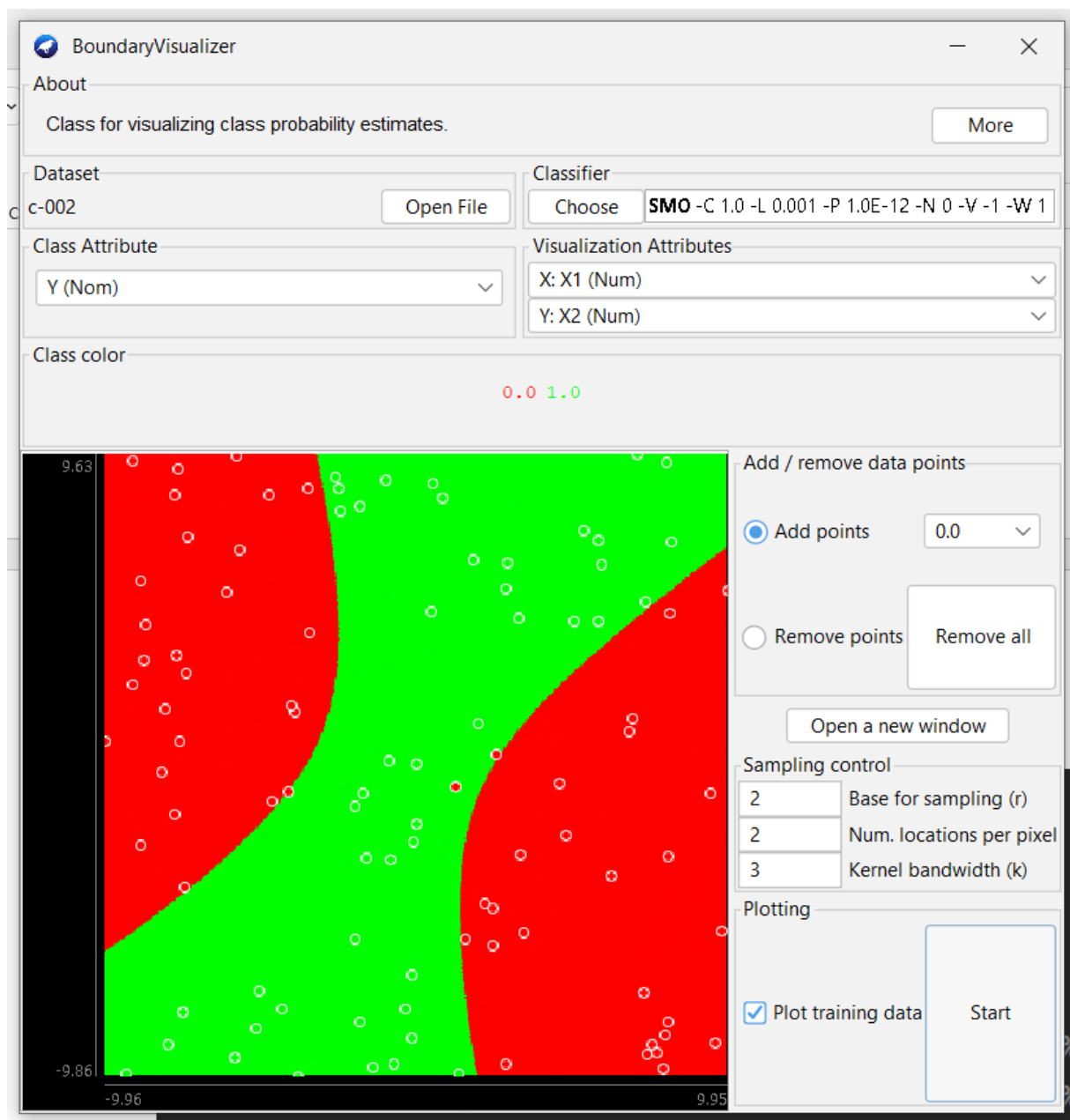
| | | | |
|----------------------------------|----------|----|---|
| Correctly Classified Instances | 55 | 55 | % |
| Incorrectly Classified Instances | 45 | 45 | % |
| Kappa statistic | 0.0234 | | |
| Mean absolute error | 0.45 | | |
| Root mean squared error | 0.6708 | | |
| Relative absolute error | 90.472 | % | |
| Root relative squared error | 134.4465 | % | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

| | | |
|----|---|-------------------|
| a | b | <-- classified as |
| 54 | 0 | a = 0.0 |
| 45 | 1 | b = 1.0 |

[prec recall fmeasure]: 0.754545 0.550000 0.400751

SMO, Exp = 8



8.8

```
private static void zad5() {
    try {
        ConverterUtils.DataSource source = new ConverterUtils.DataSource( location: "c-002.arff");
        Instances data = source.getDataSet();

        if (data.classIndex() == -1)
            data.setClassIndex(data.numAttributes() - 1);

        SMO cls;
        cls = new SMO();
        double exp = 8;
        cls.setKernel(new PolyKernel(data, cacheSize: 1000, exp, lowerOrder: true));

        Evaluation eval = new Evaluation(data);
        eval.crossValidateModel(cls, data, numFolds: 10, new Random(1));

        System.out.println(eval.toSummaryString());
        System.out.println(eval.toMatrixString());
        System.out.printf(Locale.US,
            s: "[prec recall fmeasure]:\t%f\t%f\t%f\n",
            eval.weightedPrecision(),
            eval.weightedRecall(),
            eval.weightedFMeasure());
    } catch (Exception e) {
        e.printStackTrace();
    }
}
```

Exp = 1

| | | | |
|----------------------------------|------------|----|---|
| Correctly Classified Instances | 54 | 54 | % |
| Incorrectly Classified Instances | 46 | 46 | % |
| Kappa statistic | 0.0069 | | |
| Mean absolute error | 0.46 | | |
| Root mean squared error | 0.6782 | | |
| Relative absolute error | 92.4825 % | | |
| Root relative squared error | 135.9321 % | | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

```
a  b  <-- classified as
52  2 |  a = 0.0
44  2 |  b = 1.0
```

[prec recall fmeasure]: 0.522500 0.540000 0.411200

Exp = 2

| | | | |
|----------------------------------|-----------|----|---|
| Correctly Classified Instances | 76 | 76 | % |
| Incorrectly Classified Instances | 24 | 24 | % |
| Kappa statistic | 0.509 | | |
| Mean absolute error | 0.24 | | |
| Root mean squared error | 0.4899 | | |
| Relative absolute error | 48.2517 % | | |
| Root relative squared error | 98.1858 % | | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

```
a  b  <-- classified as
47  7 |  a = 0.0
17 29 |  b = 1.0
```

[prec recall fmeasure]: 0.767118 0.760000 0.755535

Exp = 3

```
Correctly Classified Instances      87      87      %
Incorrectly Classified Instances    13      13      %
Kappa statistic                     0.7437
Mean absolute error                 0.13
Root mean squared error             0.3606
Relative absolute error             26.1364 %
Root relative squared error         72.2628 %
Total Number of Instances          100

=== Confusion Matrix ===

  a  b   <-- classified as
41 13 |  a = 0.0
 0 46 |  b = 1.0

[prec recall fmeasure]: 0.898644    0.870000    0.869153
```

Exp = 5

```
Correctly Classified Instances      90      90      %
Incorrectly Classified Instances     10      10      %
Kappa statistic                     0.8013
Mean absolute error                 0.1
Root mean squared error             0.3162
Relative absolute error             20.1049 %
Root relative squared error         63.3787 %
Total Number of Instances          100

=== Confusion Matrix ===

  a  b   <-- classified as
45  9 |  a = 0.0
 1 45 |  b = 1.0

[prec recall fmeasure]: 0.911594    0.900000    0.900000
```


Exp = 8

| | | | |
|----------------------------------|---------|----|---|
| Correctly Classified Instances | 96 | 96 | % |
| Incorrectly Classified Instances | 4 | 4 | % |
| Kappa statistic | 0.9197 | | |
| Mean absolute error | 0.04 | | |
| Root mean squared error | 0.2 | | |
| Relative absolute error | 8.042 | % | |
| Root relative squared error | 40.0842 | % | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

```
a  b  <-- classified as
51  3 |  a = 0.0
 1 45 |  b = 1.0
```

[prec recall fmeasure]: 0.960865 0.960000 0.960048

```

private static void zad5() {
    try {
        ConverterUtils.DataSource source = new ConverterUtils.DataSource( location: "c-002.arff");
        Instances data = source.getDataSet();

        if (data.classIndex() == -1)
            data.setClassIndex(data.numAttributes() - 1);

        SMO cls;
        cls = new SMO();
        double gamma = 100;
        cls.setKernel(new RBFKernel(data, cacheSize: 0, gamma));

        Evaluation eval = new Evaluation(data);
        eval.crossValidateModel(cls, data, numFolds: 10, new Random(1));

        System.out.println(eval.toSummaryString());
        System.out.println(eval.toMatrixString());
        System.out.printf(Locale.US,
            s: "[prec recall fmeasure]:\t%f\t%f\t%f\n",
            eval.weightedPrecision(),
            eval.weightedRecall(),
            eval.weightedFMeasure());
    } catch (Exception e) {
        e.printStackTrace();
    }
}

```

Gamma = 0.01

```
Correctly Classified Instances      54          54      %
Incorrectly Classified Instances    46          46      %
Kappa statistic                     0
Mean absolute error                 0.46
Root mean squared error             0.6782
Relative absolute error             92.4825 %
Root relative squared error         135.9321 %
Total Number of Instances          100
```

=== Confusion Matrix ===

```
  a  b  <-- classified as
54  0 |  a = 0.0
46  0 |  b = 1.0
```

```
[prec recall fmeasure]: 0.291600    0.540000    0.378701
```

Gamma = 0.1

```
Correctly Classified Instances      54          54      %
Incorrectly Classified Instances    46          46      %
Kappa statistic                     0
Mean absolute error                 0.46
Root mean squared error             0.6782
Relative absolute error             92.4825 %
Root relative squared error         135.9321 %
Total Number of Instances          100
```

=== Confusion Matrix ===

```
  a  b  <-- classified as
54  0 |  a = 0.0
46  0 |  b = 1.0
```

```
[prec recall fmeasure]: 0.291600    0.540000    0.378701
```

Gamma = 1

```
Correctly Classified Instances      86          86      %
Incorrectly Classified Instances    14          14      %
Kappa statistic                     0.72
Mean absolute error                  0.14
Root mean squared error              0.3742
Relative absolute error              28.1469 %
Root relative squared error          74.9907 %
Total Number of Instances           100

=== Confusion Matrix ===

  a  b   <-- classified as
45  9 |  a = 0.0
 5 41 |  b = 1.0

[prec recall fmeasure]: 0.863200    0.860000    0.860224
```

Gamma = 10

```
Correctly Classified Instances      93          93      %
Incorrectly Classified Instances     7           7      %
Kappa statistic                     0.8607
Mean absolute error                  0.07
Root mean squared error              0.2646
Relative absolute error              14.0734 %
Root relative squared error          53.0264 %
Total Number of Instances           100

=== Confusion Matrix ===

  a  b   <-- classified as
47  7 |  a = 0.0
 0 46 |  b = 1.0

[prec recall fmeasure]: 0.939245    0.930000    0.930049
```

Gamma = 100

| | | | |
|----------------------------------|-----------|----|---|
| Correctly Classified Instances | 91 | 91 | % |
| Incorrectly Classified Instances | 9 | 9 | % |
| Kappa statistic | 0.8197 | | |
| Mean absolute error | 0.09 | | |
| Root mean squared error | 0.3 | | |
| Relative absolute error | 18.0944 % | | |
| Root relative squared error | 60.1263 % | | |
| Total Number of Instances | 100 | | |

=== Confusion Matrix ===

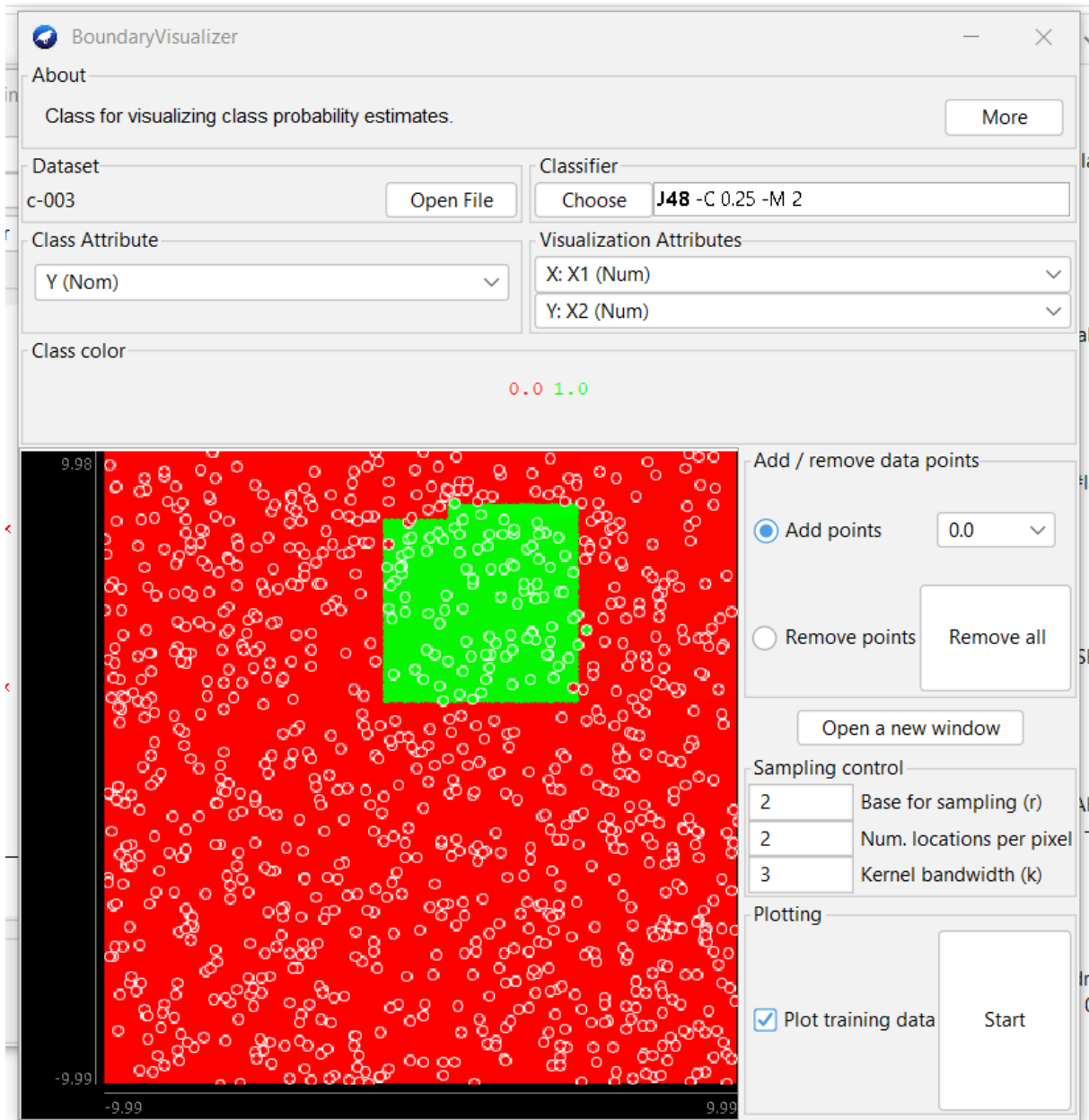
| | | |
|----|----|-------------------|
| a | b | <-- classified as |
| 48 | 6 | a = 0.0 |
| 3 | 43 | b = 1.0 |

[prec recall fmeasure]: 0.911909 0.910000 0.910135

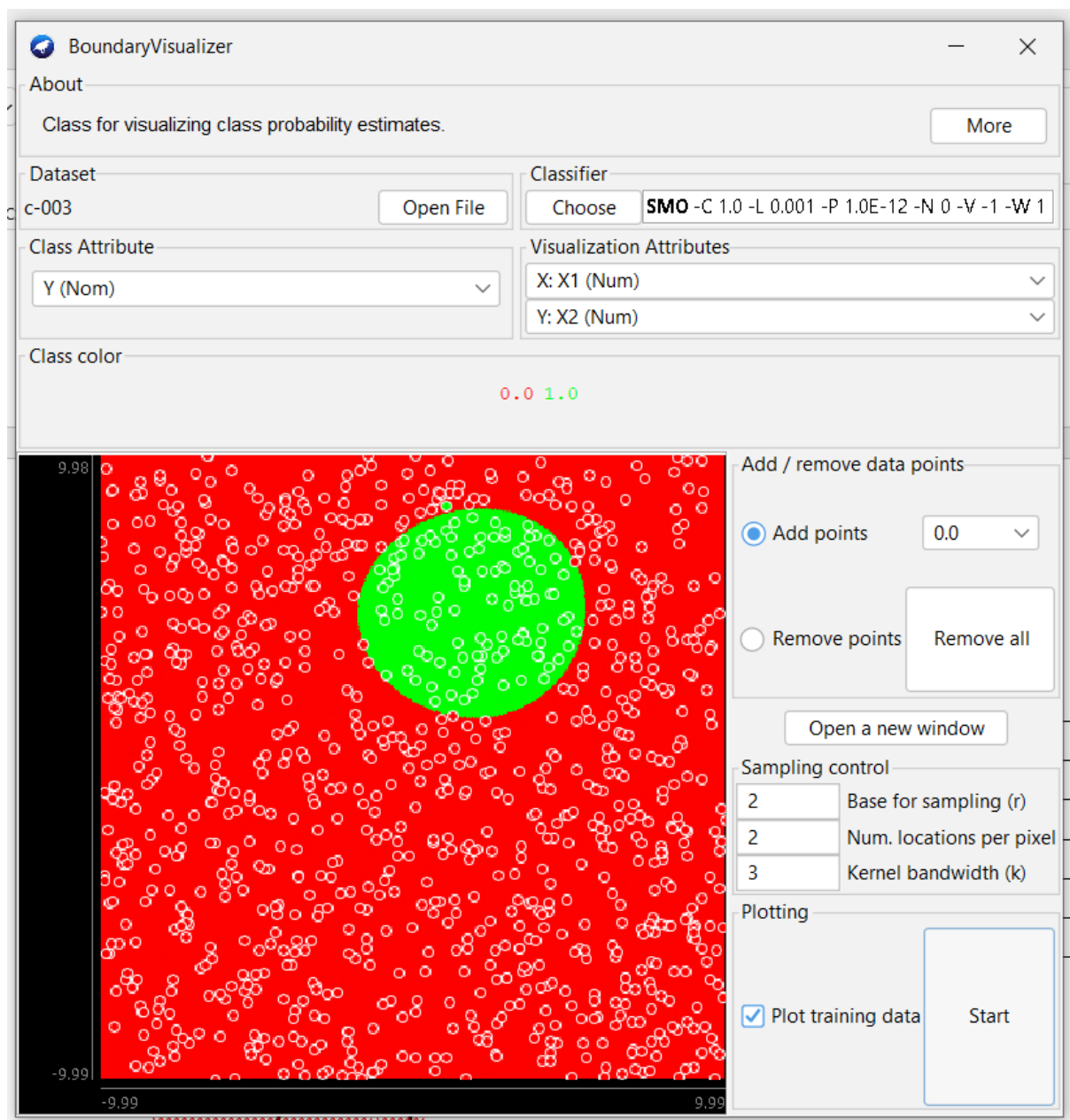
8.10

| Klasyfikator | Parametry | Precision | Recall | F measure |
|----------------|-----------|-----------|----------|-----------|
| NaiveBayes | | 0.958967 | 0.957000 | 0.951831 |
| J48 | | 0.988281 | 0.988000 | 0.988101 |
| IBk | k=5 | 0.994000 | 0.994000 | 0.994000 |
| SMO+PolyKernel | Exp=8 | 0.998000 | 0.998000 | 0.998000 |
| SMO+PolyKernel | Gamma=10 | 0.999001 | 0.999000 | 0.998998 |

J48



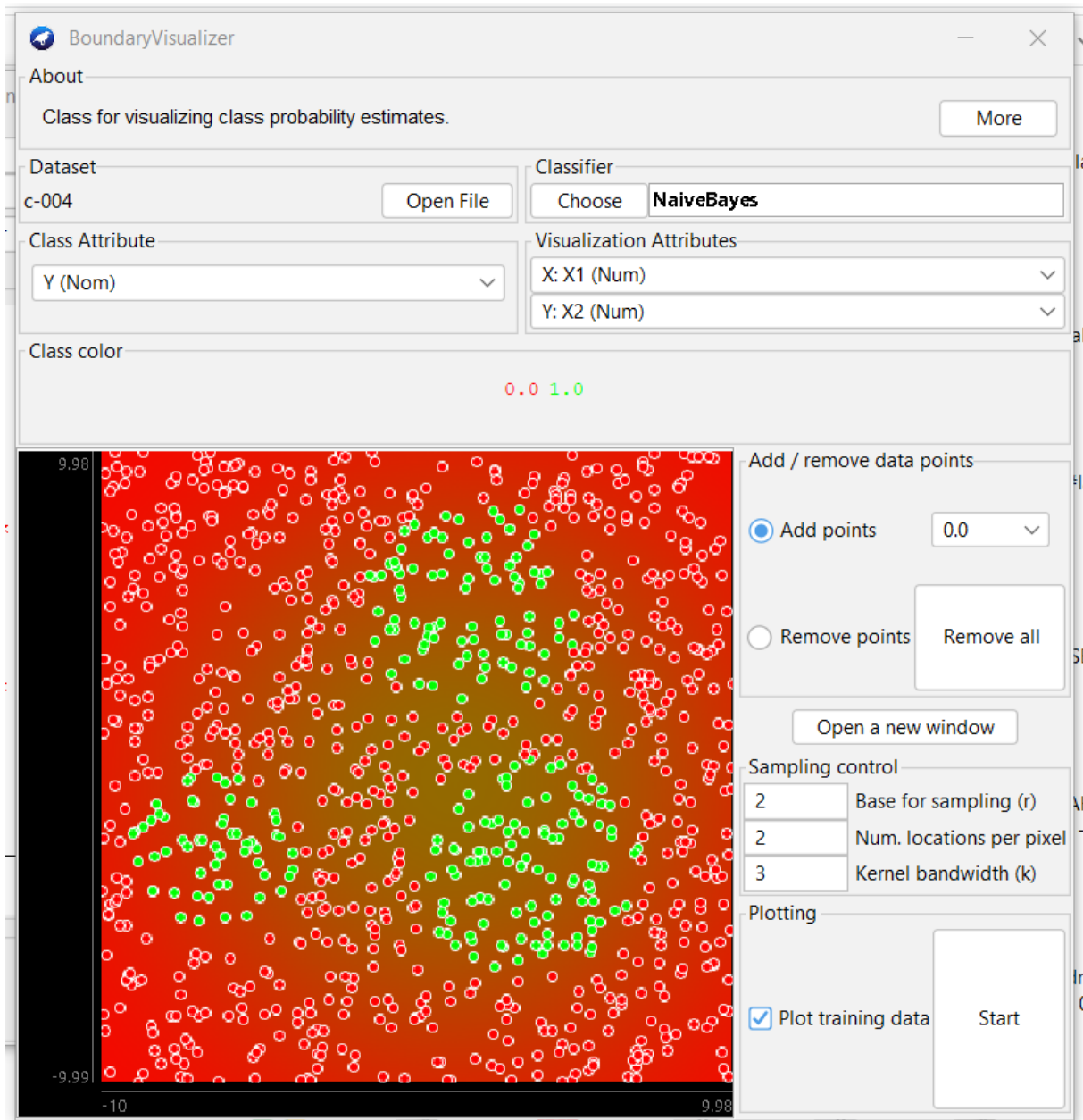
SMO+PolyKernel Exp = 8



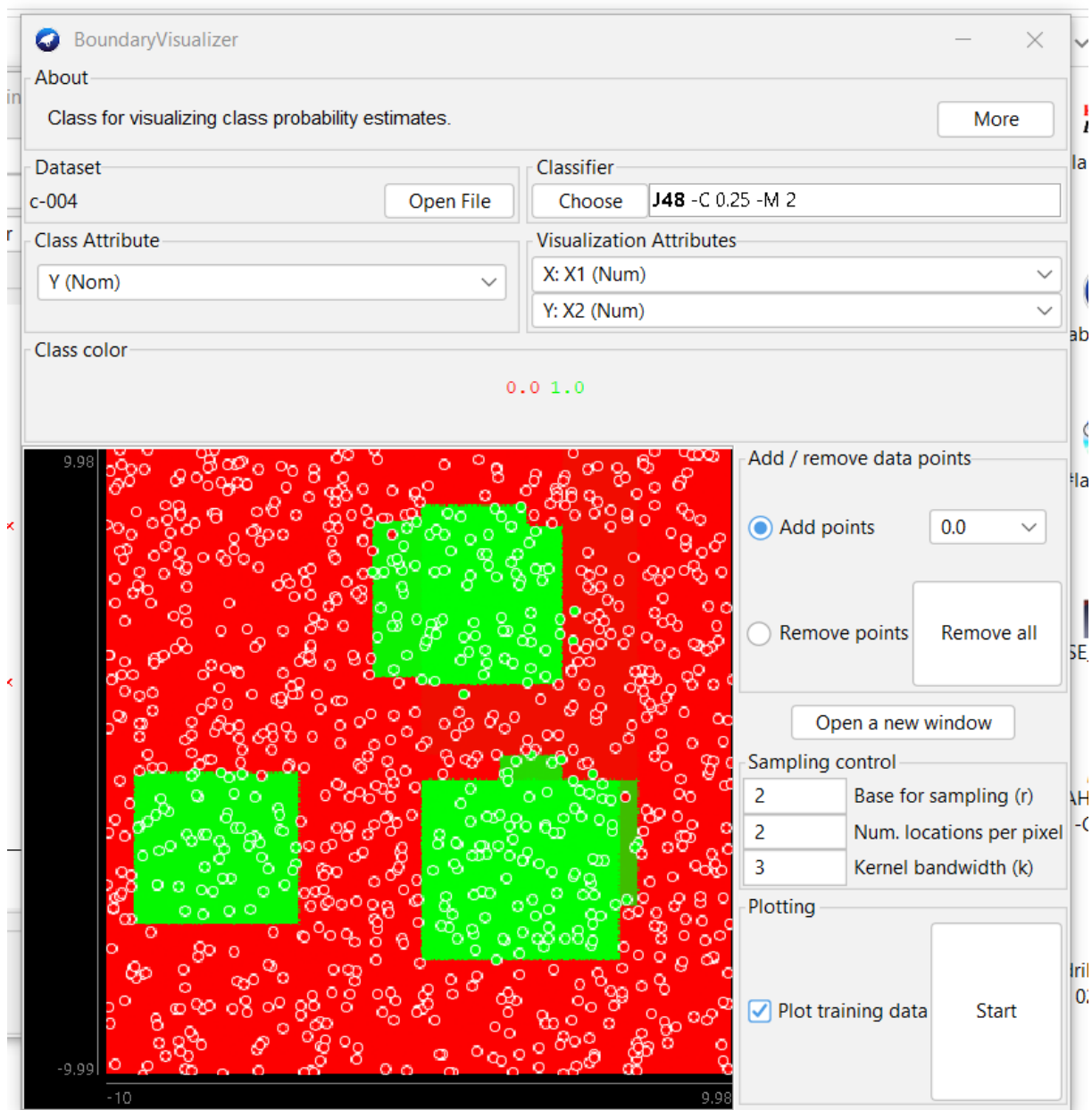
8.11

| Klasyfikator | Parametry | Precision | Recall | F measure |
|----------------|-----------|-----------|----------|-----------|
| NaiveBayes | | 0.564001 | 0.751000 | 0.644204 |
| J48 | | 0.961907 | 0.962000 | 0.961949 |
| IBk | k=5 | 0.969846 | 0.970000 | 0.969877 |
| SMO+PolyKernel | Exp=8 | 0.886017 | 0.889000 | 0.885880 |
| SMO+PolyKernel | Gamma=10 | 0.972955 | 0.973000 | 0.972754 |

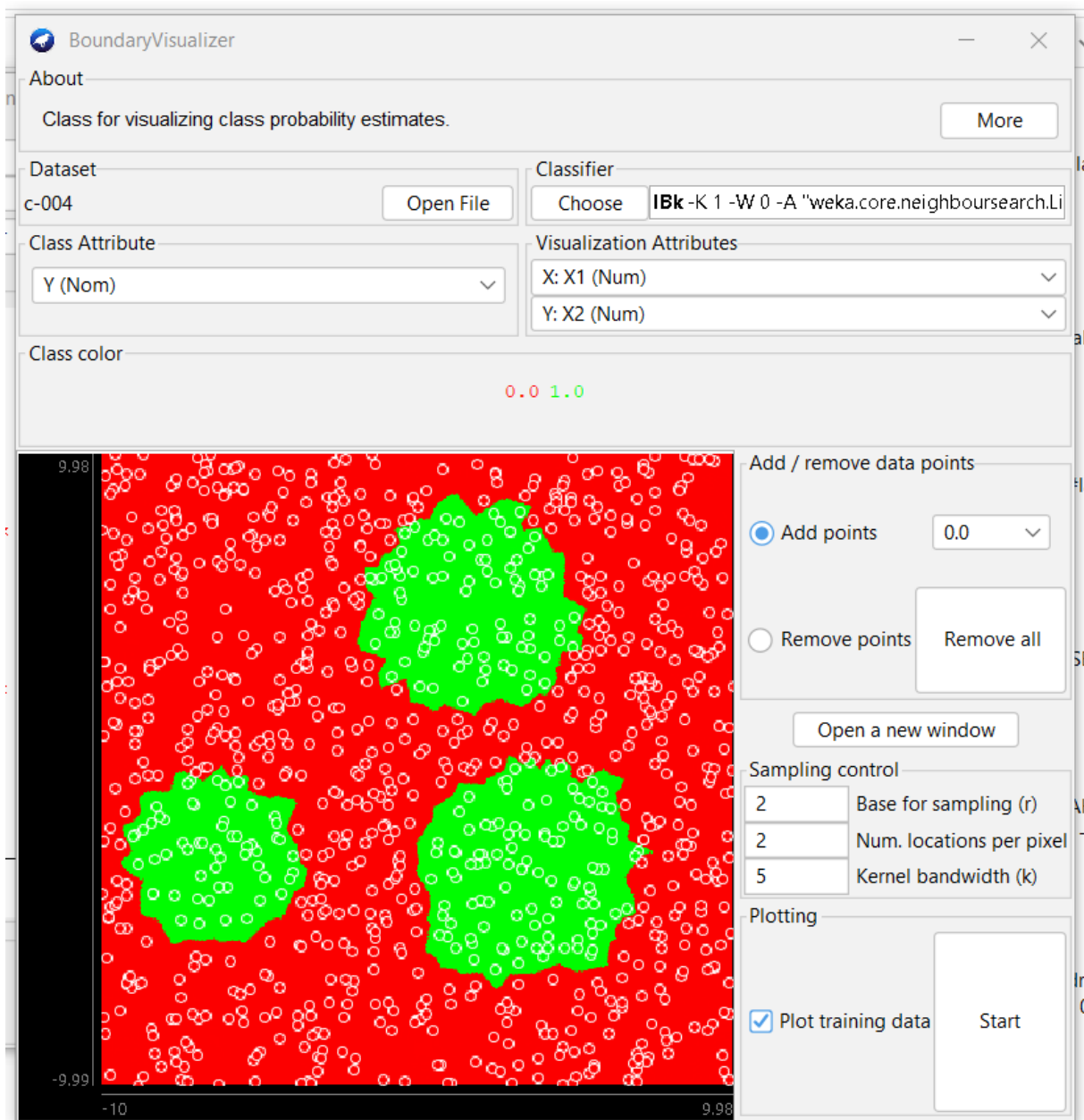
NaiveBayes



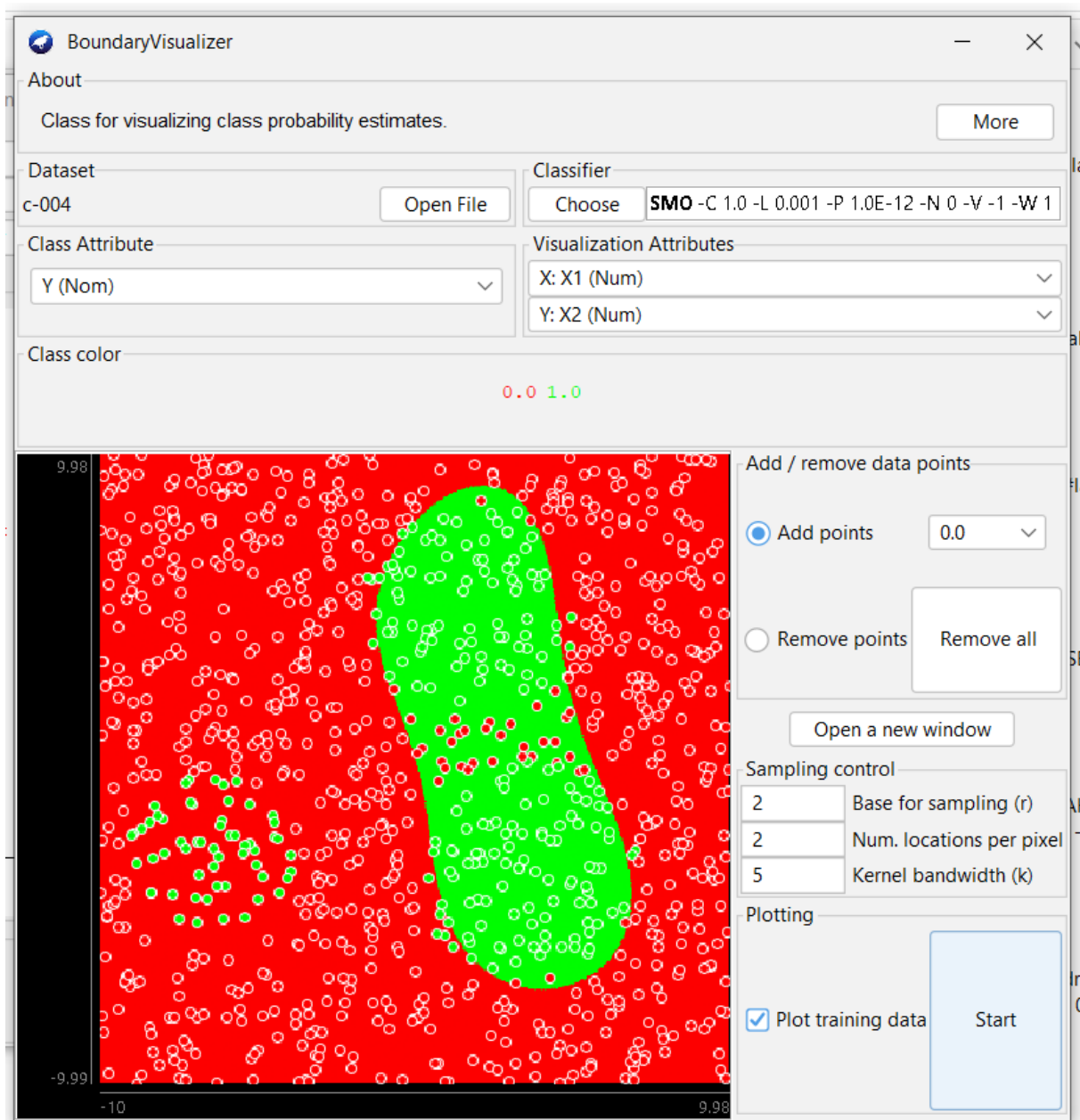
J48



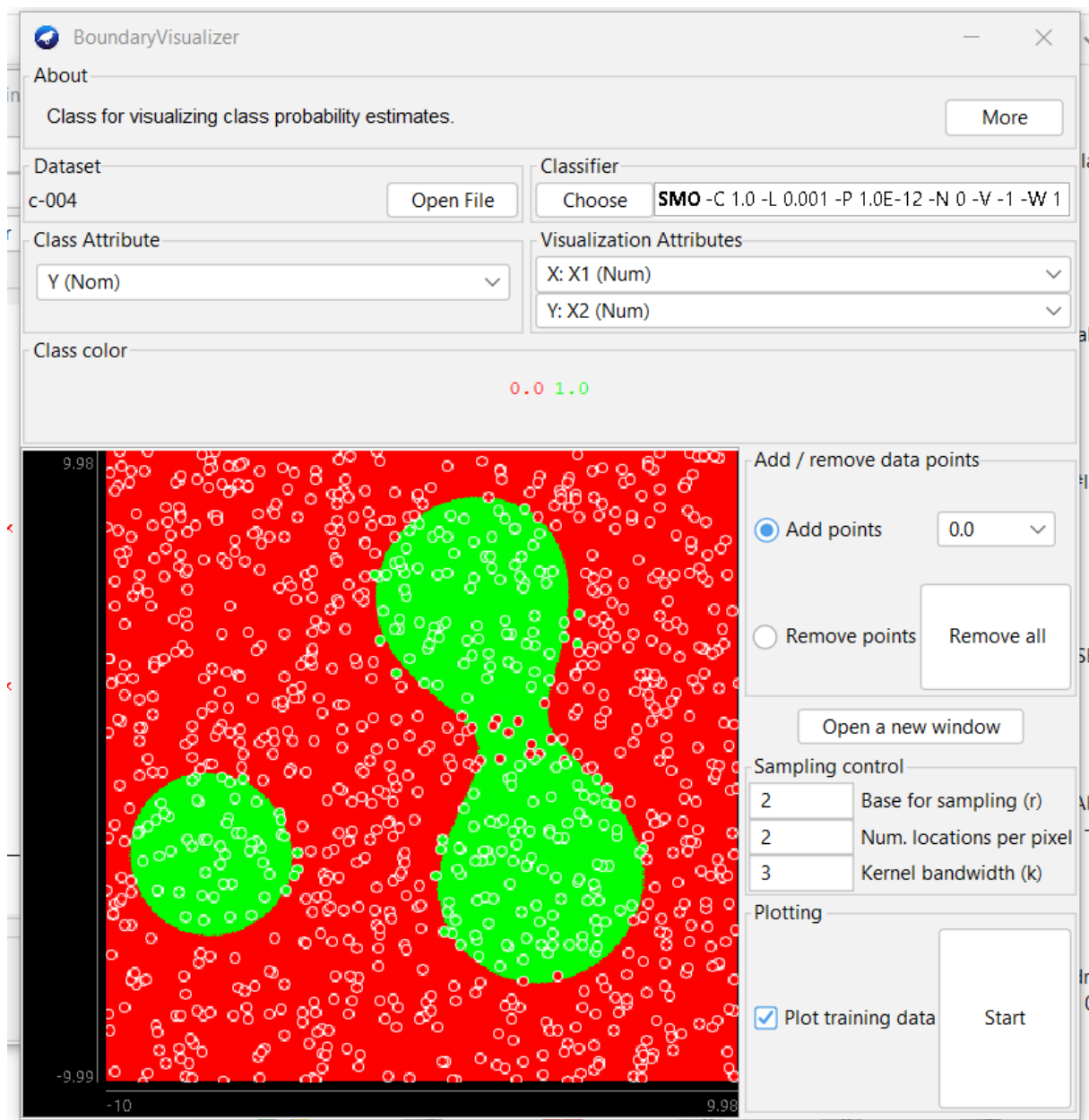
IBk(5)



SMO+PolyKernel Exp = 8



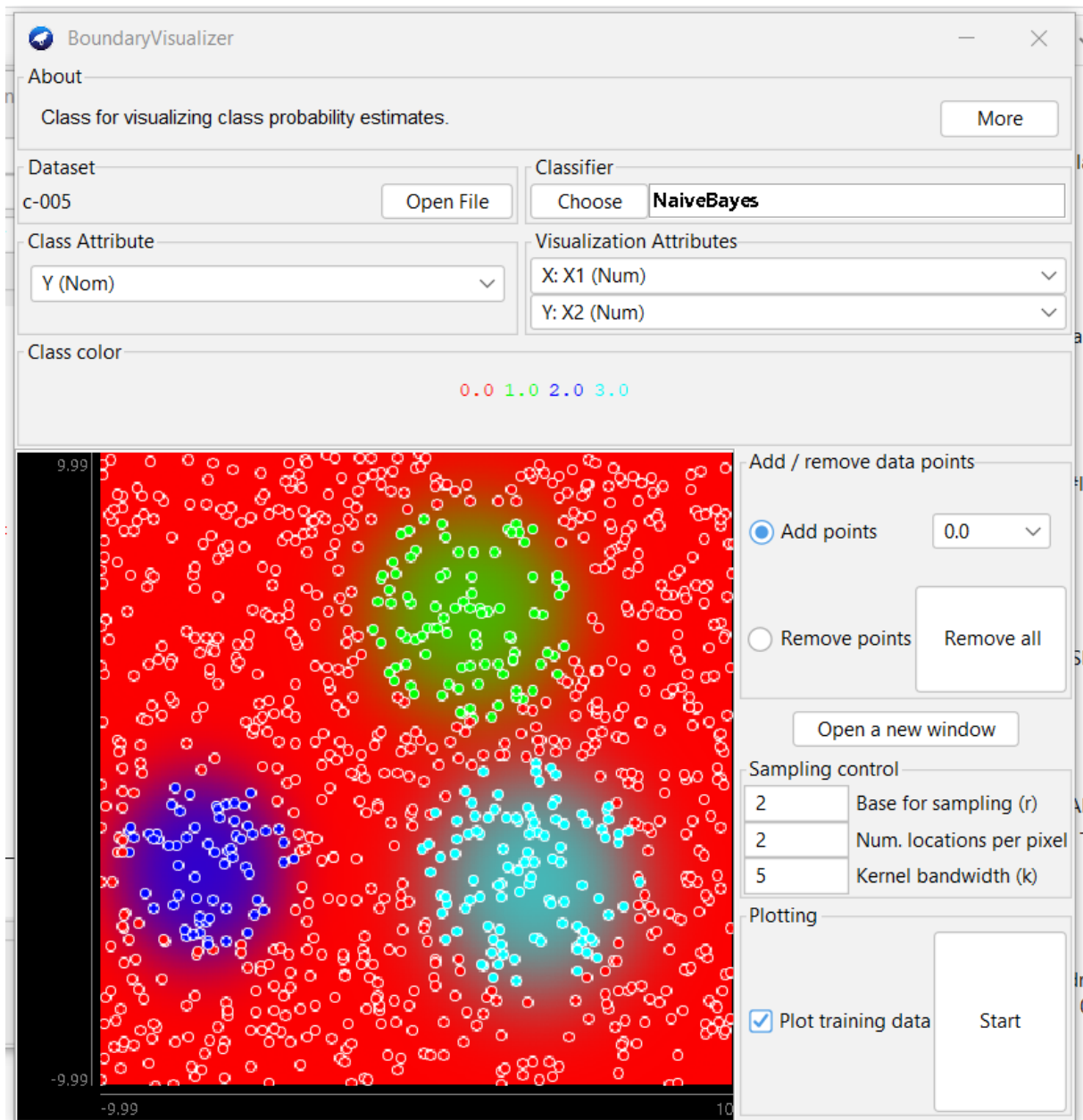
SMO+PolyKernel Gamma = 10

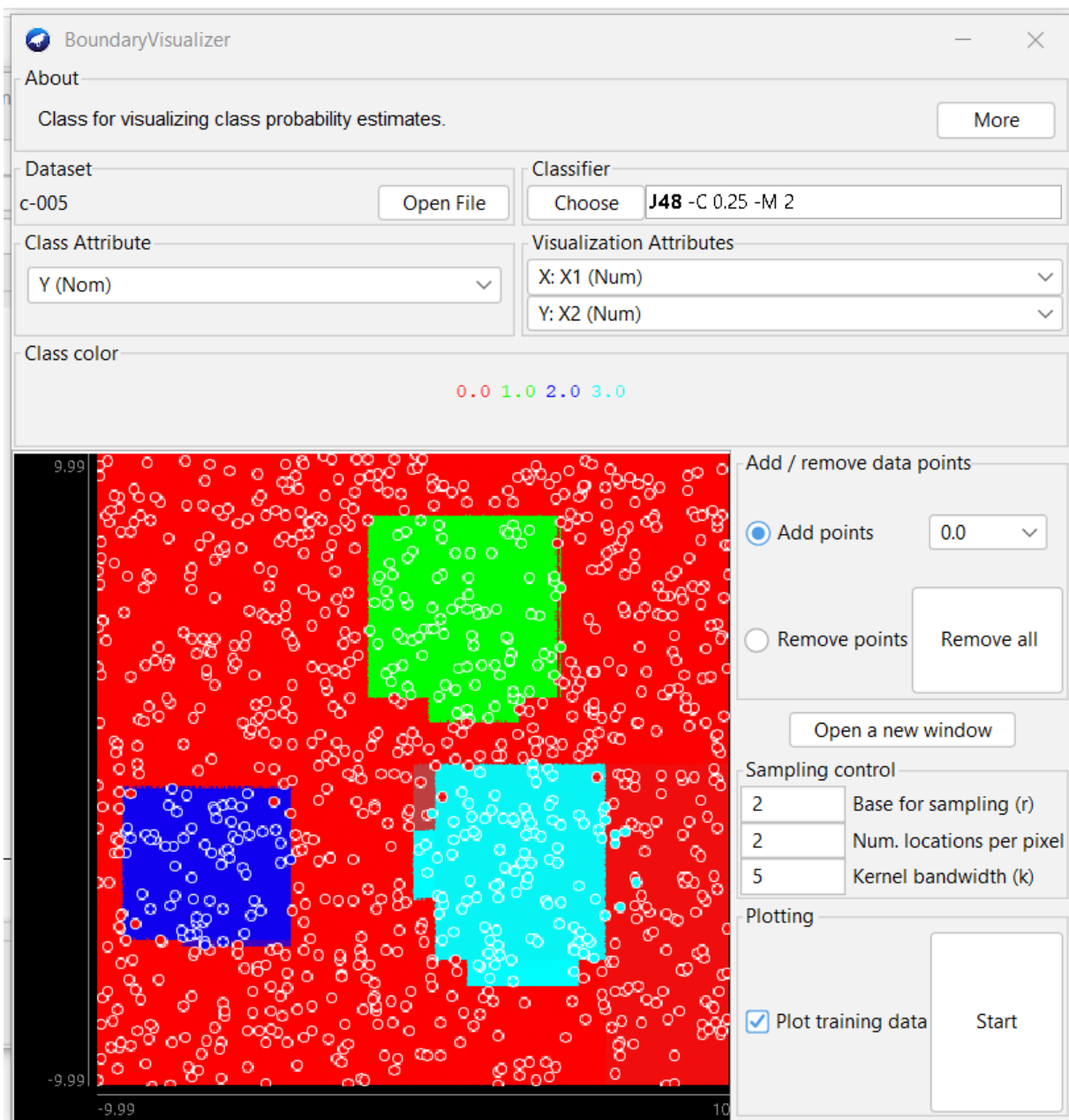


8.12

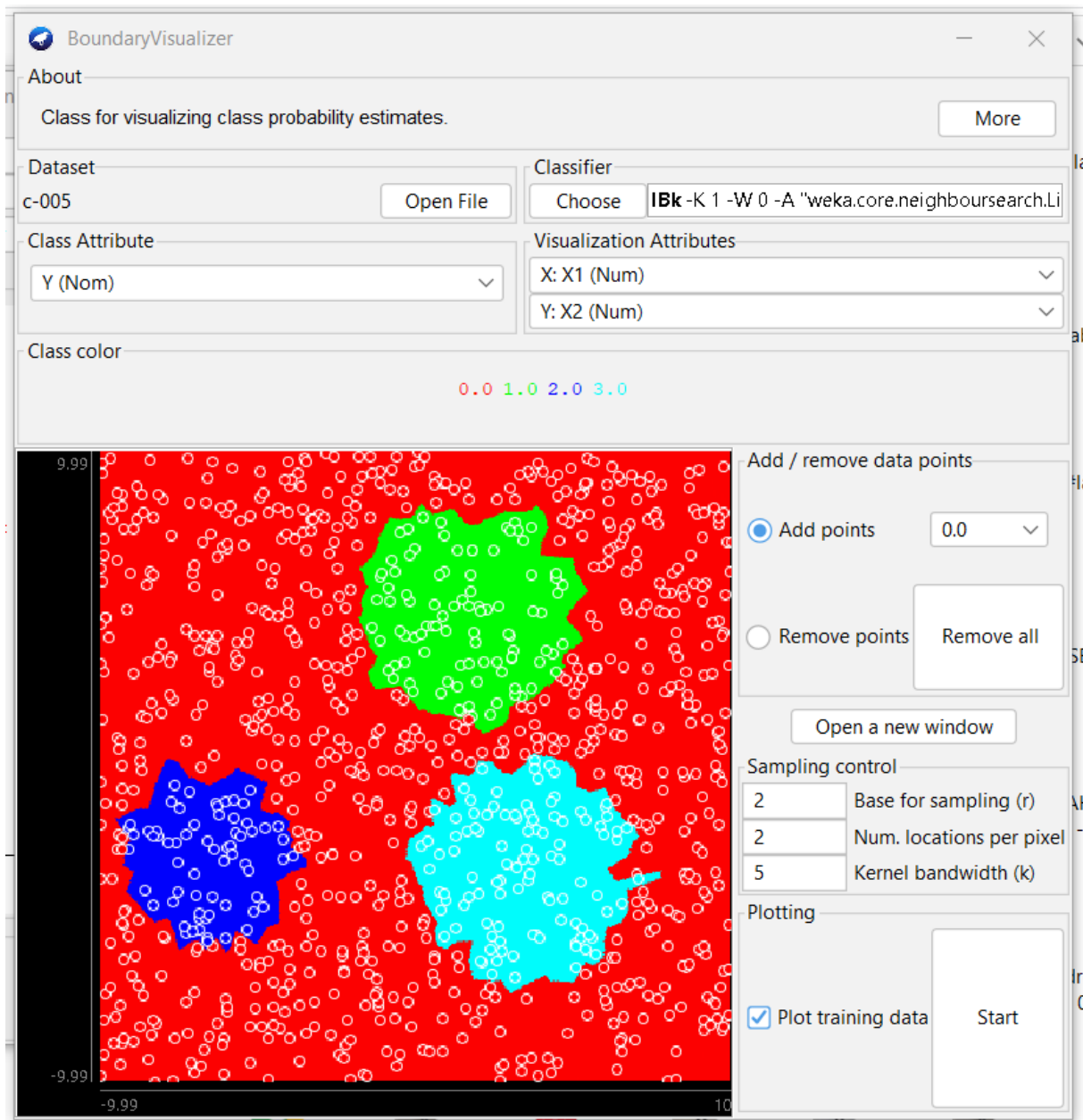
| Klasyfikator | Parametry | Precision | Recall | F measure |
|----------------|-----------|-----------|----------|-----------|
| NaiveBayes | | 0.891733 | 0.873000 | 0.855940 |
| J48 | | 0.934415 | 0.934000 | 0.934119 |
| IBk | k=5 | 0.969501 | 0.969000 | 0.969130 |
| SMO+PolyKernel | Exp=8 | 0.972837 | 0.97300 | 0.972791 |
| SMO+PolyKernel | Gamma=10 | 0.967914 | 0.968000 | 0.967596 |

NaiveBayes

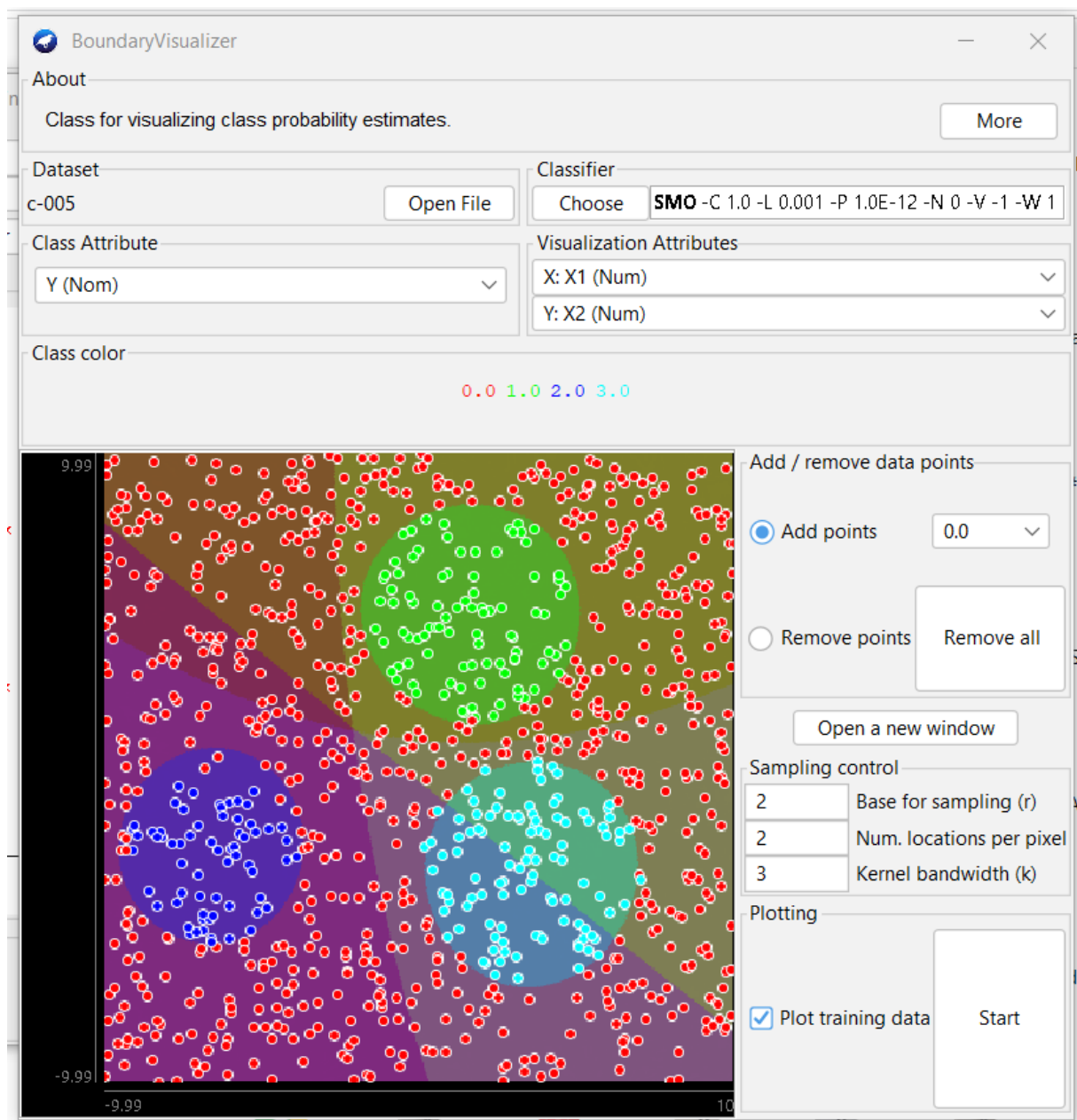




IBk(5)



SMO+PolyKernel Exp = 8



SMO+PolyKernel Gamma = 10

