German Credit Data

```
trainyes = Import[FileNameJoin[{NotebookDirectory[], "german_numeric_train_yes.txt"}],
  "Table"]; (* Using relative path for porting situation *)trainno =
 Import[FileNameJoin[{NotebookDirectory[], "german_numeric_train_no.txt"}], "Table"];
testyes = Import[FileNameJoin[
    {NotebookDirectory[], "german_numeric_test_yes.txt"}], "Table"];
testno = Import[FileNameJoin[{NotebookDirectory[], "german_numeric_test_no.txt"}],
   "Table"];
ruleyes = Rule[#, 1] & /@ trainyes; (* Creating rules to feed Classify *)
ruleno = Rule[#, 2] & /@ trainno;
testyes = Rule[#, 1] & /@ testyes;
testno = Rule[#, 2] & /@ testno;
cl3 = Classify[Join[ruleyes, ruleno], Method → "SupportVectorMachine",
   FeatureTypes → Automatic]; (* Train Classify *)
ClassifierInformation[cl3] (* Get basic information *)
```

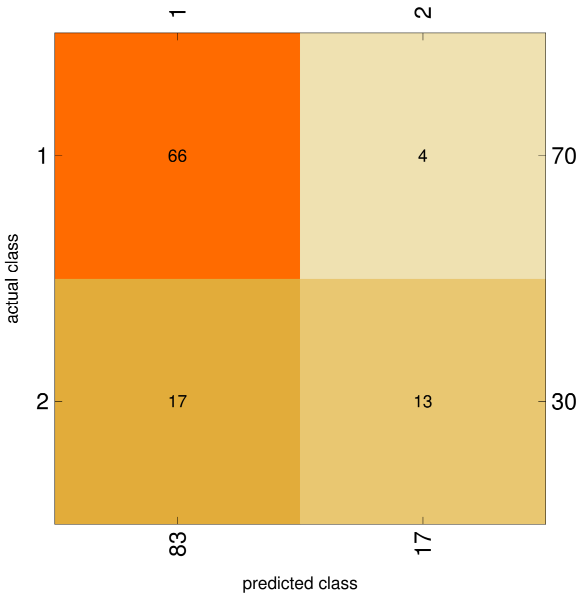
```
Credit Data German
```

```
Classifier information

                      Method | Support vector machine
           Number of classes | 2
          Number of features | 24
 Number of training examples | 900
Number of extracted features | 44
                 Kernel type | Radial basis function
       Soft margin parameter | 16 384.
```

```
cm = ClassifierMeasurements[cl3, Join[testyes, testno]]
```

```
ClassifierMeasurementsObject[ Classifier: SupportVectorMachine
                              Number of test examples: 100
                              Number of classes: 2
                              Accuracy: 0.7800±0.042 ]
```

```
cm["ConfusionMatrixPlot"]
```

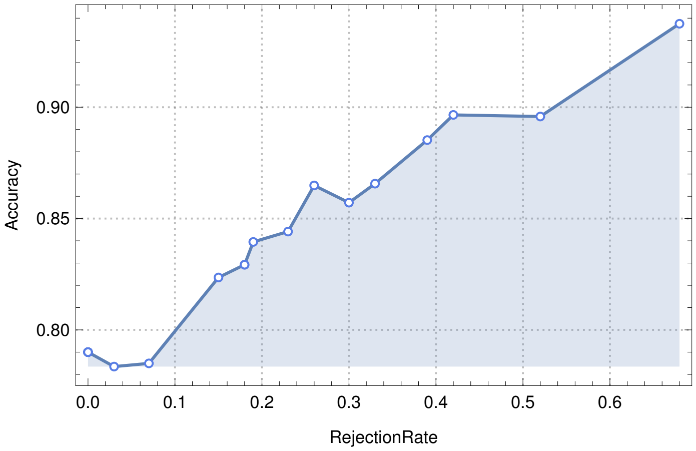


```
cm["Accuracy"]
0.79
```

```
cm["AreaUnderROCCurve"]
<|1 → 0.825714, 2 → 0.825714|>
```

```
cm["ClassRejectionRate"]
<|1 → 0., 2 → 0.|>
```

```
cm["AccuracyRejectionPlot"]
```



```
cm["DecisionUtilities"]
```

```
{1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 0., 1., 1., 1., 1., 1., 1., 1., 1.,
 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 0., 1., 1., 1., 1.,
 0., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 0., 1., 1.,
 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 0., 0., 1., 1., 0., 1., 1., 0., 1.,
 0., 1., 0., 0., 1., 1., 0., 1., 0., 1., 1., 0., 0., 0., 1., 0., 0., 0., 0., 0.}
```

```
cm["GeometricMeanProbability"]
```

```
0.592158
```

```
cm["LogLikelihood"]
```

```
-52.3981
```

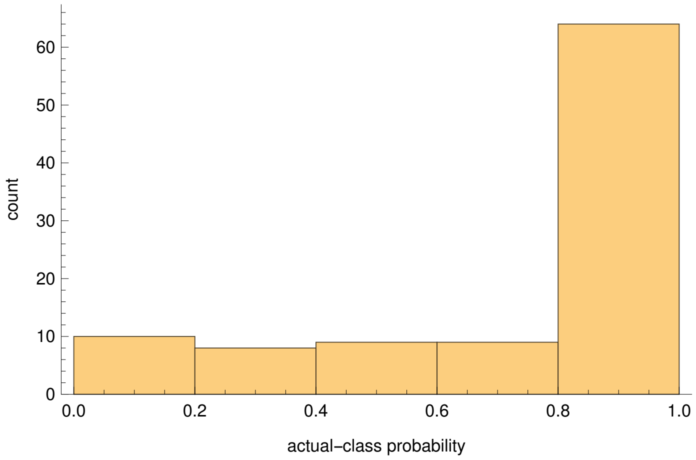
```
cm["MisclassifiedExamples"]
```

```
{{4, 36, 0, 26, 1, 3, 3, 2, 3, 27, 3, 2, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 1,
 {1, 24, 2, 24, 1, 5, 3, 4, 1, 64, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0} → 1,
 {2, 48, 1, 122, 5, 1, 3, 4, 4, 36, 3, 1, 1, 2, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0} → 1,
 {1, 15, 2, 14, 1, 3, 2, 4, 3, 28, 3, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0, 1} → 1,
 {2, 24, 4, 47, 1, 2, 2, 4, 3, 25, 1, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0} → 2,
 {3, 18, 2, 21, 1, 3, 3, 2, 1, 37, 2, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1} → 2,
 {2, 18, 2, 130, 1, 1, 2, 4, 4, 38, 3, 1, 1, 2, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0} → 2,
 {2, 15, 2, 8, 1, 5, 3, 3, 3, 37, 3, 1, 2, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {2, 9, 2, 17, 1, 2, 2, 2, 3, 22, 3, 1, 1, 2, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {4, 48, 2, 39, 5, 3, 1, 2, 1, 38, 1, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {2, 36, 2, 27, 2, 3, 2, 4, 4, 50, 3, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1} → 2,
 {4, 18, 3, 22, 1, 3, 4, 2, 3, 28, 3, 1, 1, 2, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {1, 12, 4, 48, 1, 5, 3, 4, 2, 43, 3, 2, 1, 2, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1} → 2,
 {1, 6, 1, 12, 1, 5, 2, 4, 4, 35, 3, 1, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1} → 2,
 {2, 30, 4, 84, 1, 4, 3, 2, 2, 49, 3, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {4, 36, 4, 79, 1, 3, 2, 2, 1, 25, 2, 2, 1, 2, 1, 1, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {2, 12, 2, 15, 5, 3, 4, 1, 1, 25, 3, 1, 1, 2, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {1, 24, 3, 10, 1, 2, 4, 4, 1, 48, 2, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {1, 18, 2, 75, 5, 5, 3, 4, 2, 51, 3, 1, 2, 2, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1} → 2,
 {1, 12, 4, 22, 1, 5, 3, 3, 2, 60, 3, 2, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {4, 18, 4, 15, 1, 3, 3, 2, 2, 32, 1, 2, 1, 1, 1, 1, 0, 1, 0, 0, 1, 0, 0, 1} → 2}
```

```
cm["Precision"]
```

```
<|1 → 0.795181, 2 → 0.764706|>
```

```
cm["ProbabilityHistogram"]
```



```
cm["Properties"]
```

```
{Accuracy, AccuracyRejectionPlot, AreaUnderROCCurve, BestClassifiedExamples,
 ClassifierFunction, ClassMeanCrossEntropy, ClassRejectionRate,
 CohenKappa, ConfusionFunction, ConfusionMatrix, ConfusionMatrixPlot,
 CorrectlyClassifiedExamples, DecisionUtilities, Error, Examples, F1Score,
 FalseDiscoveryRate, FalseNegativeExamples, FalseNegativeRate, FalsePositiveExamples,
 FalsePositiveRate, GeometricMeanProbability, IndeterminateExamples,
 LeastCertainExamples, Likelihood, LogLikelihood, MatthewsCorrelationCoefficient,
 MeanCrossEntropy, MeanDecisionUtility, MisclassifiedExamples, MostCertainExamples,
 NegativePredictedValue, Perplexity, Precision, Probabilities, ProbabilityHistogram,
 Properties, Recall, RejectionRate, ROCCurve, ScottPi, Specificity, TopConfusions,
 TrueNegativeExamples, TruePositiveExamples, WorstClassifiedExamples}
```

```
cm["ScottPi"]
```

```
0.415937
```

```
cm["Specificity"]
```

```
<|1 → 0.433333, 2 → 0.942857|>
```

```
cm["TopConfusions"]
```

```
{1 → 2}
```

```
cm["WorstClassifiedExamples"]
```

```
{{2, 12, 2, 15, 5, 3, 4, 1, 1, 25, 3, 1, 1, 2, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {4, 18, 3, 22, 1, 3, 4, 2, 3, 28, 3, 1, 1, 2, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {1, 18, 2, 75, 5, 5, 3, 4, 2, 51, 3, 1, 2, 2, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1} → 2,
 {1, 12, 4, 22, 1, 5, 3, 3, 2, 60, 3, 2, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {3, 18, 2, 21, 1, 3, 3, 2, 1, 37, 2, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1} → 2,
 {2, 30, 4, 84, 1, 4, 3, 2, 2, 49, 3, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {2, 15, 2, 8, 1, 5, 3, 3, 3, 37, 3, 1, 2, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {4, 48, 2, 39, 5, 3, 1, 2, 1, 38, 1, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1} → 2,
 {1, 15, 2, 14, 1, 3, 2, 4, 3, 28, 3, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0, 1} → 1,
 {4, 18, 4, 15, 1, 3, 3, 2, 2, 32, 1, 2, 1, 1, 1, 1, 0, 1, 0, 0, 1, 0, 0, 1} → 2}
```

```
ClassifierInformation[cl3, "Properties"]
```

```
{BiasParameter, Classes, ClassNumber, ClassPriors, ExampleNumber,
 ExtractedFeatureNumber, FeatureNames, FeatureNumber, FeatureTypes, FunctionProperties,
 GammaScalingParameter, HyperparameterOptimizationMethod, IndeterminateThreshold,
 KernelType, MaxTrainingMemory, Method, MethodDescription, MulticlassMethod,
 PerformanceGoal, PolynomialDegree, Properties, SoftMarginParameter,
 SupportVectorNumbers, TrainingClassPriors, TrainingTime, UtilityFunction}
```

Australian Credit Data

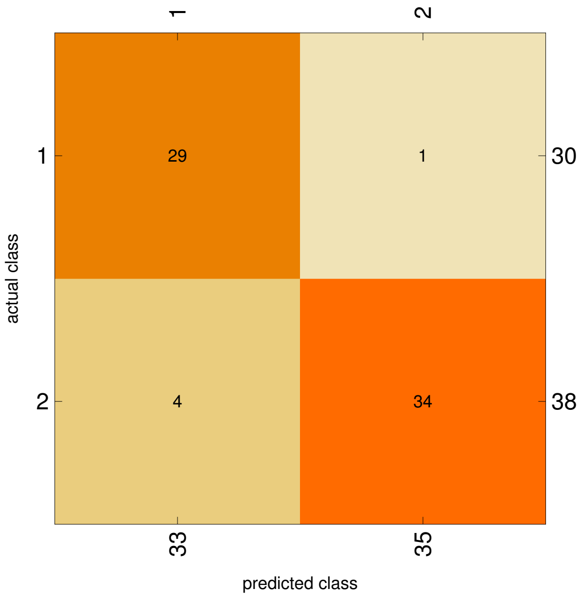
```
autrainyes =
  Import[FileNameJoin[{NotebookDirectory[], "australian_train_yes.txt"}], "Table"];
autrainno = Import[FileNameJoin[{NotebookDirectory[], "australian_train_no.txt"}],
   "Table"];
autestyes = Import[FileNameJoin[{NotebookDirectory[], "australian_test_yes.txt"}],
   "Table"];
autestno = Import[FileNameJoin[{NotebookDirectory[], "australian_test_no.txt"}],
   "Table"];
auruleyes = Rule[#, 1] & /@ autrainyes;
auruleno = Rule[#, 2] & /@ autrainno;
autestyes = Rule[#, 1] & /@ autestyes;
autestno = Rule[#, 2] & /@ autestno;
aucl = Classify[Join[auruleyes, auruleno],
   Method → "SupportVectorMachine", FeatureTypes → Automatic];
ClassifierInformation[aucl]
```

```
Australian Credit Data

Classifier information

                            Method | Support vector machine
                 Number of classes | 2
                Number of features | 14
       Number of training examples | 622
      Number of extracted features | 18
                       Kernel type | Radial basis function
             Soft margin parameter | 2.82843
```

```
aucm = ClassifierMeasurements[aucl, Join[autestyes, autestno]]
```

```
ClassifierMeasurementsObject[ Classifier: SupportVectorMachine
                              Number of test examples: 68
                              Number of classes: 2
                              Accuracy: 0.9265±0.032 ]
```

```
aucm["ConfusionMatrixPlot"]
```

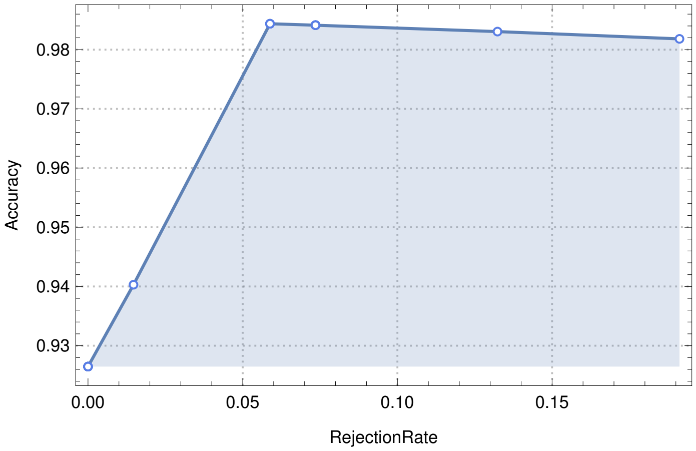


```
aucm["Accuracy"]
0.926471
```

```
aucm["AreaUnderROCCurve"]
<|1 → 0.992105, 2 → 0.992105|>
```

```
aucm["ClassRejectionRate"]
<|1 → 0., 2 → 0.|>
```

```
aucm["AccuracyRejectionPlot"]
```



```
aucm["DecisionUtilities"]
{1., 1., 1., 1., 1., 1., 1., 0., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,
 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 0., 1., 1., 1., 1., 1., 1., 1., 1.,
 1., 1., 1., 1., 1., 1., 0., 1., 1., 1., 1., 1., 1., 1., 0., 1., 1., 1., 1., 1., 1., 0.}
```

```
aucm["GeometricMeanProbability"]
```

```
0.88818
```

```
aucm["LogLikelihood"]
```

```
-8.06346
```

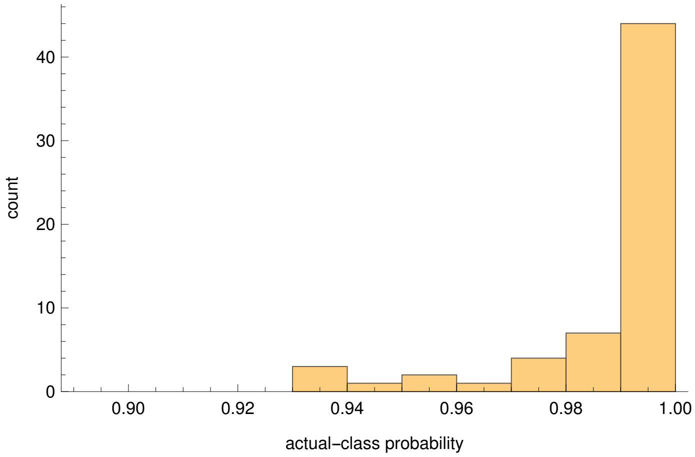
```
aucm["MisclassifiedExamples"]
```

```
{{0, 22.5, 8.46, 1, 14, 4, 2.46, 0, 0, 0, 0, 2, 164, 1} → 1,
 {1, 16.25, 0.835, 2, 7, 4, 0.085, 1, 0, 0, 0, 1, 200, 1} → 2,
 {1, 42.75, 3, 2, 3, 5, 1, 1, 0, 0, 0, 2, 0, 201} → 2,
 {1, 39.83, 0.5, 2, 7, 4, 0.25, 1, 0, 0, 0, 1, 288, 1} → 2,
 {1, 25.67, 2.21, 1, 6, 4, 4, 1, 0, 0, 0, 2, 188, 1} → 2}
```

```
aucm["Precision"]
```

```
<|1 → 0.878788, 2 → 0.971429|>
```

```
aucm["ProbabilityHistogram"]
```



```
aucm["Properties"]
```

```
{Accuracy, AccuracyRejectionPlot, AreaUnderROCCurve, BestClassifiedExamples,
 ClassifierFunction, ClassMeanCrossEntropy, ClassRejectionRate,
 CohenKappa, ConfusionFunction, ConfusionMatrix, ConfusionMatrixPlot,
 CorrectlyClassifiedExamples, DecisionUtilities, Error, Examples, F1Score,
 FalseDiscoveryRate, FalseNegativeExamples, FalseNegativeRate, FalsePositiveExamples,
 FalsePositiveRate, GeometricMeanProbability, IndeterminateExamples,
 LeastCertainExamples, Likelihood, LogLikelihood, MatthewsCorrelationCoefficient,
 MeanCrossEntropy, MeanDecisionUtility, MisclassifiedExamples, MostCertainExamples,
 NegativePredictedValue, Perplexity, Precision, Probabilities, ProbabilityHistogram,
 Properties, Recall, RejectionRate, ROCCurve, ScottPi, Specificity, TopConfusions,
 TrueNegativeExamples, TruePositiveExamples, WorstClassifiedExamples}
```

```
aucm["ScottPi"]
```

```
0.852142
```

```
aucm["Specificity"]
```

```
<|1 → 0.894737, 2 → 0.966667|>
```

```
aucm["TopConfusions"]
```

```
{1 → 2}
```

```
aucm["WorstClassifiedExamples"]
```

```
{{0, 22.5, 8.46, 1, 14, 4, 2.46, 0, 0, 0, 0, 2, 164, 1} → 1,
 {1, 39.83, 0.5, 2, 7, 4, 0.25, 1, 0, 0, 0, 1, 288, 1} → 2,
 {1, 25.67, 2.21, 1, 6, 4, 4, 1, 0, 0, 0, 2, 188, 1} → 2,
 {1, 42.75, 3, 2, 3, 5, 1, 1, 0, 0, 0, 2, 0, 201} → 2,
 {1, 16.25, 0.835, 2, 7, 4, 0.085, 1, 0, 0, 0, 1, 200, 1} → 2,
 {1, 20.5, 10, 1, 8, 4, 2.5, 1, 0, 0, 0, 1, 40, 1} → 1,
 {1, 18.5, 2, 2, 3, 4, 1.5, 1, 1, 2, 0, 2, 120, 301} → 1,
 {0, 18.25, 10, 2, 9, 4, 1, 0, 1, 1, 0, 2, 120, 2} → 2,
 {1, 47.83, 4.165, 2, 14, 5, 0.085, 0, 0, 0, 1, 2, 520, 1} → 2,
 {0, 32.33, 0.54, 2, 13, 4, 0.04, 1, 0, 0, 0, 2, 440, 11 178} → 1}
```

```
ClassifierInformation[aucl, "Properties"]
```

```
{BiasParameter, Classes, ClassNumber, ClassPriors, ExampleNumber,
 ExtractedFeatureNumber, FeatureNames, FeatureNumber, FeatureTypes, FunctionProperties,
 GammaScalingParameter, HyperparameterOptimizationMethod, IndeterminateThreshold,
 KernelType, MaxTrainingMemory, Method, MethodDescription, MulticlassMethod,
 PerformanceGoal, PolynomialDegree, Properties, SoftMarginParameter,
 SupportVectorNumbers, TrainingClassPriors, TrainingTime, UtilityFunction}
```

```
aucl2 = Classify[Join[auruleyes, auruleno],
   Method → {"SupportVectorMachine", "KernelType" → "RadialBasisFunction"},
   FeatureTypes → Automatic];
ClassifierInformation[aucl2]
aucm2 = ClassifierMeasurements[aucl2, Join[autestyes, autestno]]
```

```
Classifier information

                         Method | Support vector machine
              Number of classes | 2
             Number of features | 14
    Number of training examples | 622
   Number of extracted features | 18
                    Kernel type | Radial basis function
          Soft margin parameter | 0.0947323
```

```
ClassifierMeasurementsObject[ Classifier: SupportVectorMachine
                              Number of test examples: 68
                              Number of classes: 2
                              Accuracy: 0.9265±0.032 ]
```

```
gecl = Classify[Join[ruleyes, ruleno],
   Method → {"SupportVectorMachine", "KernelType" → "RadialBasisFunction"},
   FeatureTypes → Automatic]; (* Train Classify *)
ClassifierInformation[gecl]
gecm = ClassifierMeasurements[gecl, Join[testyes, testno]]
```

```
Classifier information

                         Method | Support vector machine
              Number of classes | 2
             Number of features | 24
    Number of training examples | 900
   Number of extracted features | 44
                    Kernel type | Radial basis function
          Soft margin parameter | 8.
```

```
ClassifierMeasurementsObject[ Classifier: SupportVectorMachine
                              Number of test examples: 100
                              Number of classes: 2
                              Accuracy: 0.7800±0.042 ]
```

References:

- functionalities
https://mathematica.stackexchange.com/questions/14987/machine-learning-svm-algorithm
https://www.reddit.com/r/Mathematica/comments/2rzjd3/classify_and_kernel_svm_in_mathematica/
https://mathematica.stackexchange.com/questions/6013/relative-paths-for-portable-notebooks-in-mathematica

- possible bugs in Mathematica
https://mathematica.stackexchange.com/questions/106008/how-to-get-the-training-error-and-the-validation-error-using-classify-function-w
https://mathematica.stackexchange.com/questions/106195/error-when-training-support-vector-machine-svm-classifier