MACHINE LEARNING WITH WEKA

Note: these slides are obtained from the WEKA website. But I did modify the slides to include only contents related to the homework in this subject.

WEKA: the software

- Machine learning/data mining software written in Java (distributed under the GNU Public License)
- Used for research, education, and applications
- Complements “Data Mining” by Witten & Frank
- Main features:
  - Comprehensive set of data pre-processing tools, learning algorithms and evaluation methods
  - Graphical user interfaces (incl. data visualization)
  - Environment for comparing learning algorithms

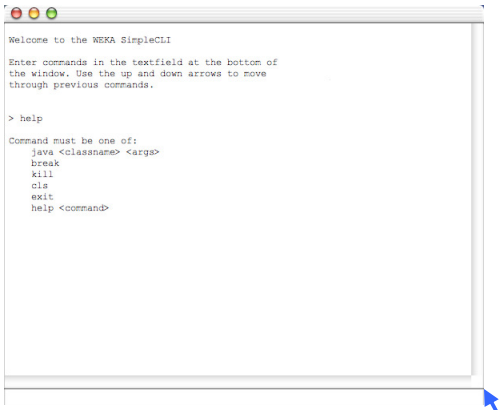
WEKA only deals with “flat” files

```
@relation heart-disease-simplified

@attribute age numeric
@attribute sex { female, male}
@attribute chest_pain_type { typ_angina, asympt, non_anginal, atyp_angina}
@attribute cholesterol numeric
@attribute exercise_induced_angina { no, yes}
@attribute class { present, not_present}

@data
63,male,typ_angina,233,no,not_present
67,male,asympt,286,yes,present
67,male,asympt,229,yes,present
38,female,non_anginal,?,no,not_present
...
```

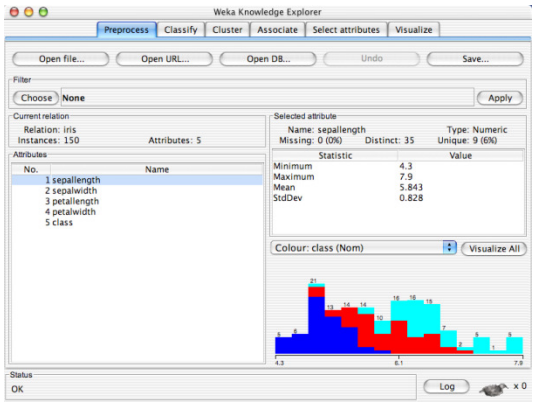
Flat file in ARFF format

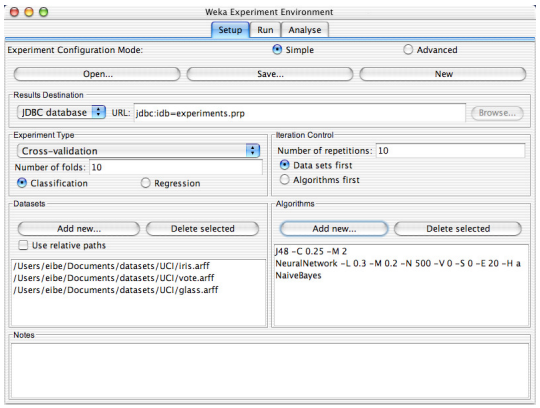
WEKA only deals with “flat” files

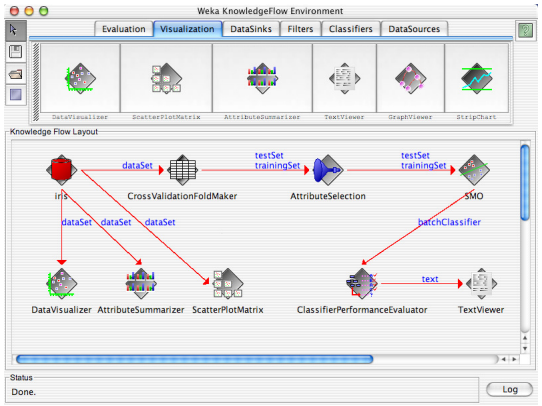

```
@relation heart-disease-simplified

@attribute age numeric
@attribute sex { female, male}
@attribute chest_pain_type { typ_angina, asympt, non_anginal, atyp_angina}
@attribute cholesterol numeric
@attribute exercise_induced_angina { no, yes}
@attribute class { present, not_present}

@data
63,male,typ_angina,233,no,not_present
67,male,asympt,286,yes,present
67,male,asympt,229,yes,present
38,female,non_anginal,?,no,not_present
...
```


Welcome to the WEKA SimpleCLI
Enter commands in the textfield at the bottom of the window. Use the up and down arrows to move through previous commands.
> help
Command must be one of:
java <classname> <args>
break
kill
cls
exit
help <command>


Weka GUI Chooser
Waikato Environment for Knowledge Analysis
(c) 1999 - 2003
University of Waikato
New Zealand
GUI
Simple CLI
Explorer
Experimenter
KnowledgeFlow


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
None
Apply
Current relation
Relation: iris
Instances: 150
Attributes: 5
Selected attribute
Name: sepallength
Missing: 0 (0%)
Distinct: 35
Type: Numeric
Unique: 9 (6%)
Attributes
No.
Name
1 sepallength
2 sepalwidth
3 petallength
4 petalwidth
5 class
Statistic
Value
Minimum 4.3
Maximum 7.9
Mean 5.843
StdDev 0.828
Colour: class (Nom)
Visualize All
Status
OK
Log
x 0


Weka Experiment Environment
Setup
Run
Analyse
Experiment Configuration Mode:
Simple
Advanced
Open...
Save...
New
Results Destination
JDBC database
URL: jdbc:idb=experiments.prp
Browse...
Experiment Type
Cross-validation
Number of folds: 10
Classification
Regression
Iteration Control
Number of repetitions: 10
Data sets first
Algorithms first
Datasets
Add new...
Delete selected
Use relative paths
/Users/eibe/Documents/datasets/UCI/iris.arff
/Users/eibe/Documents/datasets/UCI/vote.arff
/Users/eibe/Documents/datasets/UCI/glass.arff
Algorithms
Add new...
Delete selected
J48 -C 0.25 -M 2
NeuralNetwork -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H a
NaiveBayes
Notes


Weka KnowledgeFlow Environment
Evaluation
Visualization
DataSinks
Filters
Classifiers
DataSources
Knowledge Flow Layout
iris
dataSet
CrossValidationFoldMaker
testSet
trainingSet
AttributeSelection
SMO
batchClassifier
DataVisualizer
AttributeSummarizer
ScatterPlotMatrix
ClassifierPerformanceEvaluator
text
TextViewer
Status
Done.
Log


Welcome to the WEKA SimpleCLI
> help
Command must be one of:
java <classname> <args>
break
kill
cls
exit
help <command>


Weka GUI Chooser
Waikato Environment for Knowledge Analysis
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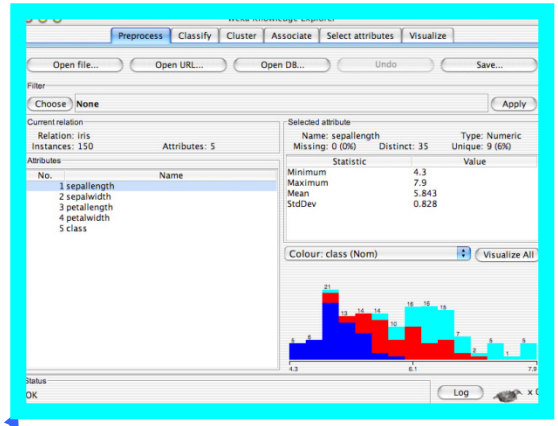
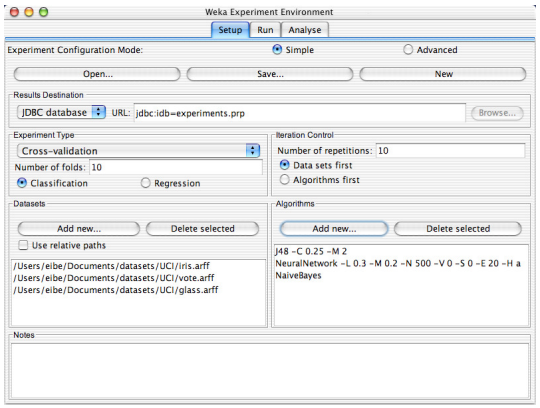
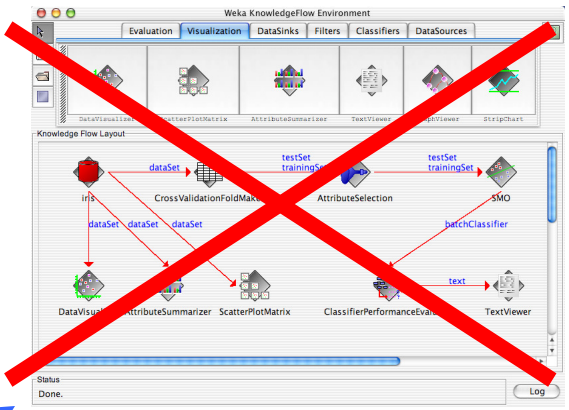
New Zealand
GUI
Simple CLI
Explorer
Experimenter
KnowledgeFlow

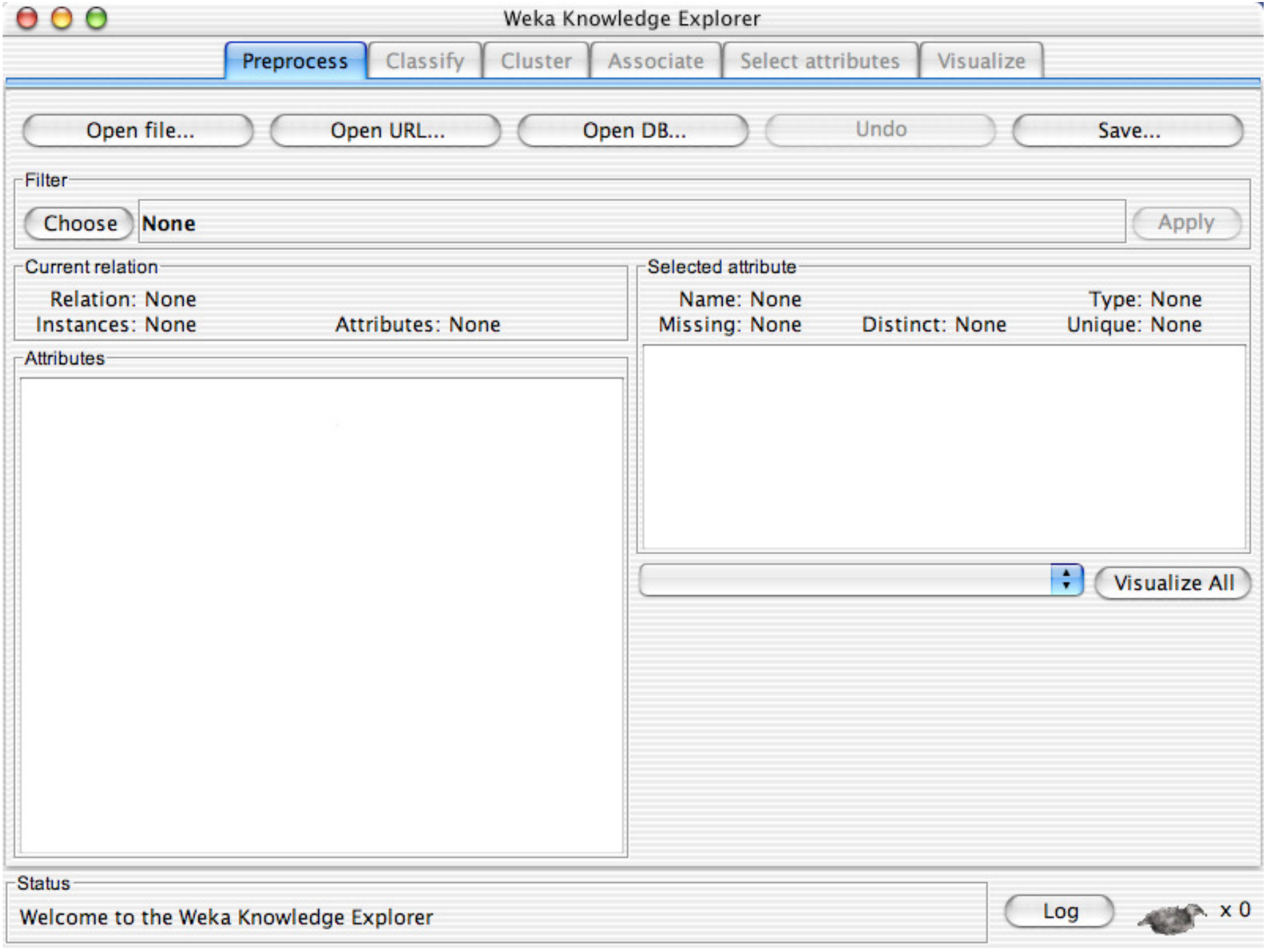

Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Choose
None
Apply
Relation: iris
Instances: 150
Attributes: 5
1 sepallength
2 sepalwidth
3 petallength
4 petalwidth
5 class
Minimum 4.3
Maximum 7.9
Mean 5.843
StdDev 0.828
Colour: class (Nom)
Visualize All
Status
OK
Log

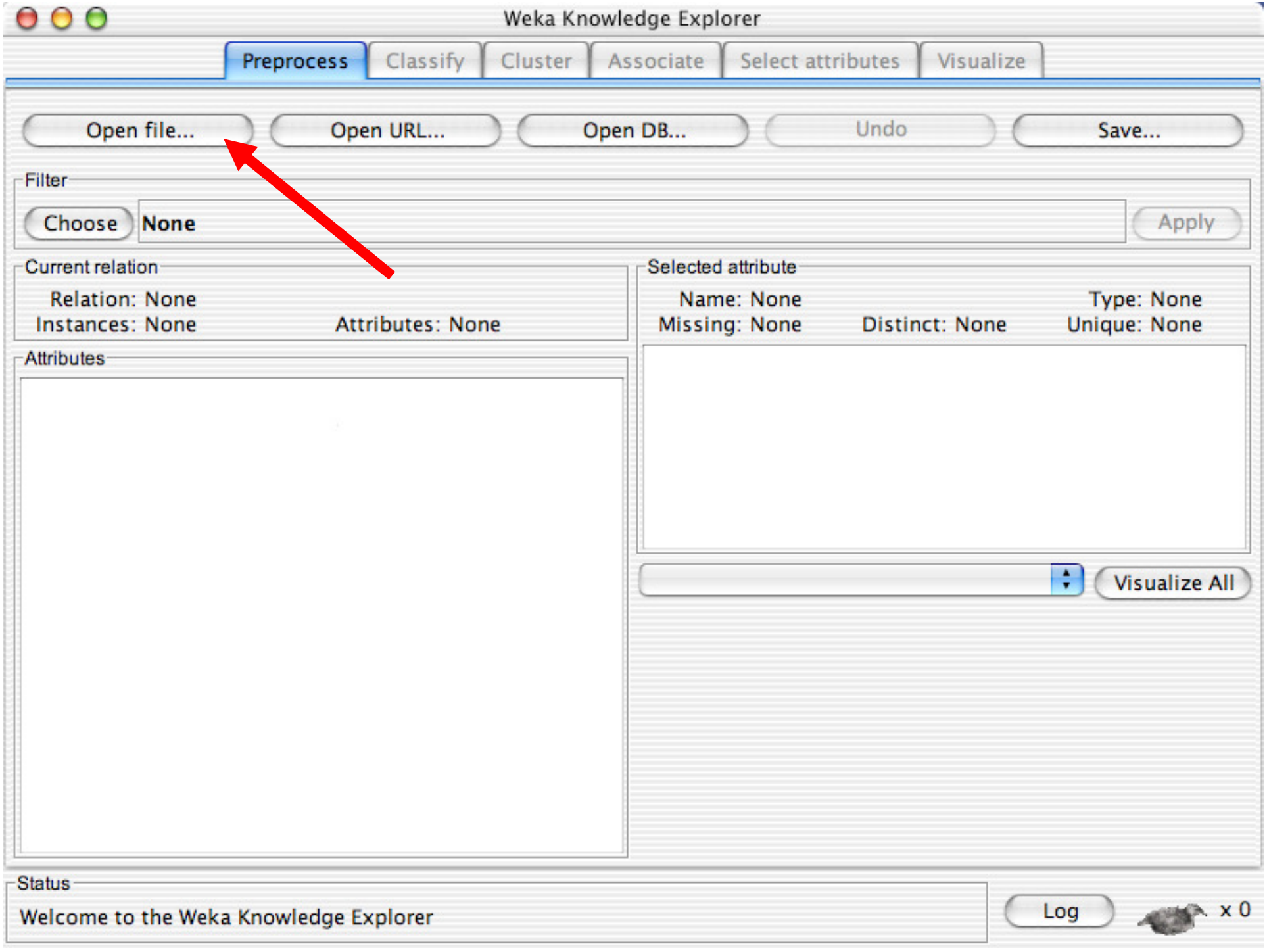

Weka Experiment Environment
Setup
Run
Analyse
Experiment Configuration Mode:
Simple
Advanced
Open...
Save...
New
Results Destination
JDBC database
URL: jdbc:idb=experiments.prp
Experiment Type
Cross-validation
Number of folds: 10
Classification
Regression
Iteration Control
Number of repetitions: 10
Data sets first
Algorithms first
Datasets
Add new...
Delete selected
Use relative paths
/Users/eibe/Documents/datasets/UCI/iris.arff
/Users/eibe/Documents/datasets/UCI/vote.arff
/Users/eibe/Documents/datasets/UCI/glass.arff
Algorithms
Add new...
Delete selected
J48 -C 0.25 -M 2
NeuralNetwork -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H a
NaiveBayes
Notes


Weka KnowledgeFlow Environment
Evaluation
Visualization
DataSinks
Filters
Classifiers
DataSources
Knowledge Flow Layout
iris
CrossValidationFoldMaker
AttributeSelection
SMO
DataVisualizer
AttributeSummarizer
ScatterPlotMatrix
ClassifierPerformanceEvaluator
TextViewer
dataSet
testSet
trainingSet
batchClassifier
text
Status
Done.
Log

Explorer: pre-processing the data

- Data can be imported from a file in various formats: ARFF, CSV, C4.5, binary
- Data can also be read from a URL or from an SQL database (using JDBC)
- Pre-processing tools in WEKA are called “filters”
- WEKA contains filters for:
  - Discretization, normalization, resampling, attribute selection, transforming and combining attributes, …


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
None
Apply
Current relation
Relation: None
Instances: None
Attributes: None
Selected attribute
Name: None
Type: None
Missing: None
Distinct: None
Unique: None
Attributes
Visualize All
Status
Welcome to the Weka Knowledge Explorer
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
None
Apply
Current relation
Relation: None
Instances: None
Attributes: None
Selected attribute
Name: None
Type: None
Missing: None
Distinct: None
Unique: None
Attributes
Visualize All
Status
Welcome to the Weka Knowledge Explorer
Log
x 0

Weka Knowledge Explorer

Preprocess | Classify | Cluster | Associate | Select attributes | Visualize

Open file... | Open URL... | Open DB... | Undo | Save...

Filter

Choose **None** | Apply

Current relation

Relation: iris
Instances: 150 Attributes: 5

Attributes

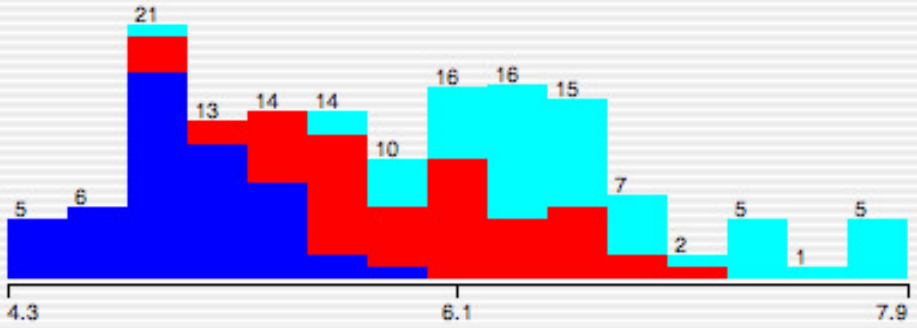
No.	Name
1	sepallength
2	sepalwidth
3	petallength
4	petalwidth
5	class

Selected attribute

Name: sepallength Type: Numeric
Missing: 0 (0%) Distinct: 35 Unique: 9 (6%)

Statistic	Value
Minimum	4.3
Maximum	7.9
Mean	5.843
StdDev	0.828

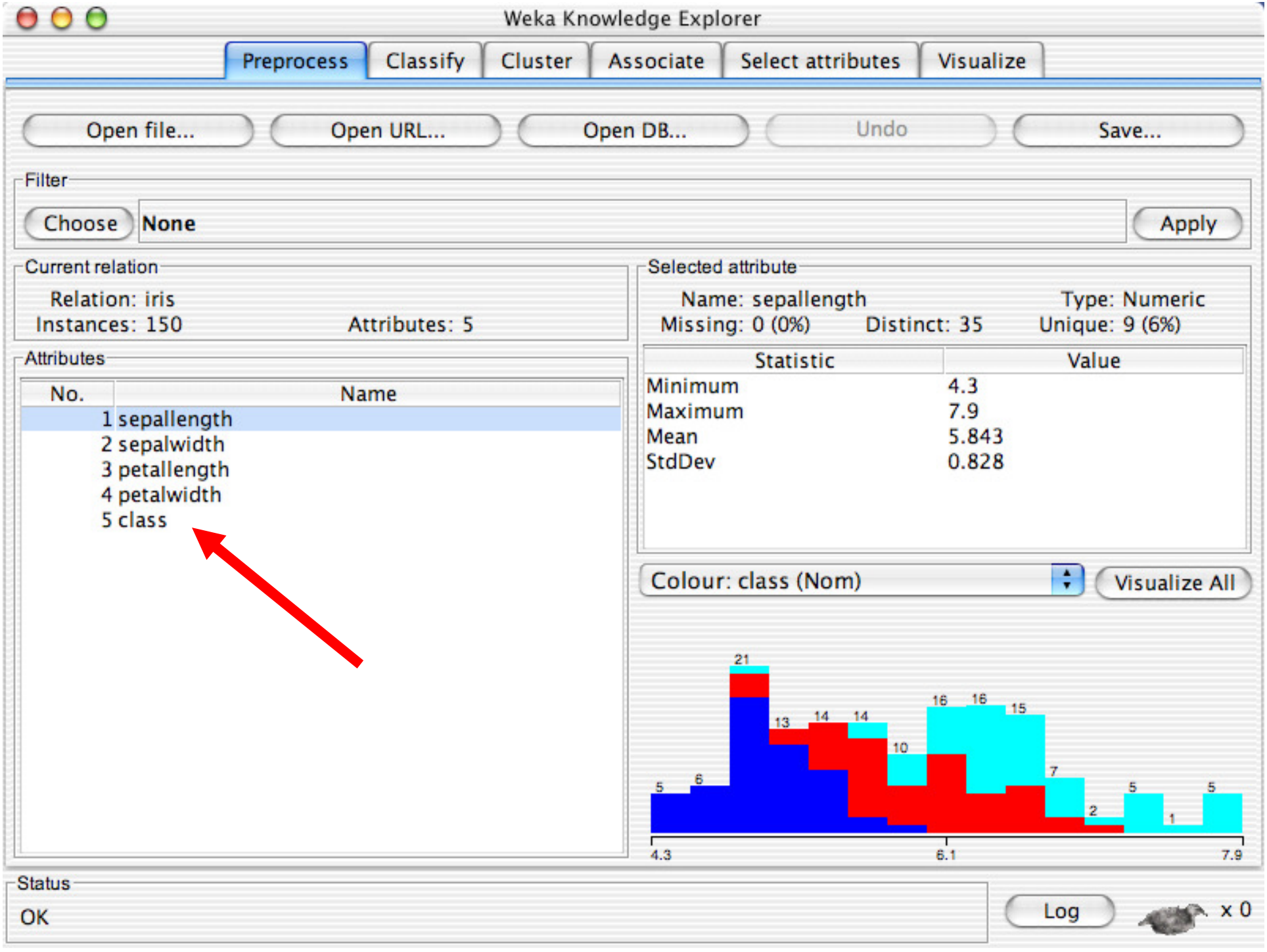
Colour: class (Nom) | Visualize All

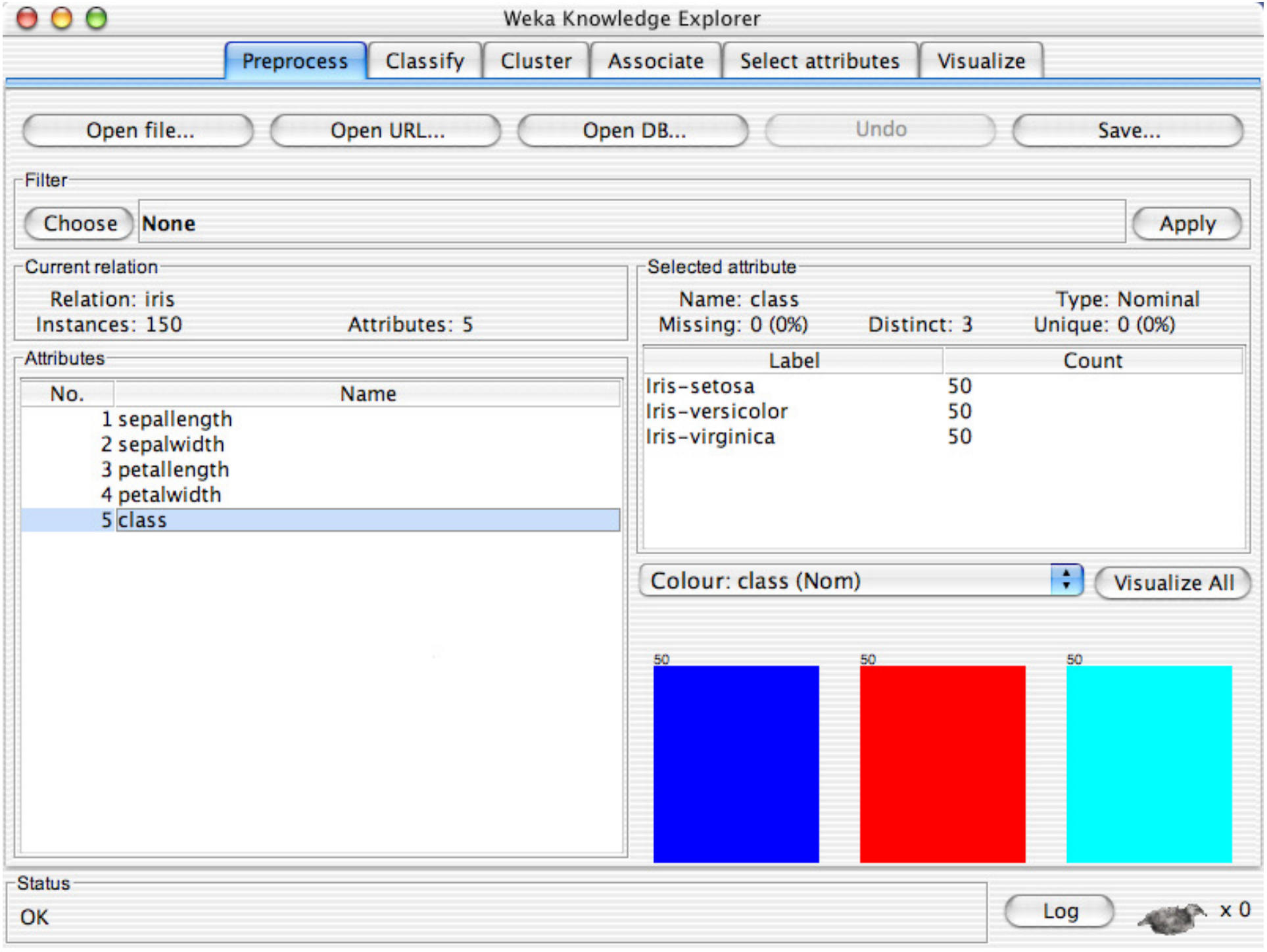


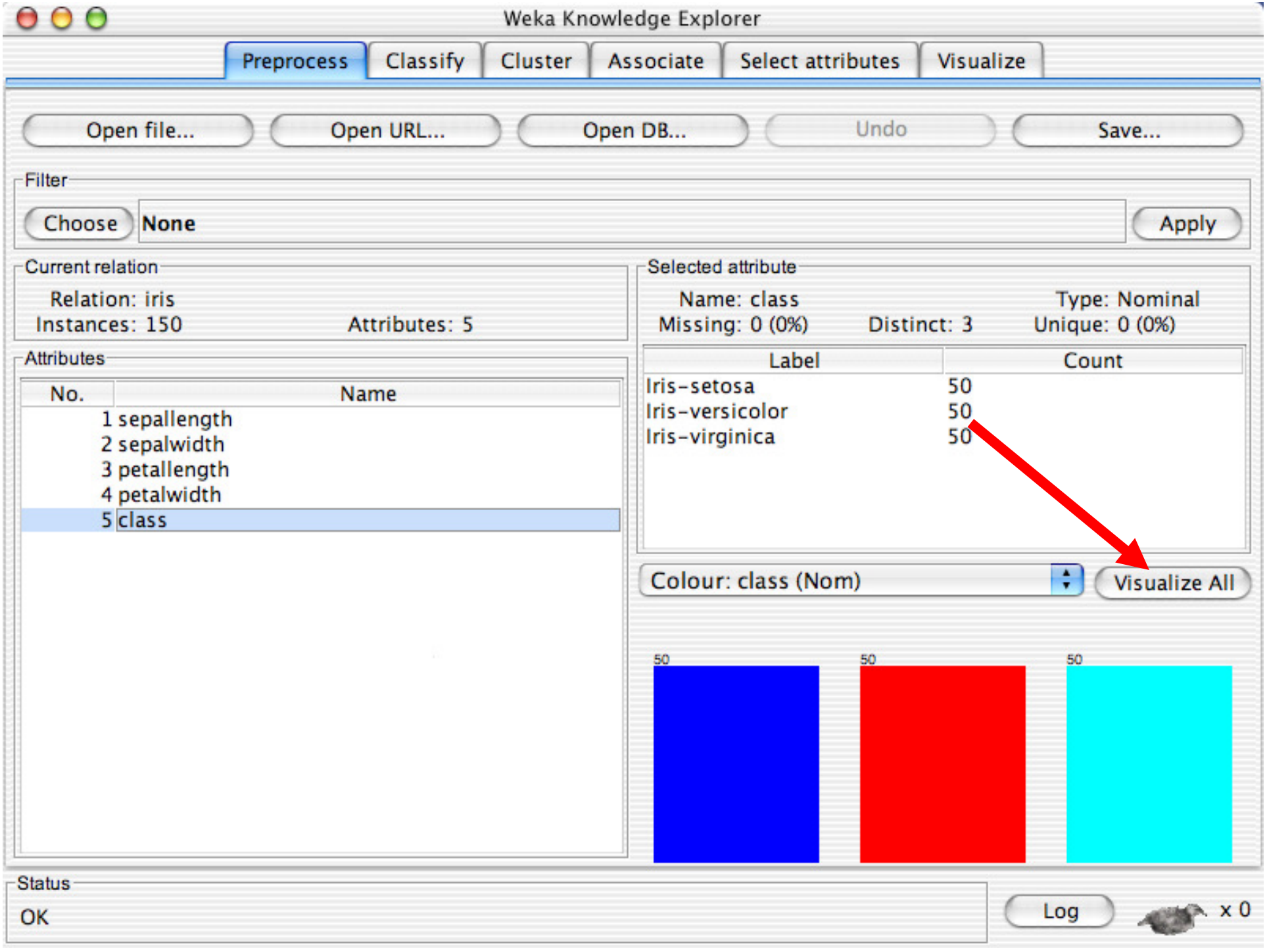
Status

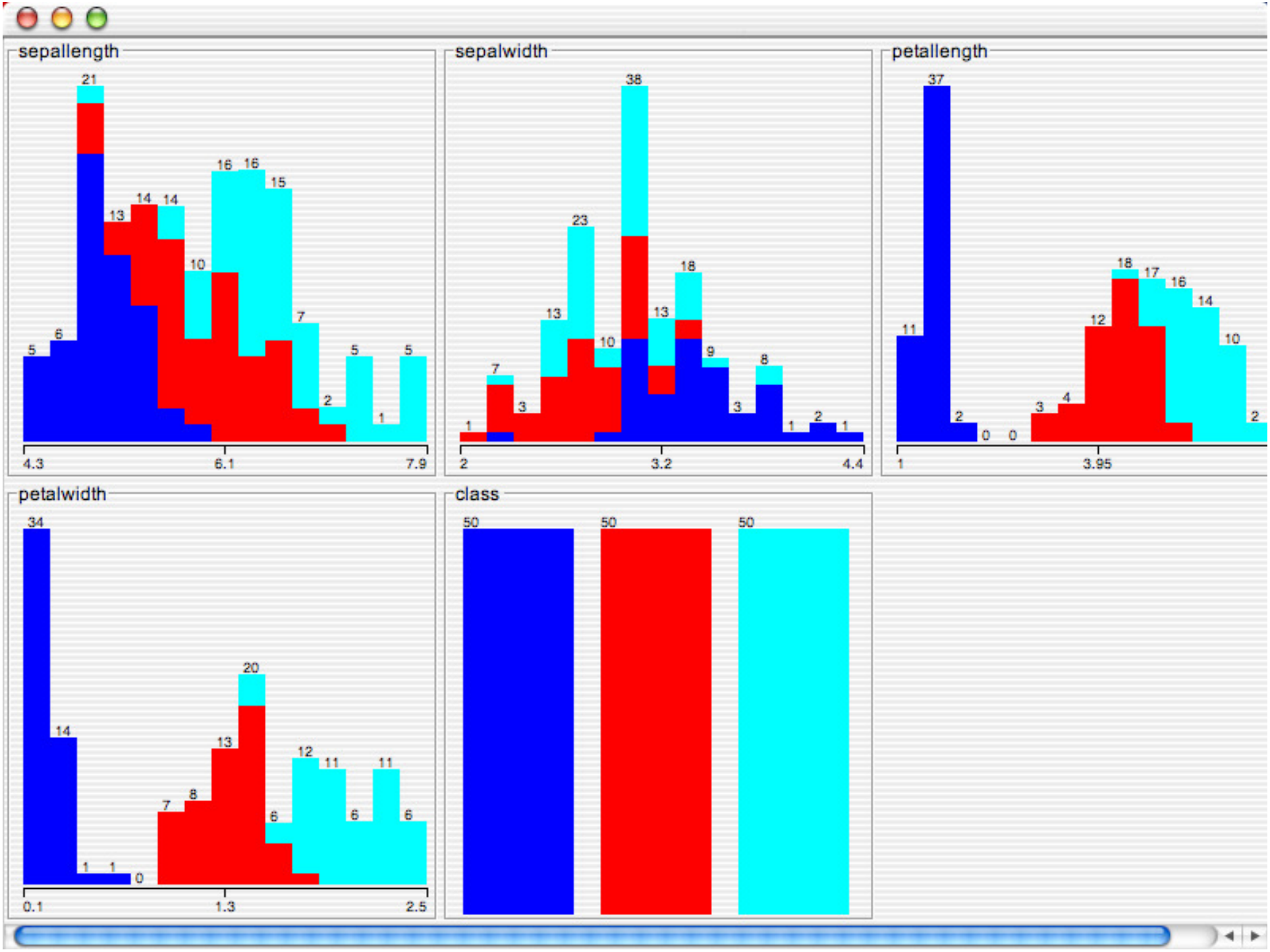
OK

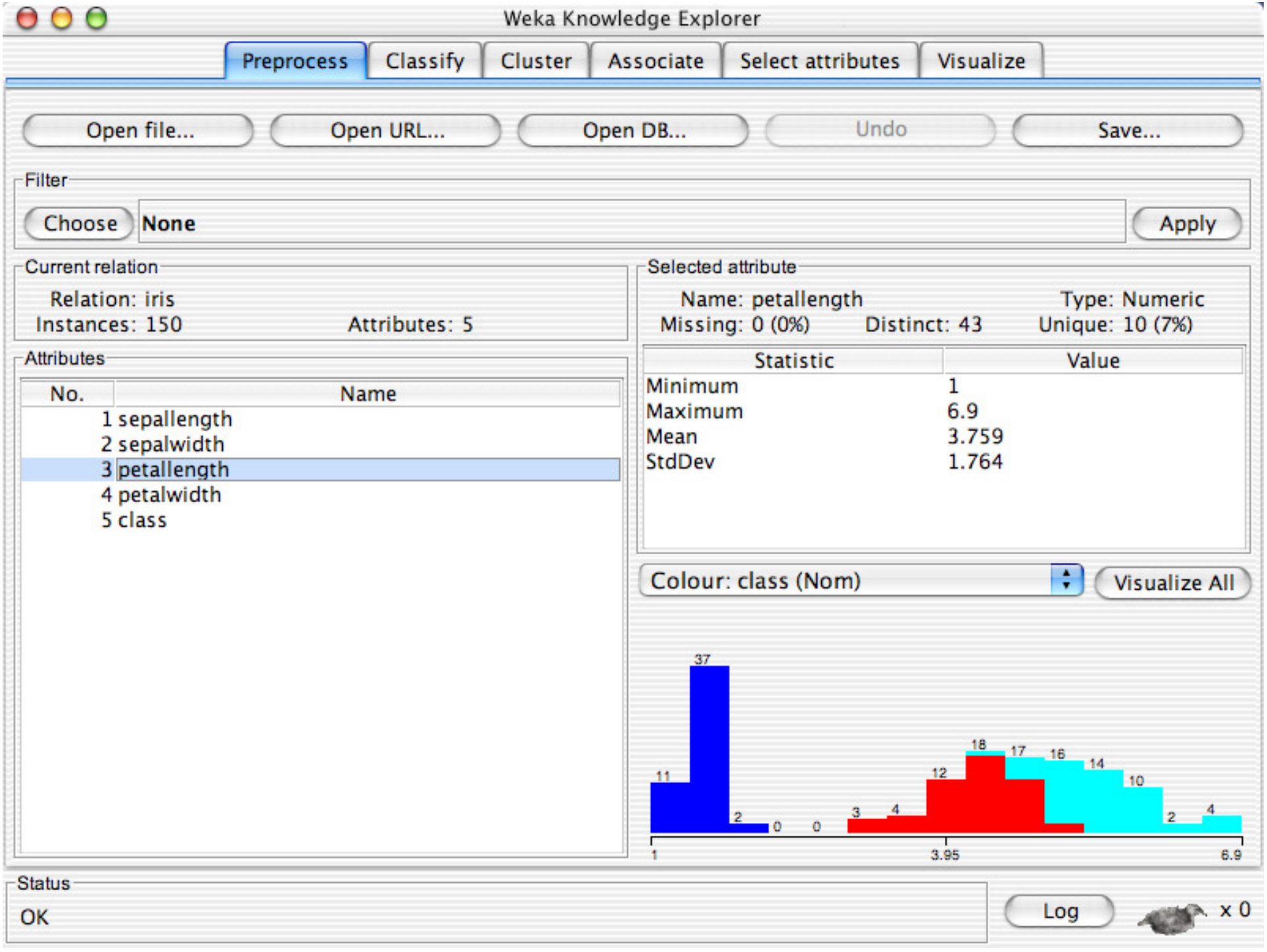
Log | x 0

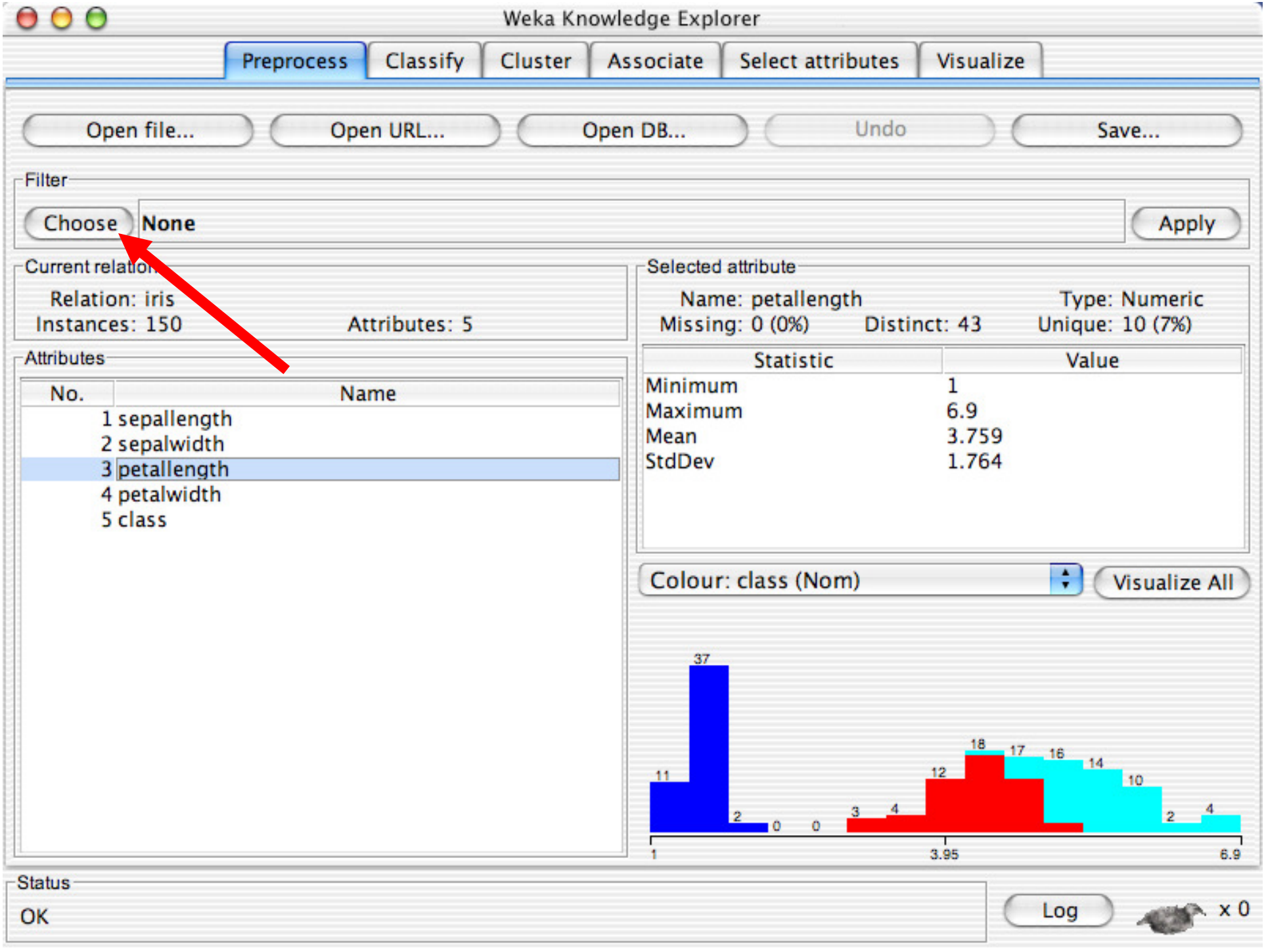

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
None
Apply
Current relation
Relation: iris
Instances: 150
Attributes: 5
Attributes
No.
Name
1 sepallength
2 sepalwidth
3 petallength
4 petalwidth
5 class
Selected attribute
Name: sepallength
Type: Numeric
Missing: 0 (0%)
Distinct: 35
Unique: 9 (6%)
Statistic
Value
Minimum
4.3
Maximum
7.9
Mean
5.843
StdDev
0.828
Colour: class (Nom)
Visualize All
21
13
14
14
10
16
16
15
7
2
5
1
5
6
5
4.3
6.1
7.9
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
None
Apply
Current relation
Relation: iris
Instances: 150
Attributes: 5
Attributes
No.
Name
1 sepallength
2 sepalwidth
3 petallength
4 petalwidth
5 class
Selected attribute
Name: class
Type: Nominal
Missing: 0 (0%)
Distinct: 3
Unique: 0 (0%)
Label
Count
Iris-setosa
50
Iris-versicolor
50
Iris-virginica
50
Colour: class (Nom)
Visualize All
50
50
50
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
None
Apply
Current relation
Relation: iris
Instances: 150
Attributes: 5
Attributes
No.
Name
1 sepallength
2 sepalwidth
3 petallength
4 petalwidth
5 class
Selected attribute
Name: class
Type: Nominal
Missing: 0 (0%)
Distinct: 3
Unique: 0 (0%)
Label
Count
Iris-setosa
50
Iris-versicolor
50
Iris-virginica
50
Colour: class (Nom)
Visualize All
50
50
50
Status
OK
Log
x 0


sepallength
21
16 16
15
14 14
13
10
7
6
5
5 5
2
1
4.3
6.1
7.9
sepalwidth
38
23
18
13 13
10
9
8
7
3
3
2 1
1
2
3.2
4.4
petallength
37
18
17
16
14
12
11
10
4
3
2
2
0 0
1
3.95
petalwidth
34
20
14
13
12 11 11
8
7
6 6 6
1 1
0
0.1
1.3
2.5
class
50
50
50


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
None
Apply
Current relation
Relation: iris
Instances: 150
Attributes: 5
Attributes
No.
Name
1 sepallength
2 sepalwidth
3 petallength
4 petalwidth
5 class
Selected attribute
Name: petallength
Type: Numeric
Missing: 0 (0%)
Distinct: 43
Unique: 10 (7%)
Statistic
Value
Minimum
1
Maximum
6.9
Mean
3.759
StdDev
1.764
Colour: class (Nom)
Visualize All
37
11
2
0
0
3
4
12
18
17
16
14
10
2
4
1
3.95
6.9
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
None
Apply
Current relation
Relation: iris
Instances: 150
Attributes: 5
Attributes
No.
Name
1 sepallength
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Selected attribute
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Distinct: 43
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Value
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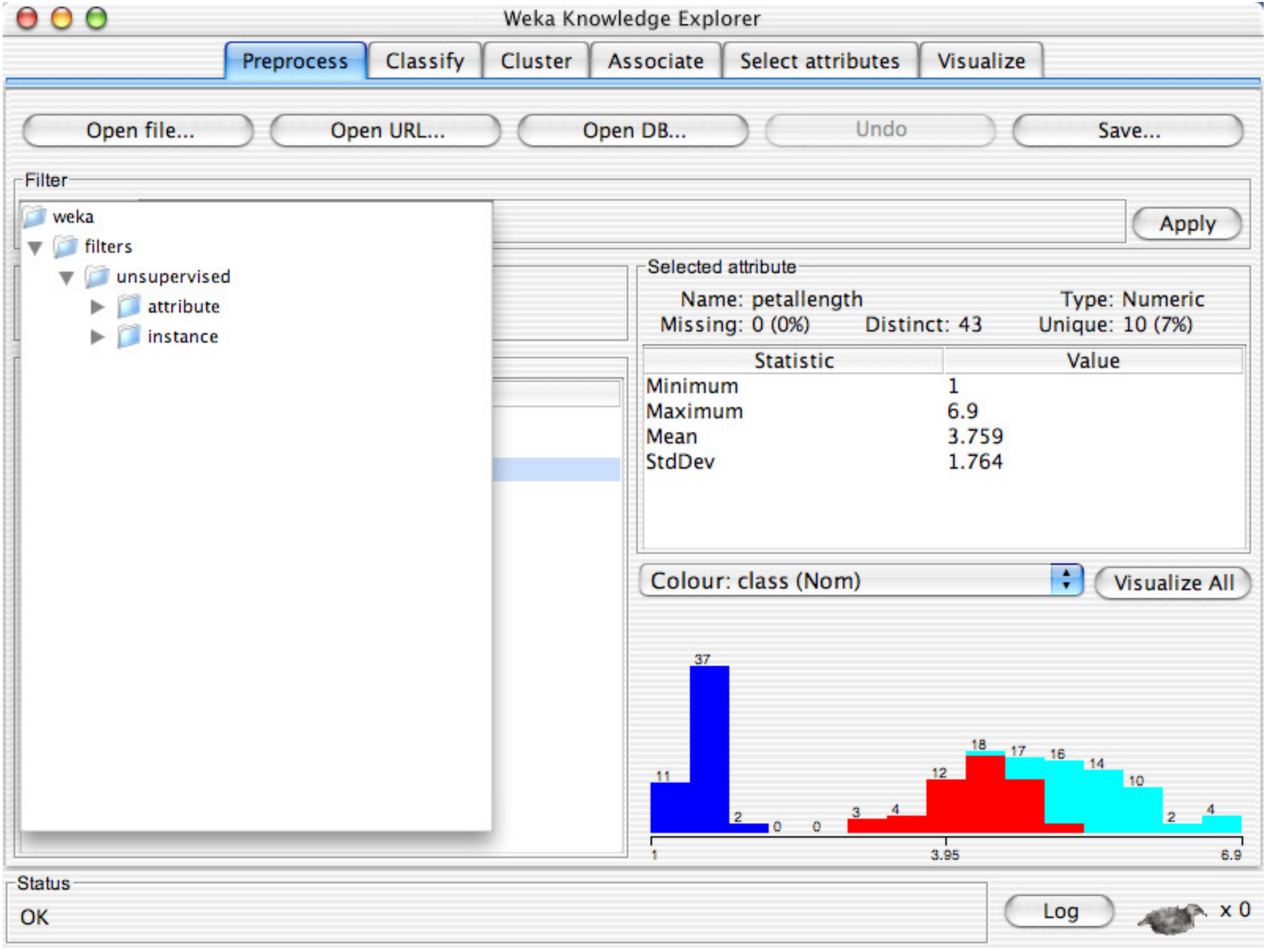
1.764
Colour: class (Nom)
Visualize All
37
11
2
0
0
3
4
12
18
17
16
14
10
2
4
1
3.95
6.9
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
weka
filters
unsupervised
attribute
instance
Apply
Selected attribute
Name: petallength
Type: Numeric
Missing: 0 (0%)
Distinct: 43
Unique: 10 (7%)
Statistic
Value
Minimum
1
Maximum
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Mean
3.759
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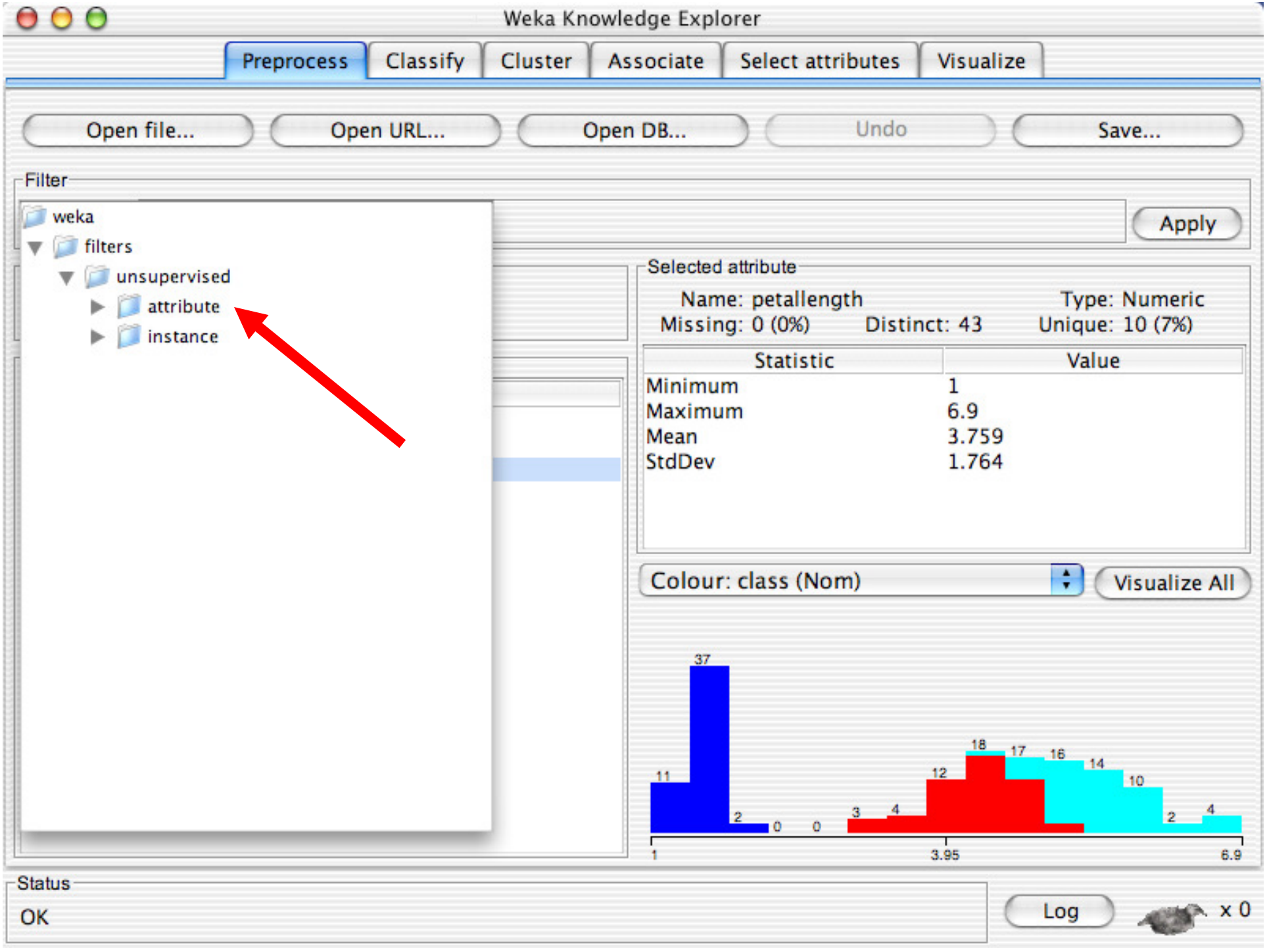
1.764
Colour: class (Nom)
Visualize All
37
11
2
0
0
3
4
12
18
17
16
14
10
2
4
1
3.95
6.9
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
weka
filters
unsupervised
attribute
instance
Apply
Selected attribute
Name: petallength
Type: Numeric
Missing: 0 (0%)
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Value
Minimum
1
Maximum
6.9
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3.759
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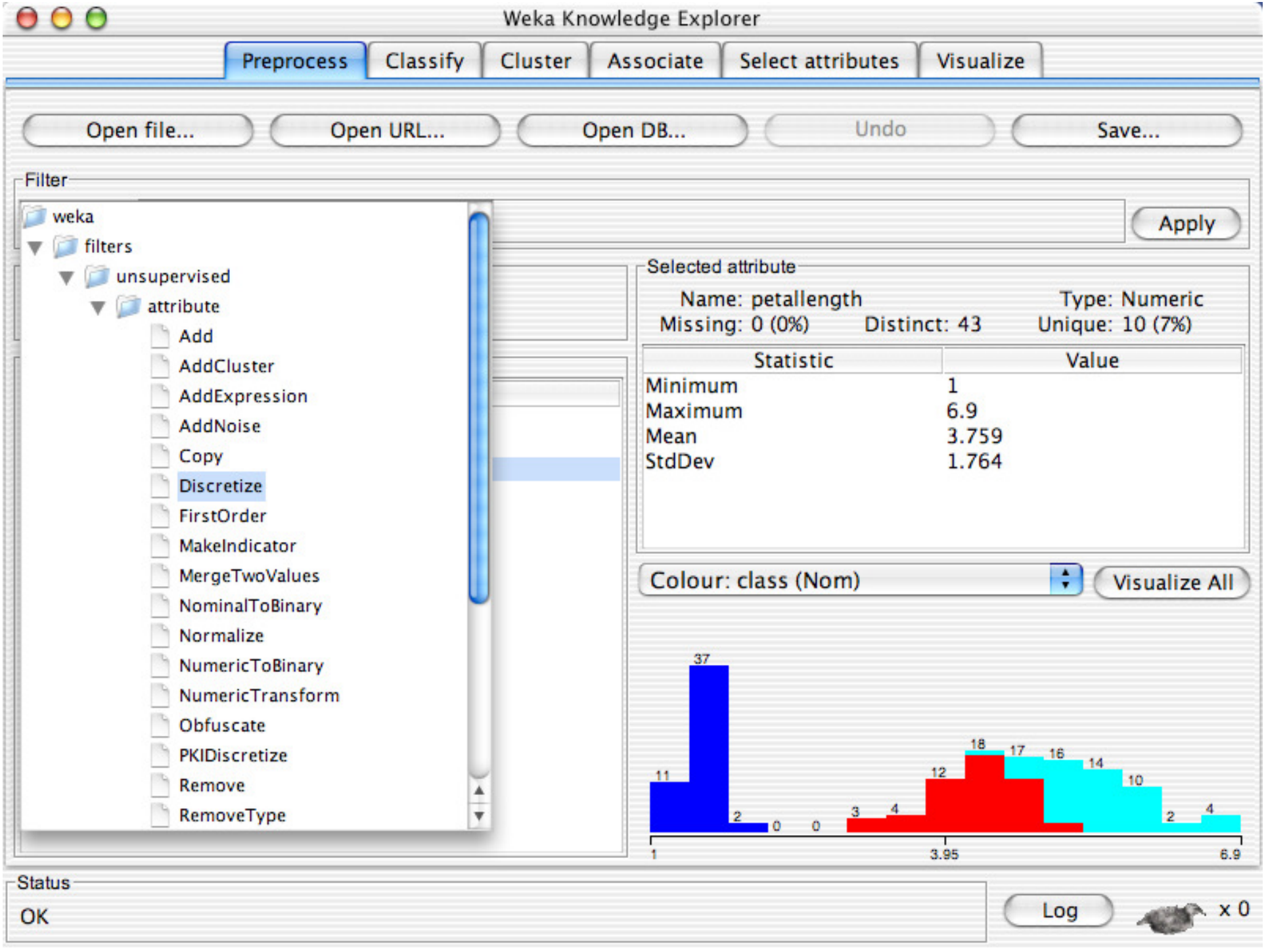
Colour: class (Nom)
Visualize All
37
11
2
0
0
3
4
12
18
17
16
14
10
2
4
1
3.95
6.9
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
weka
filters
unsupervised
attribute
Add
AddCluster
AddExpression
AddNoise
Copy
Discretize
FirstOrder
MakeIndicator
MergeTwoValues
NominalToBinary
Normalize
NumericToBinary
NumericTransform
Obfuscate
PKIDiscretize
Remove
RemoveType
Apply
Selected attribute
Name: petallength
Type: Numeric
Missing: 0 (0%)
Distinct: 43
Unique: 10 (7%)
Statistic
Value
Minimum
1
Maximum
6.9
Mean
3.759
StdDev
1.764
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Visualize All
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11
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16
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10
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4
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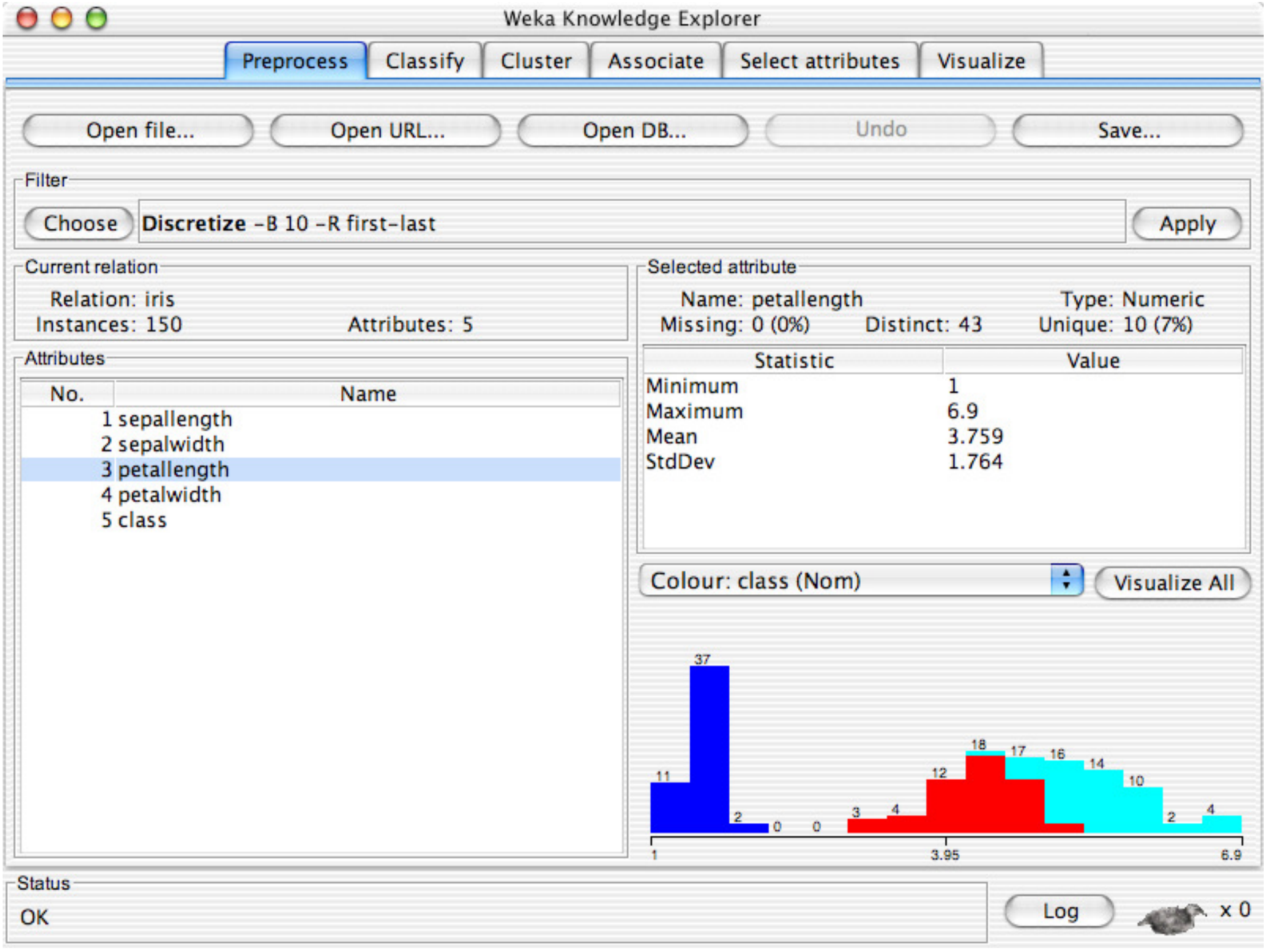
3.95
6.9
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Open file...
Open URL...
Open DB...
Undo
Save...
Filter
Choose
Discretize -B 10 -R first-last
Apply
Current relation
Relation: iris
Instances: 150
Attributes: 5
Attributes
No.
Name
1 sepallength
2 sepalwidth
3 petallength
4 petalwidth
5 class
Selected attribute
Name: petallength
Type: Numeric
Missing: 0 (0%)
Distinct: 43
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Value
Minimum
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6.9
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StdDev
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Visualize All
37
11
2
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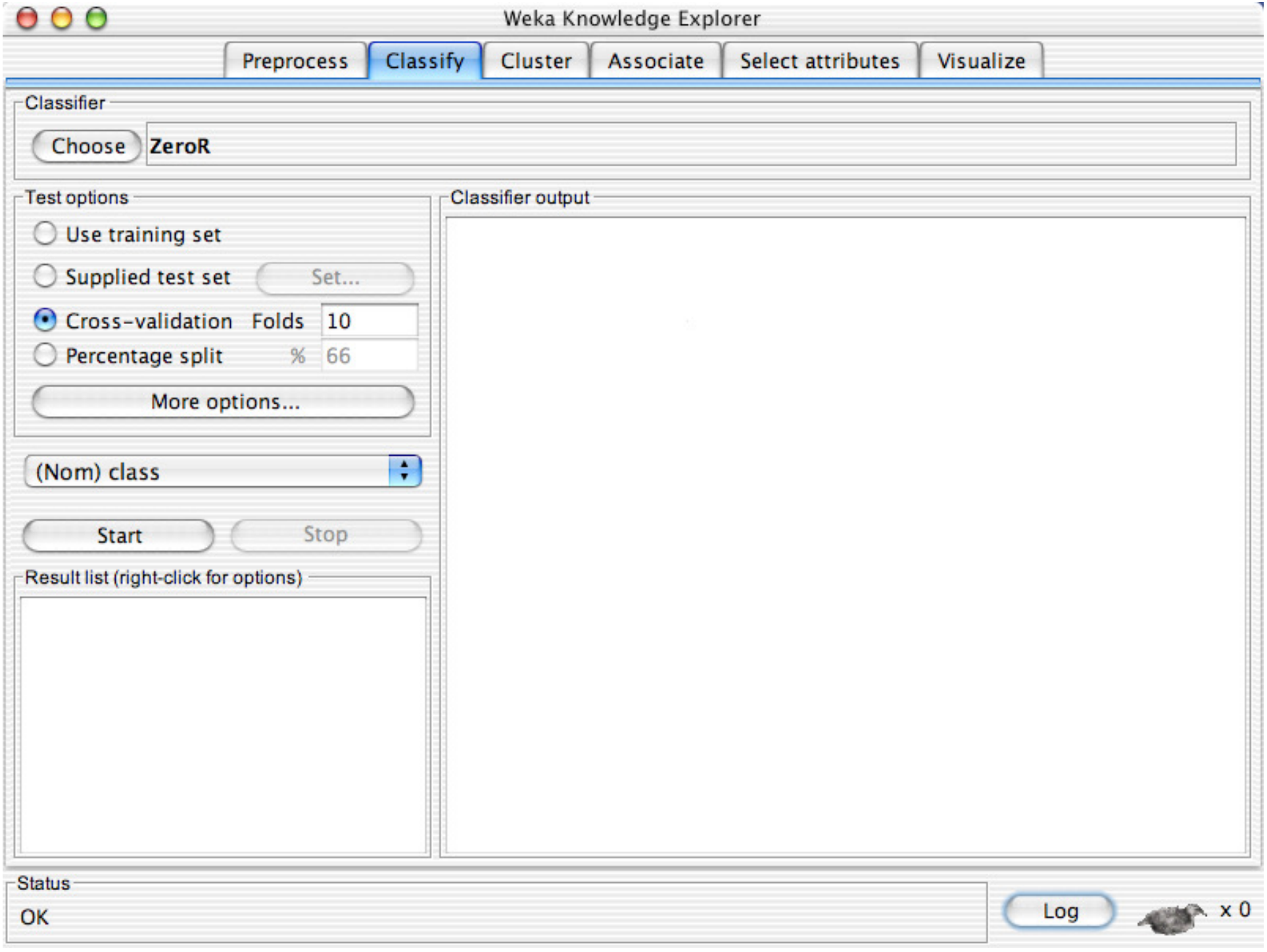
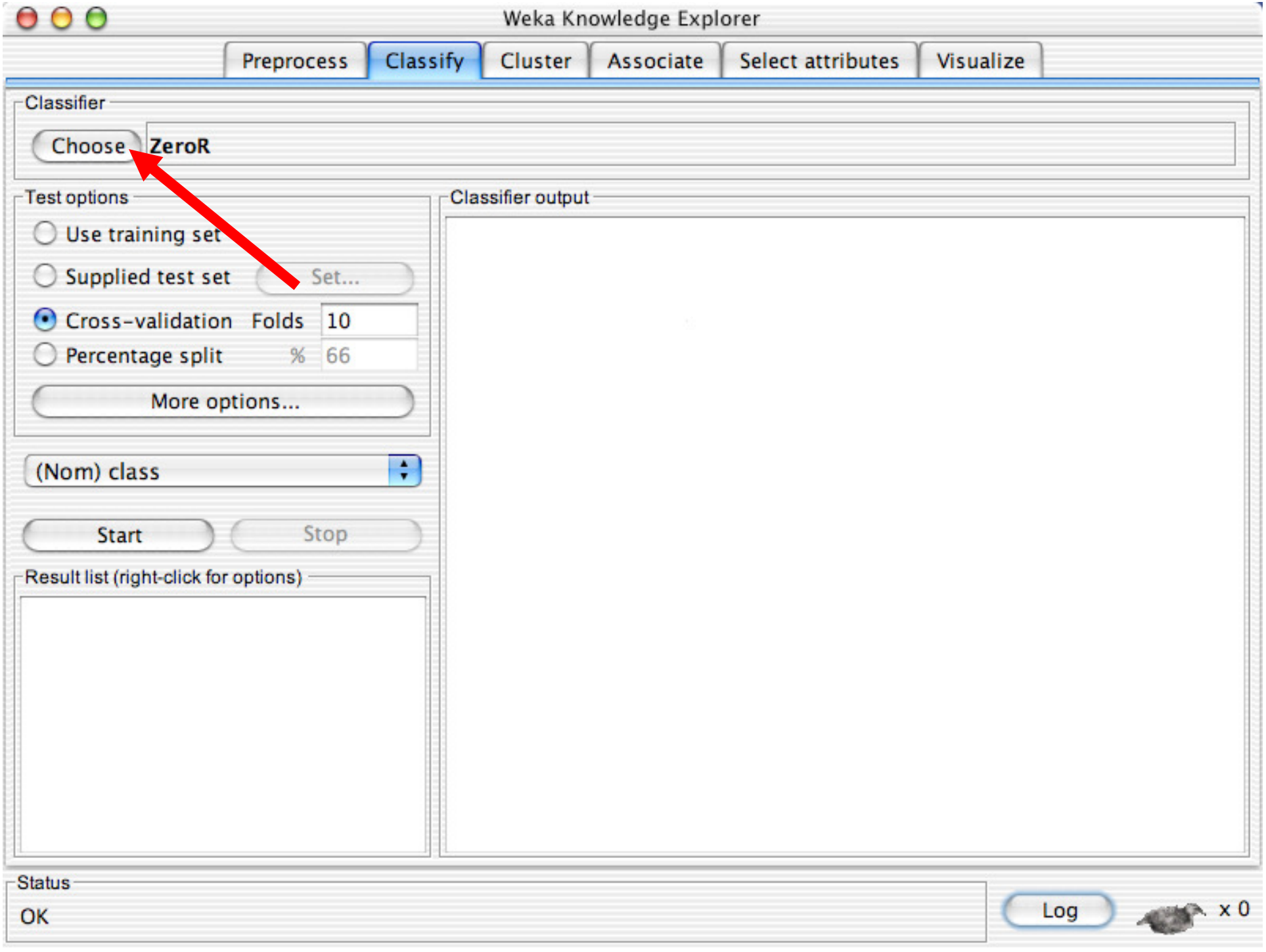
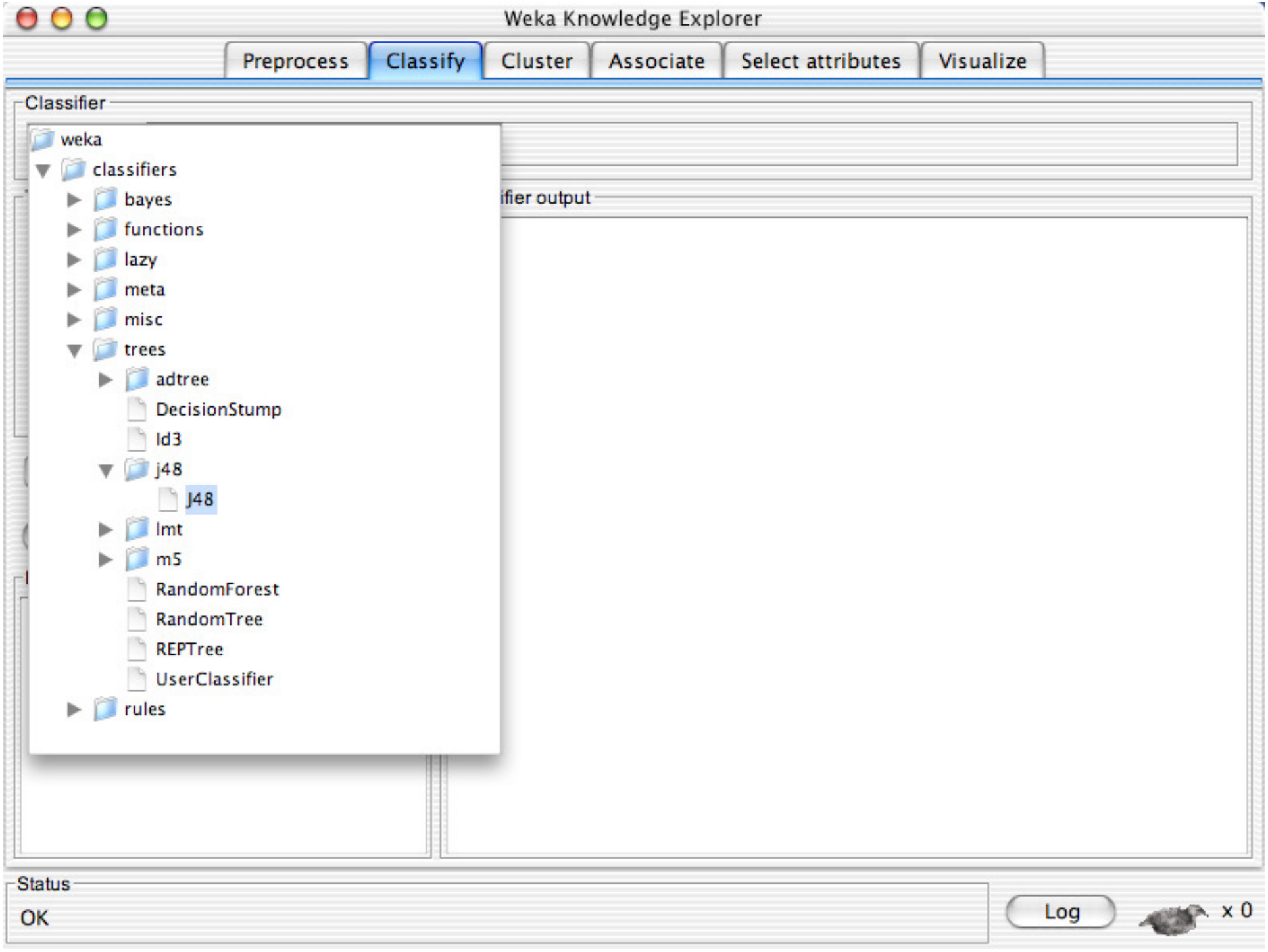
18
17
16
14
10
2
4
1
3.95
6.9
Status
OK
Log
x 0

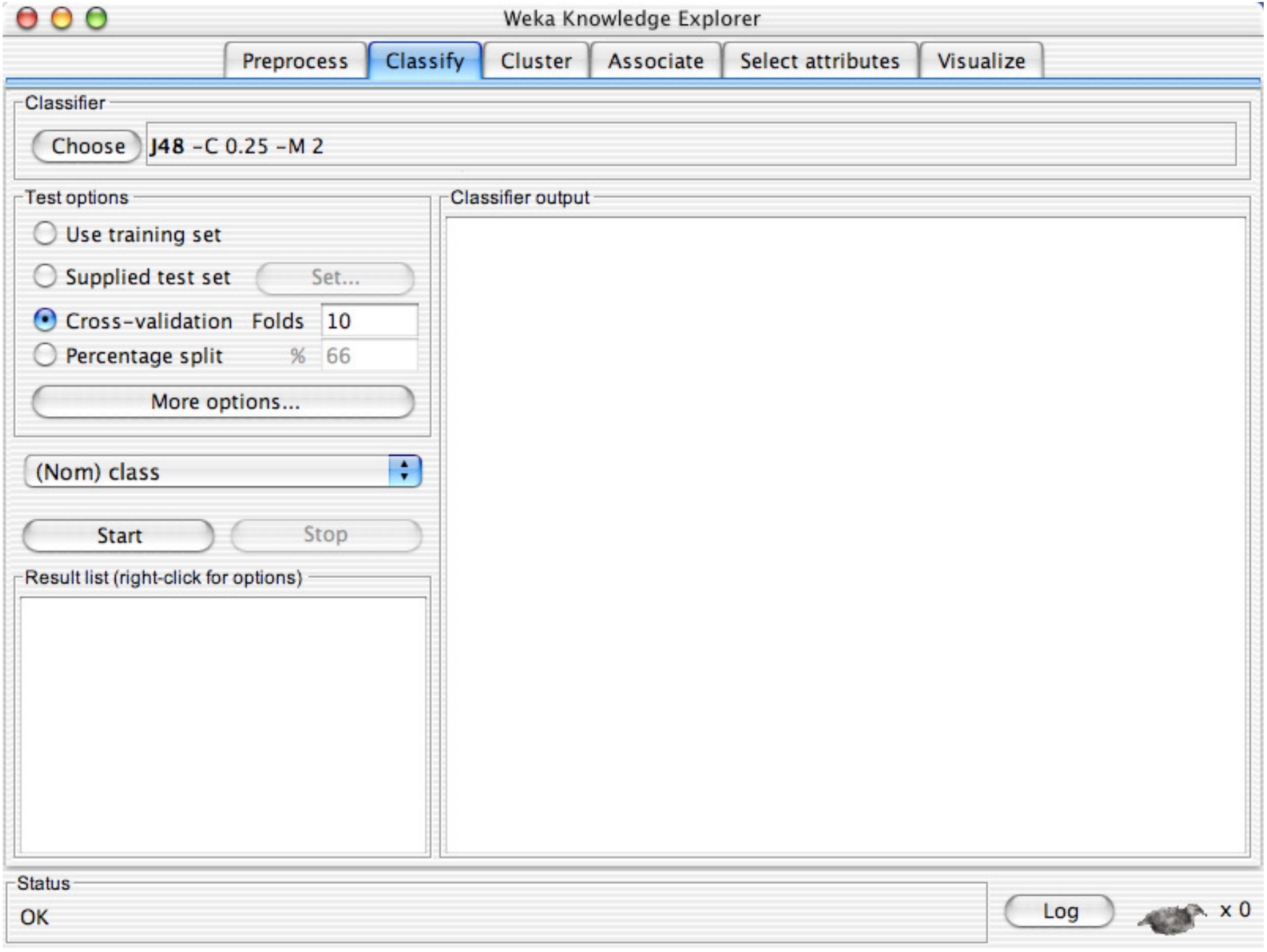
Explorer: building "classifiers"

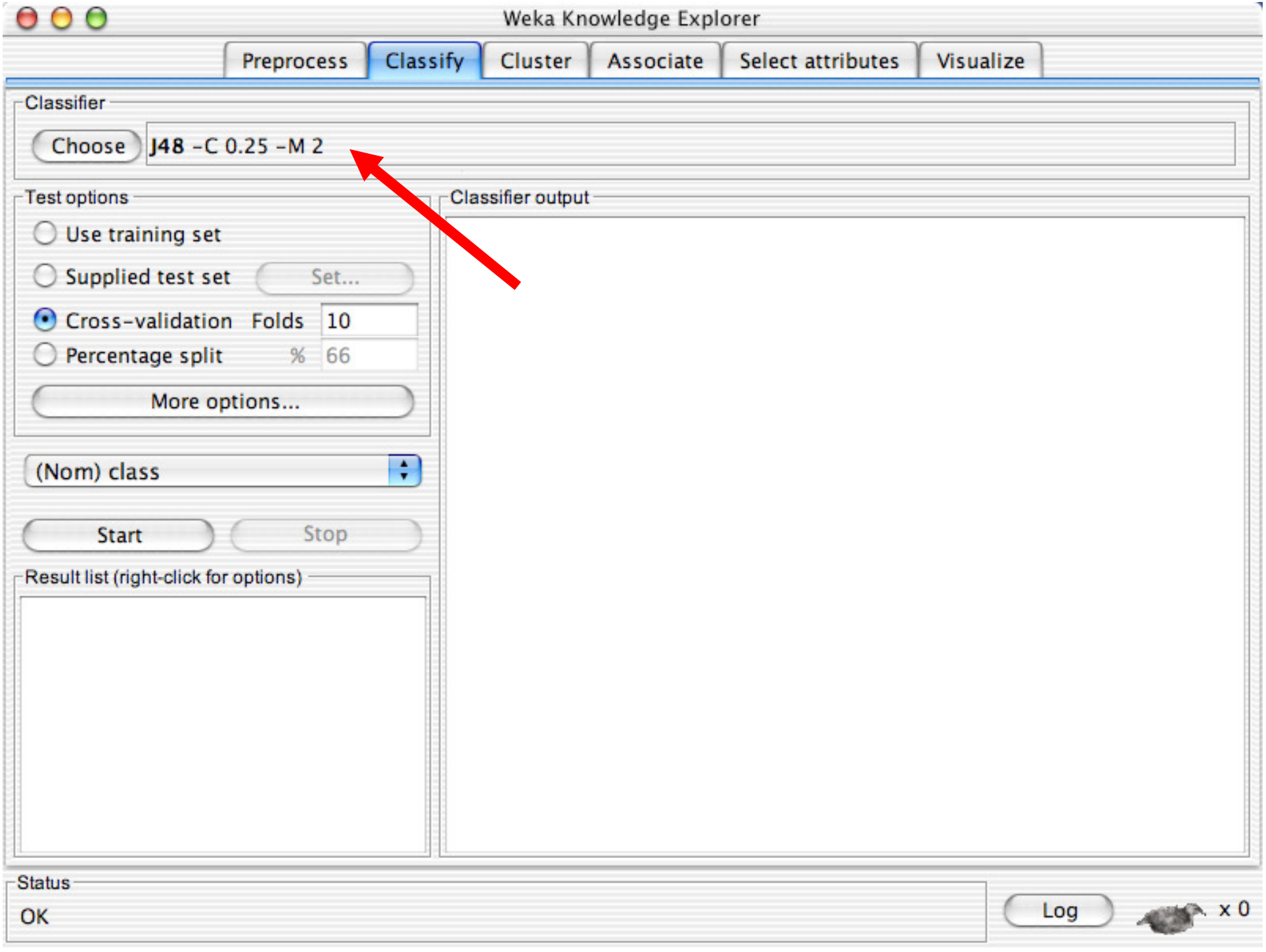
- Classifiers in WEKA are models for predicting nominal or numeric quantities
- Implemented learning schemes include:
  - Decision trees and lists, instance-based classifiers, support vector machines, multi-layer perceptrons, logistic regression, Bayes' nets, …
- "Meta"-classifiers include:
  - Bagging, boosting, stacking, error-correcting output codes, locally weighted learning, …

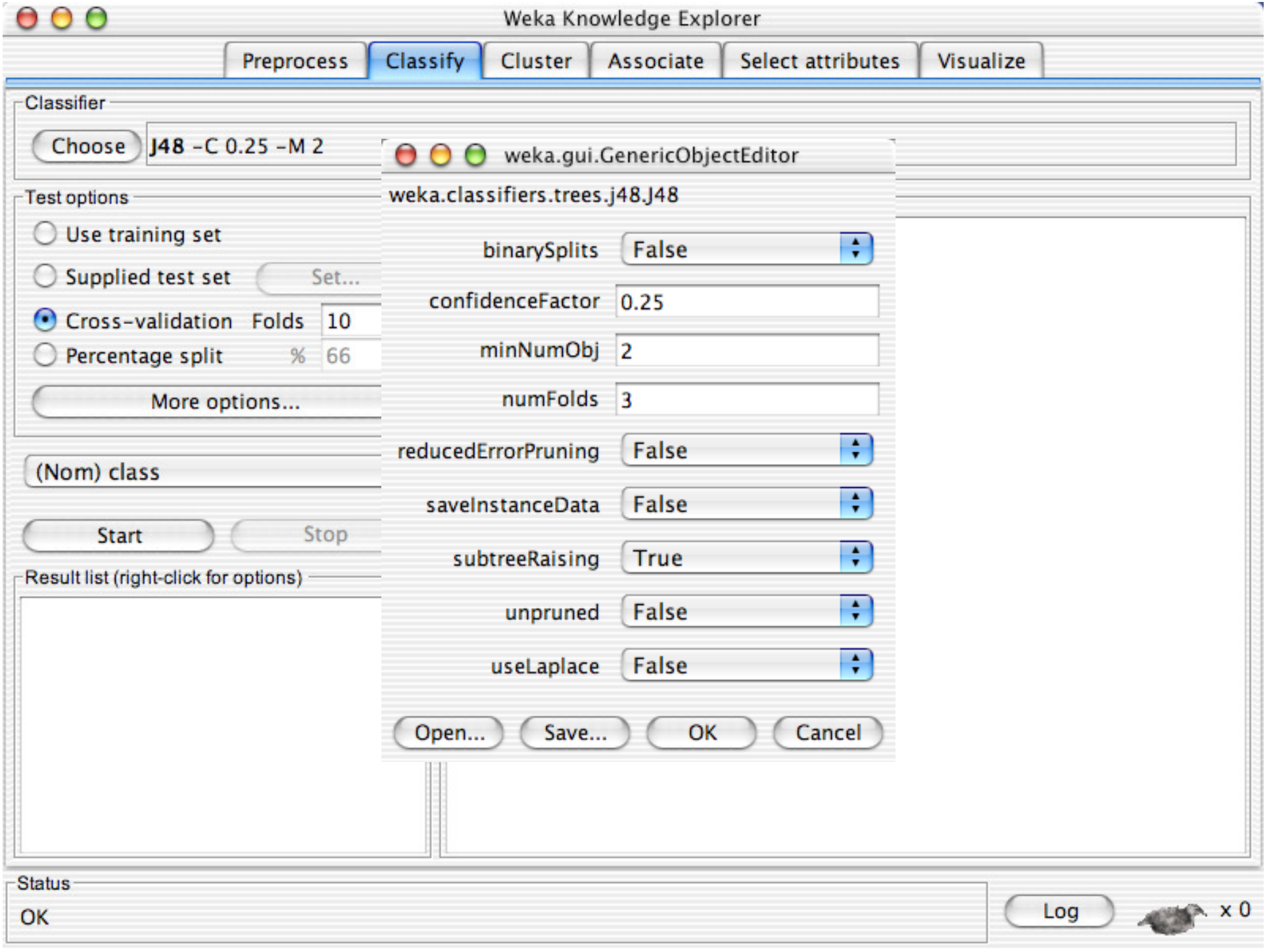

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
ZeroR
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
Classifier output
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

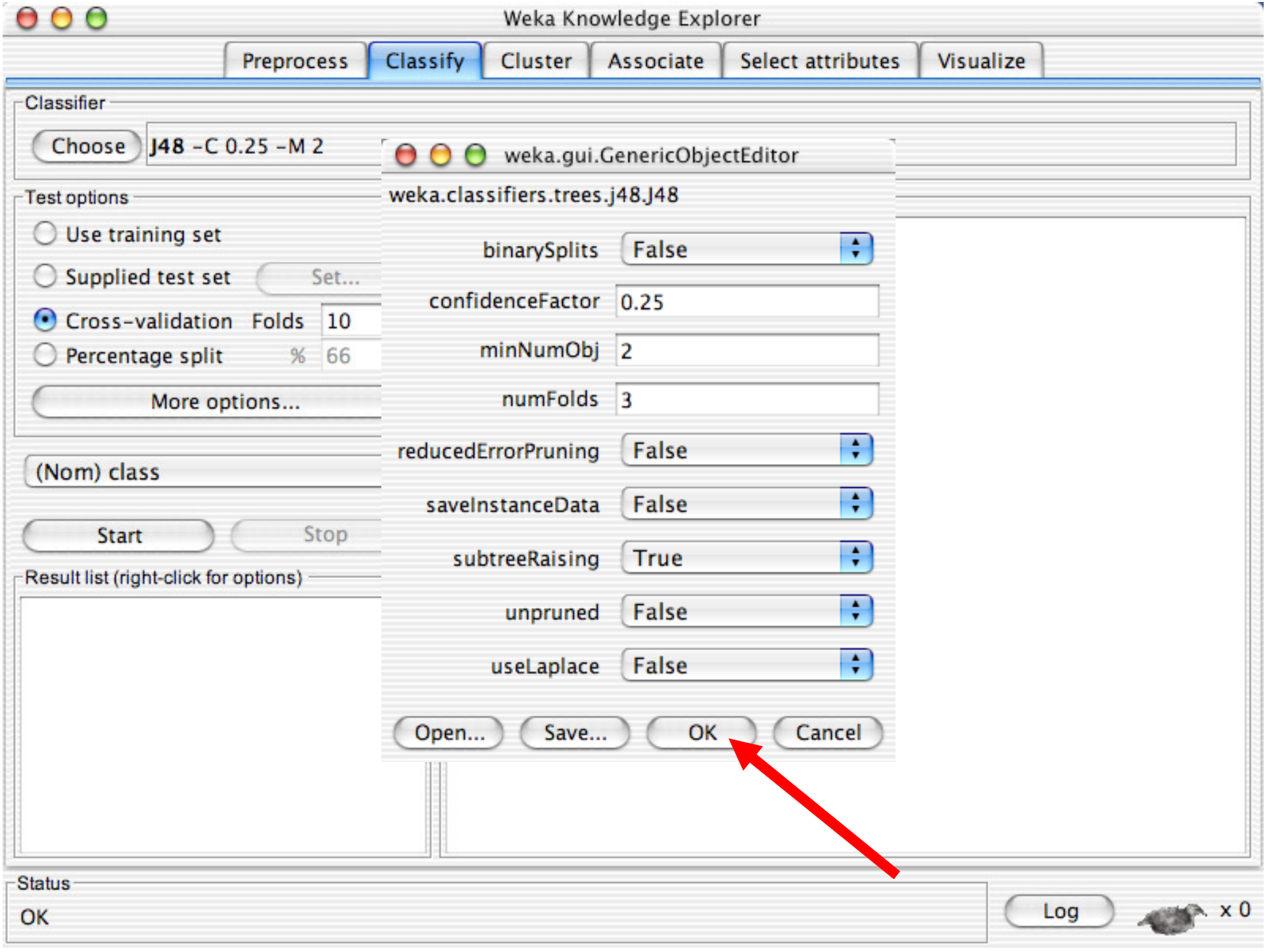

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
ZeroR
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
Classifier output
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

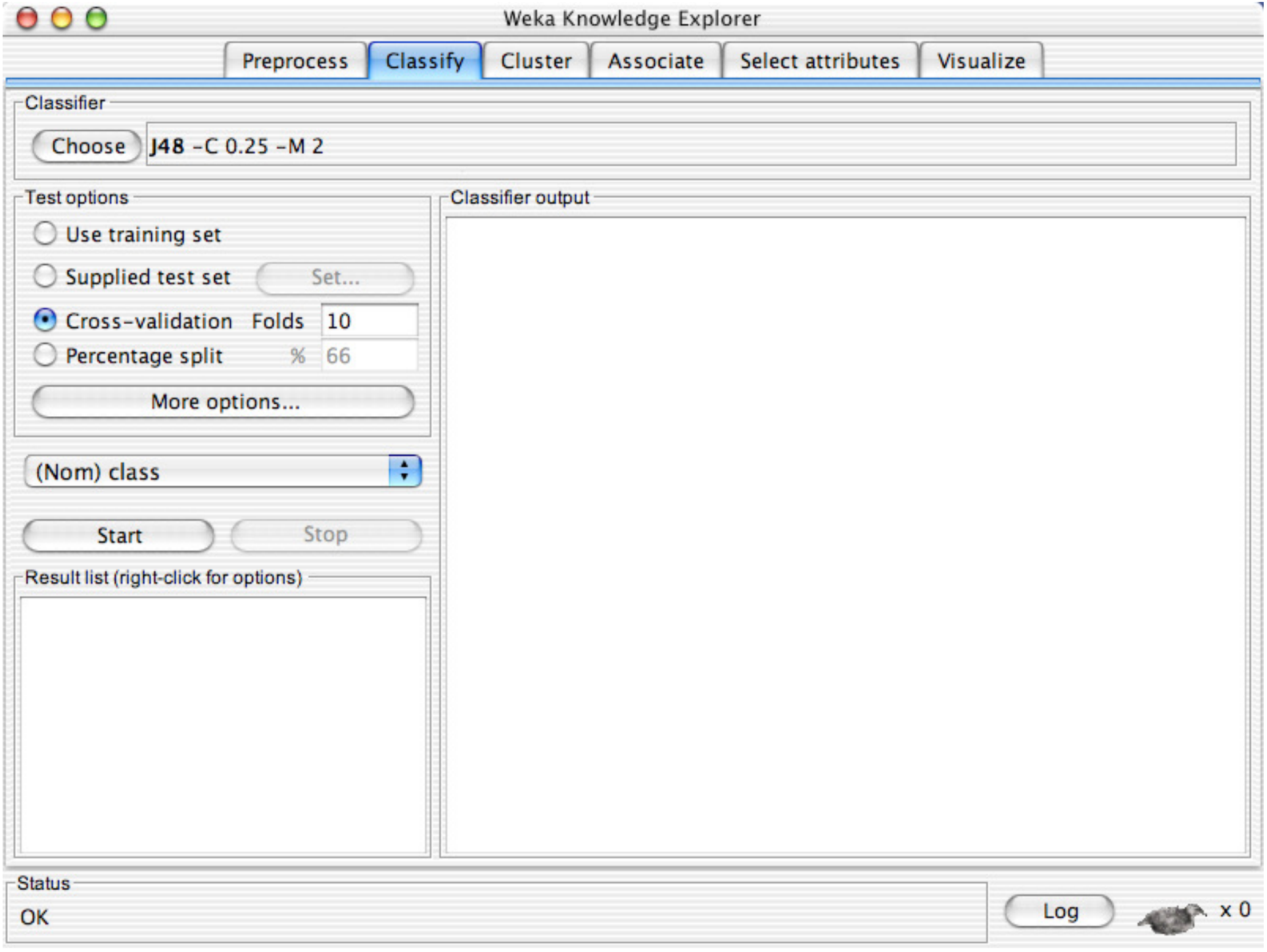

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
weka
classifiers
bayes
functions
lazy
meta
misc
trees
adtree
DecisionStump
Id3
j48
J48
lmt
m5
RandomForest
RandomTree
REPTree
UserClassifier
rules
ifier output
Status
OK
Log
x 0

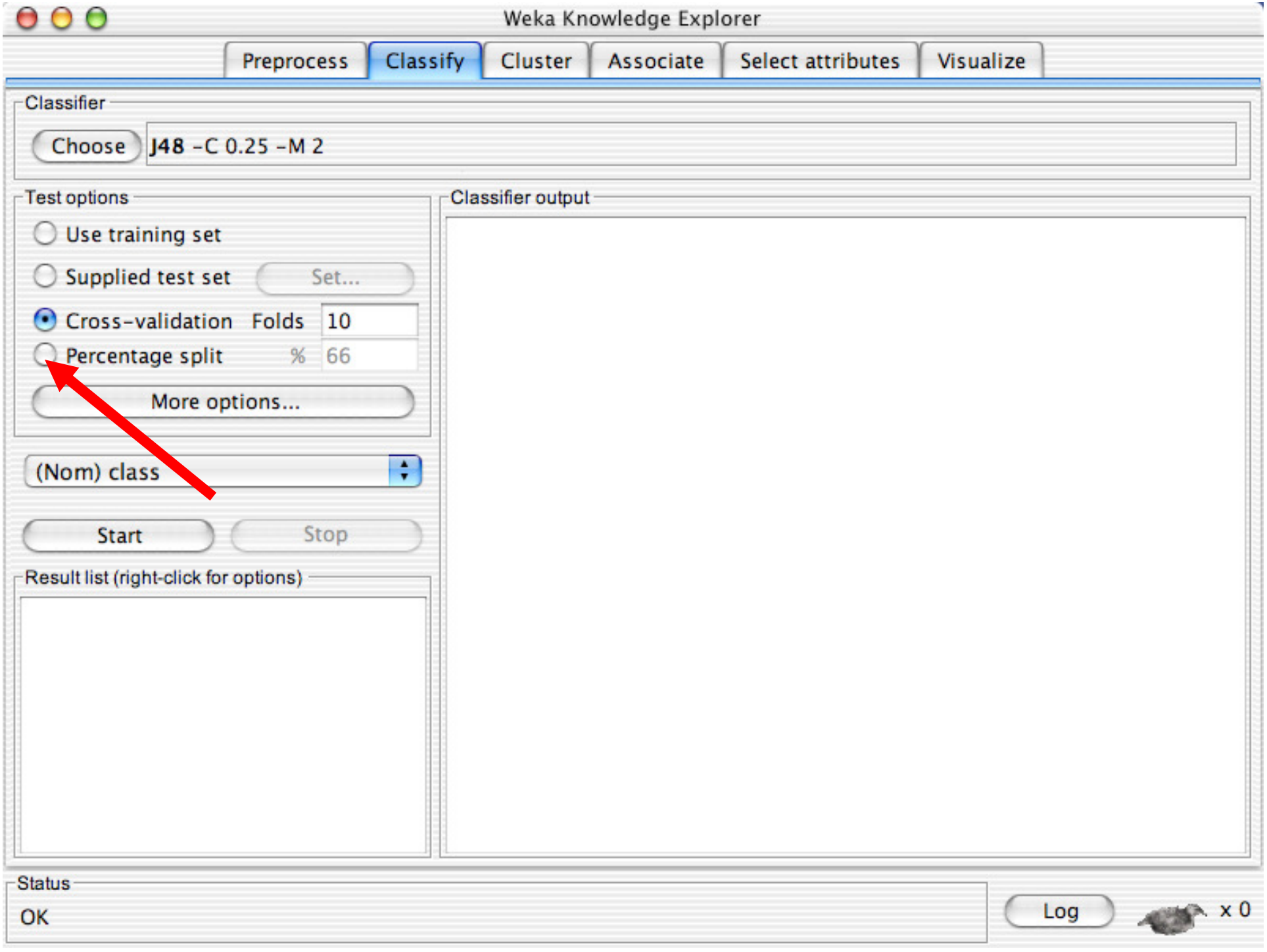

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
Classifier output
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

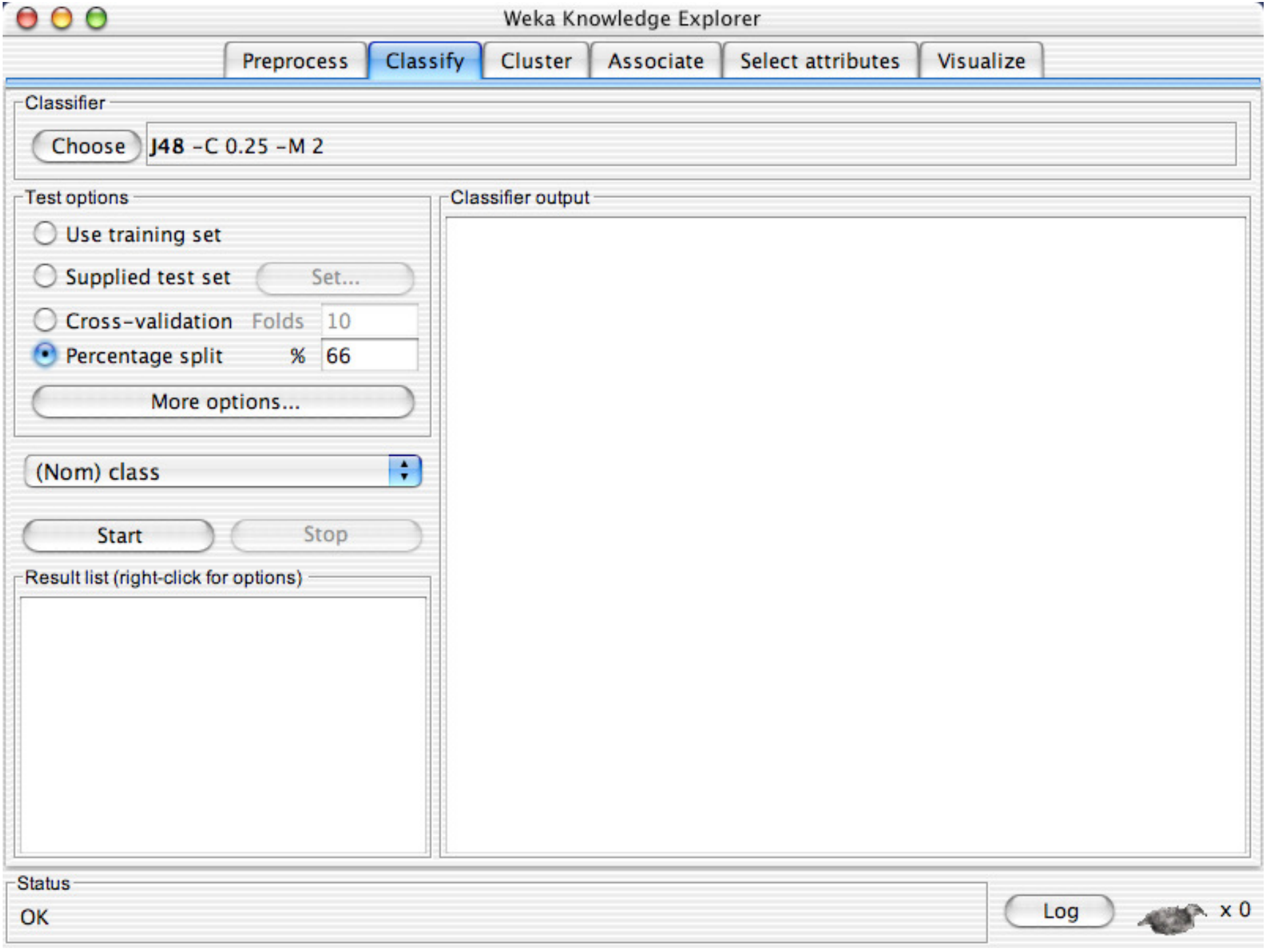

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
Classifier output
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

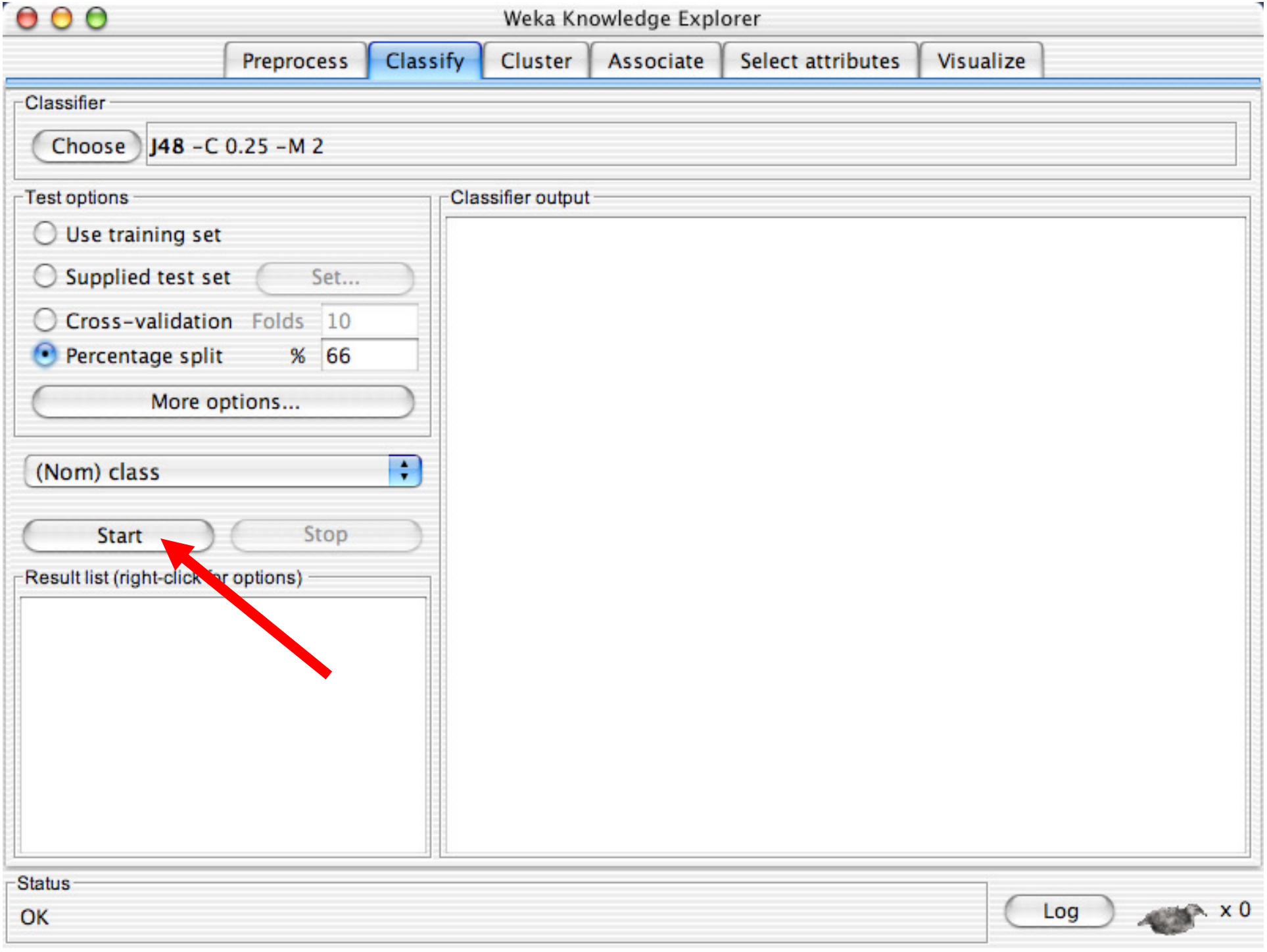

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
weka.gui.GenericObjectEditor
weka.classifiers.trees.j48.J48
binarySplits
False
confidenceFactor
0.25
minNumObj
2
numFolds
3
reducedErrorPruning
False
saveInstanceData
False
subtreeRaising
True
unpruned
False
useLaplace
False
Open...
Save...
OK
Cancel
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

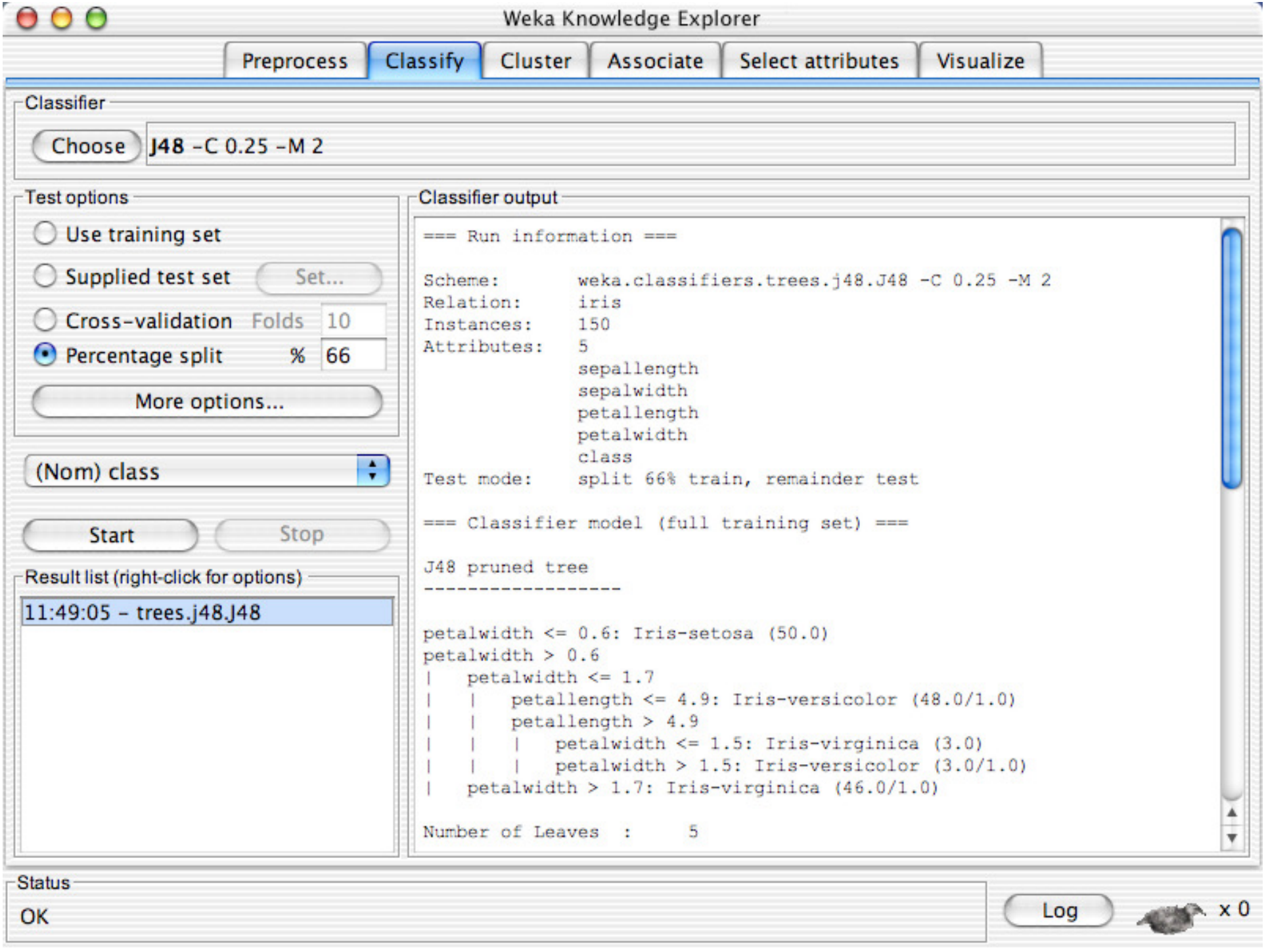

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
weka.gui.GenericObjectEditor
weka.classifiers.trees.j48.J48
binarySplits
False
confidenceFactor
0.25
minNumObj
2
numFolds
3
reducedErrorPruning
False
saveInstanceData
False
subtreeRaising
True
unpruned
False
useLaplace
False
Open...
Save...
OK
Cancel
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

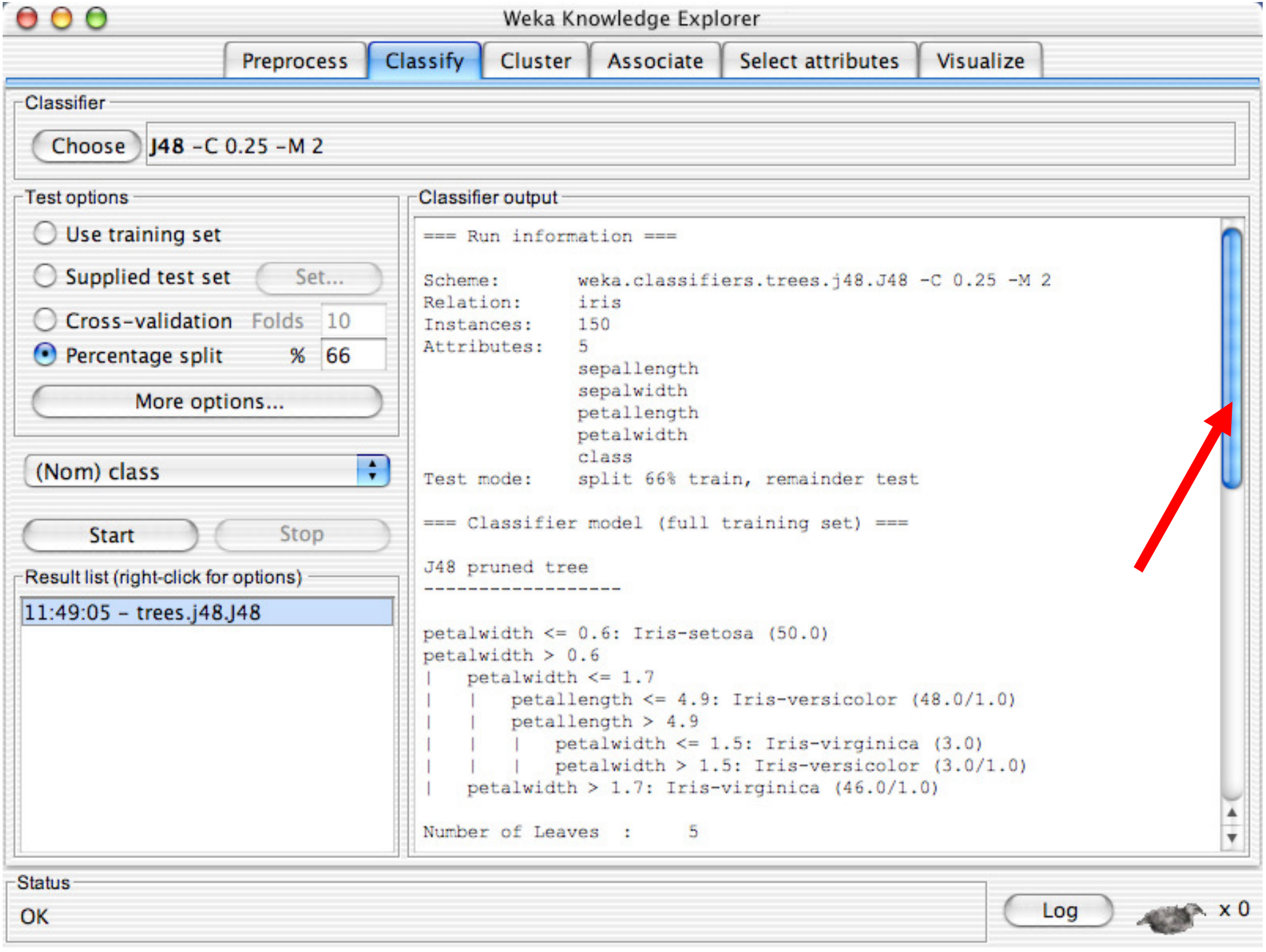

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
Classifier output
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

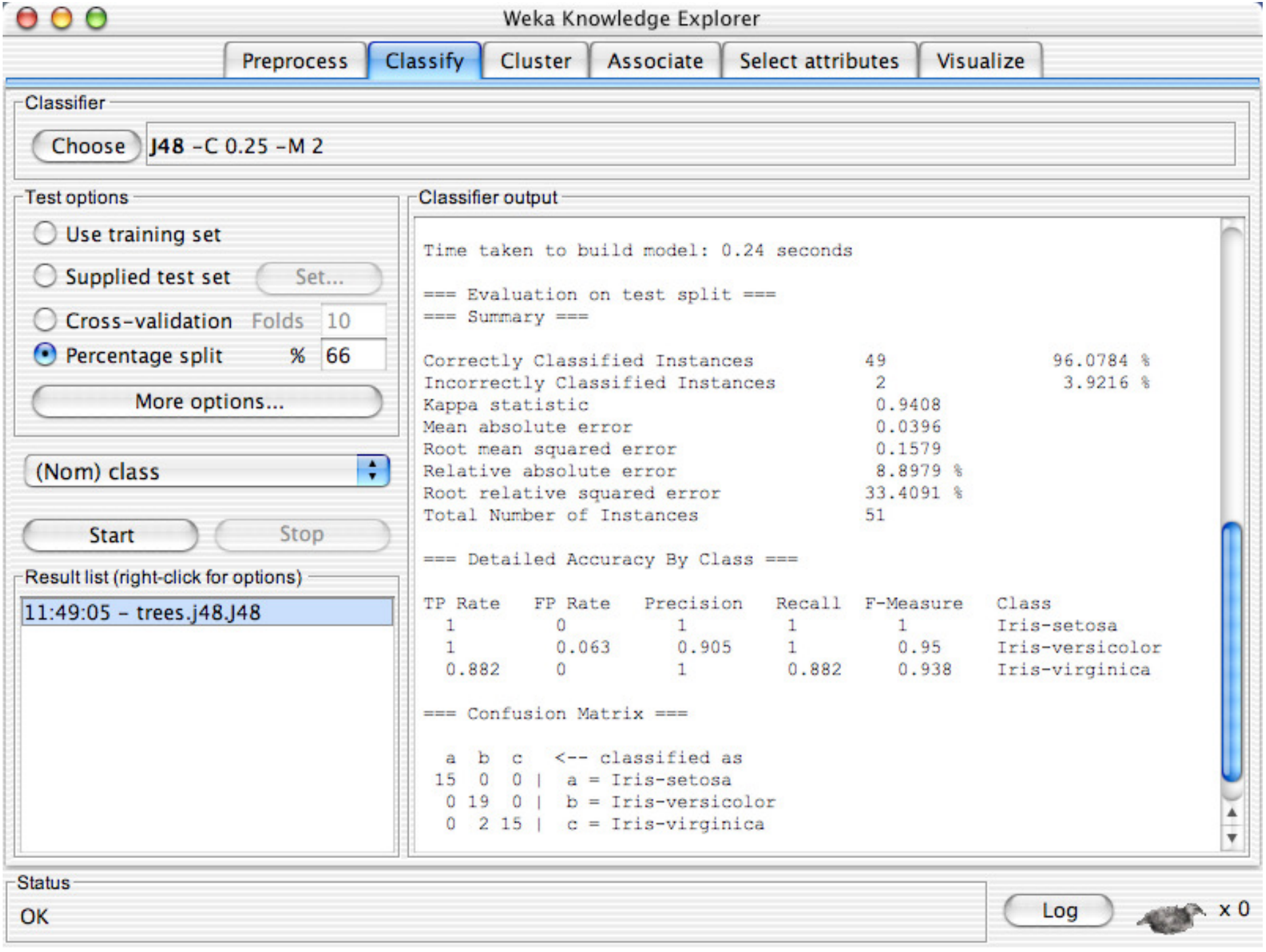

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
Classifier output
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

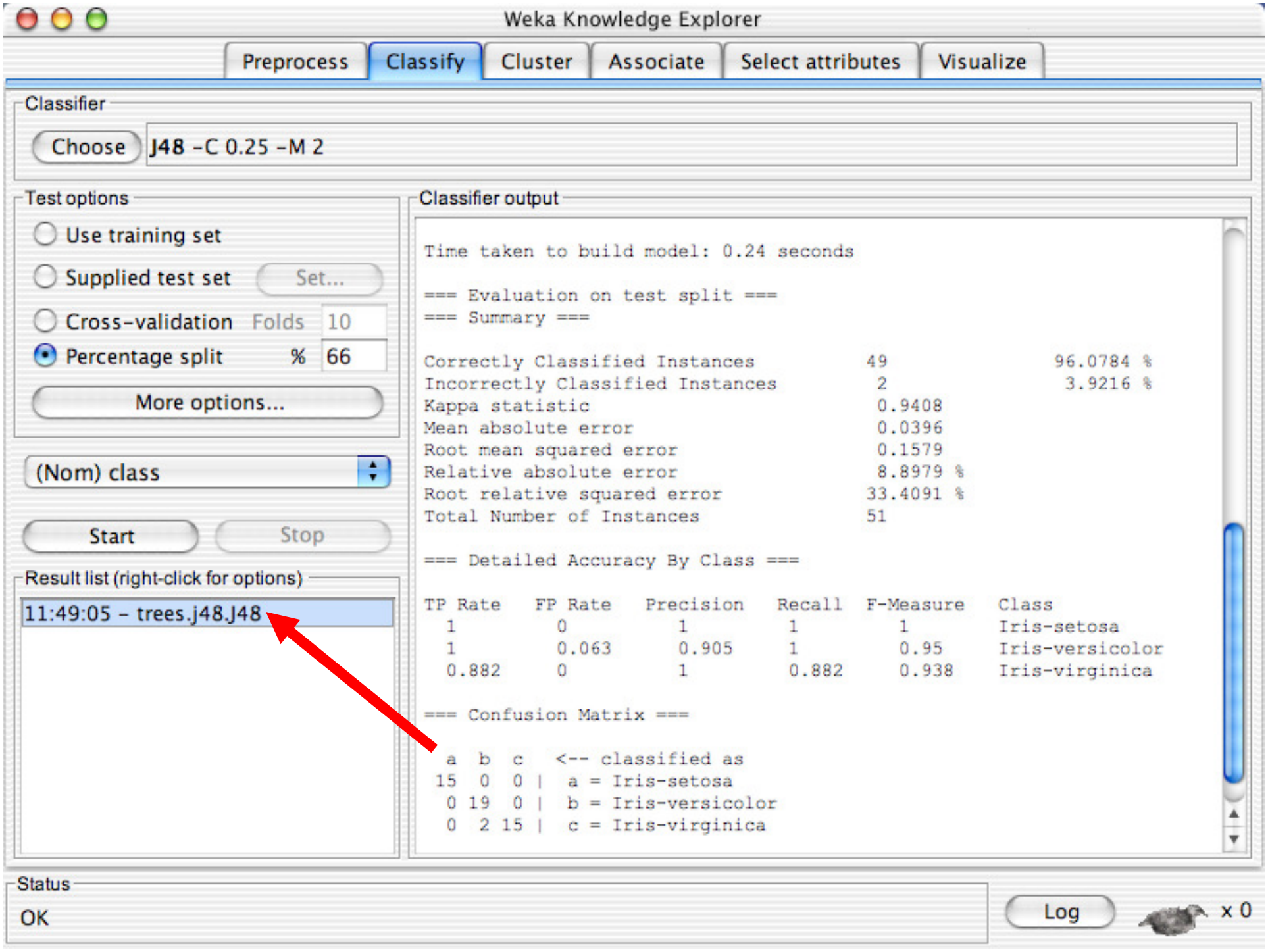

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
Classifier output
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

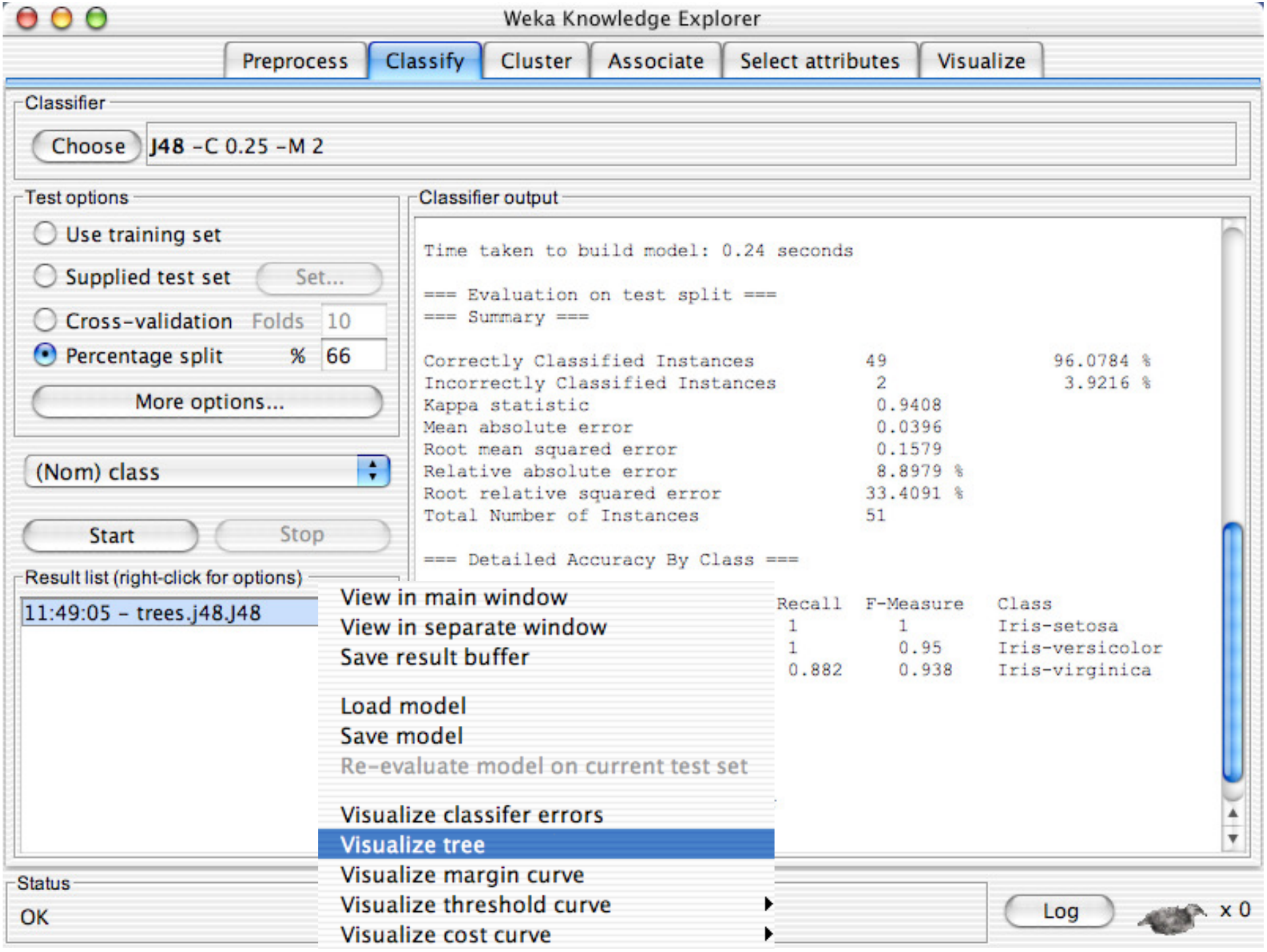

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
Classifier output
(Nom) class
Start
Stop
Result list (right-click for options)
Status
OK
Log
x 0

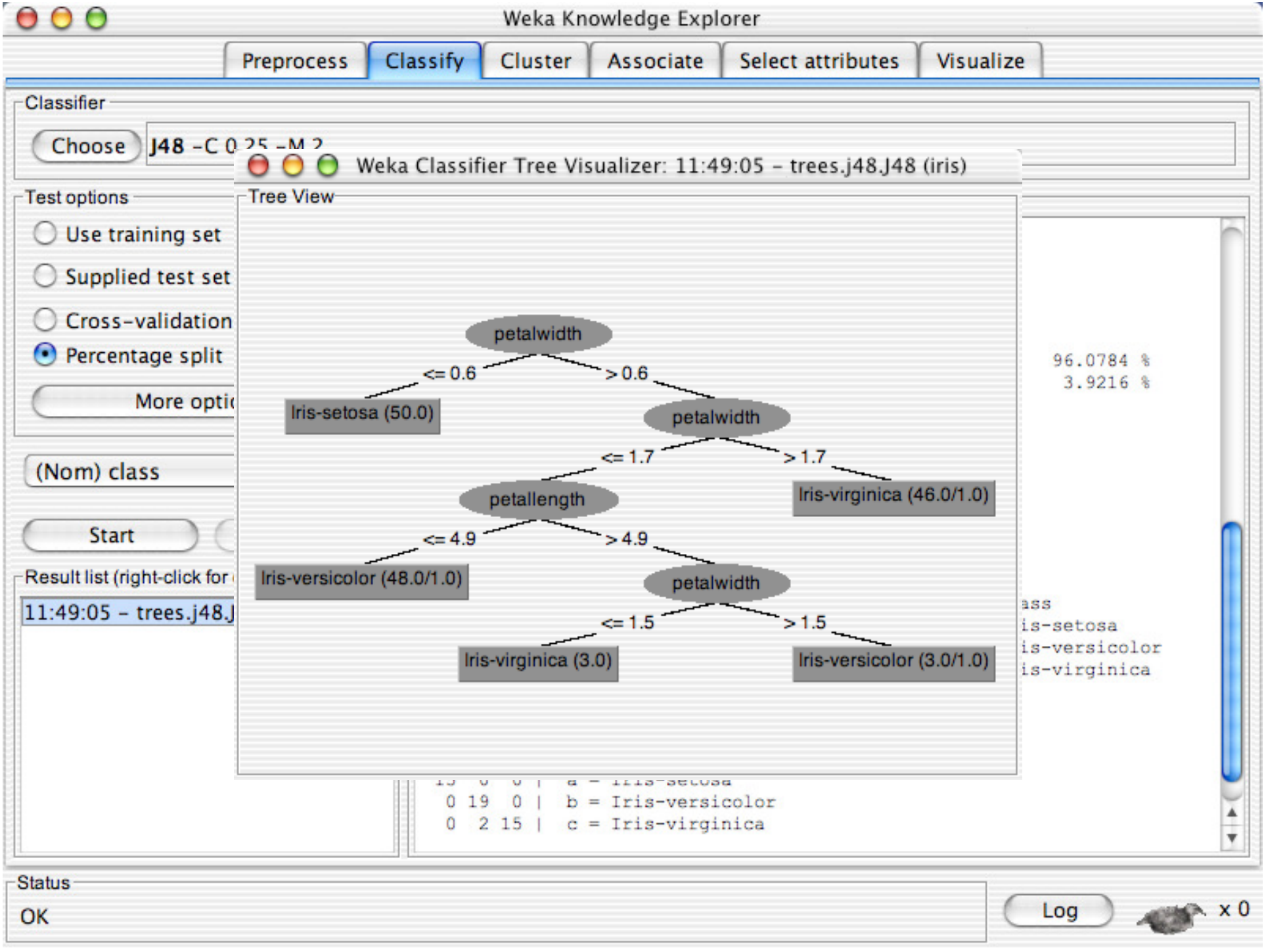

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
11:49:05 - trees.j48.J48
Classifier output
=== Run information ===
Scheme: weka.classifiers.trees.j48.J48 -C 0.25 -M 2
Relation: iris
Instances: 150
Attributes: 5
sepallength
sepalwidth
petallength
petalwidth
class
Test mode: split 66% train, remainder test
=== Classifier model (full training set) ===
J48 pruned tree
petalwidth <= 0.6: Iris-setosa (50.0)
petalwidth > 0.6
| petalwidth <= 1.7
| | petallength <= 4.9: Iris-versicolor (48.0/1.0)
| | petallength > 4.9
| | | petalwidth <= 1.5: Iris-virginica (3.0)
| | | petalwidth > 1.5: Iris-versicolor (3.0/1.0)
| petalwidth > 1.7: Iris-virginica (46.0/1.0)
Number of Leaves : 5
Status
OK
Log
x 0

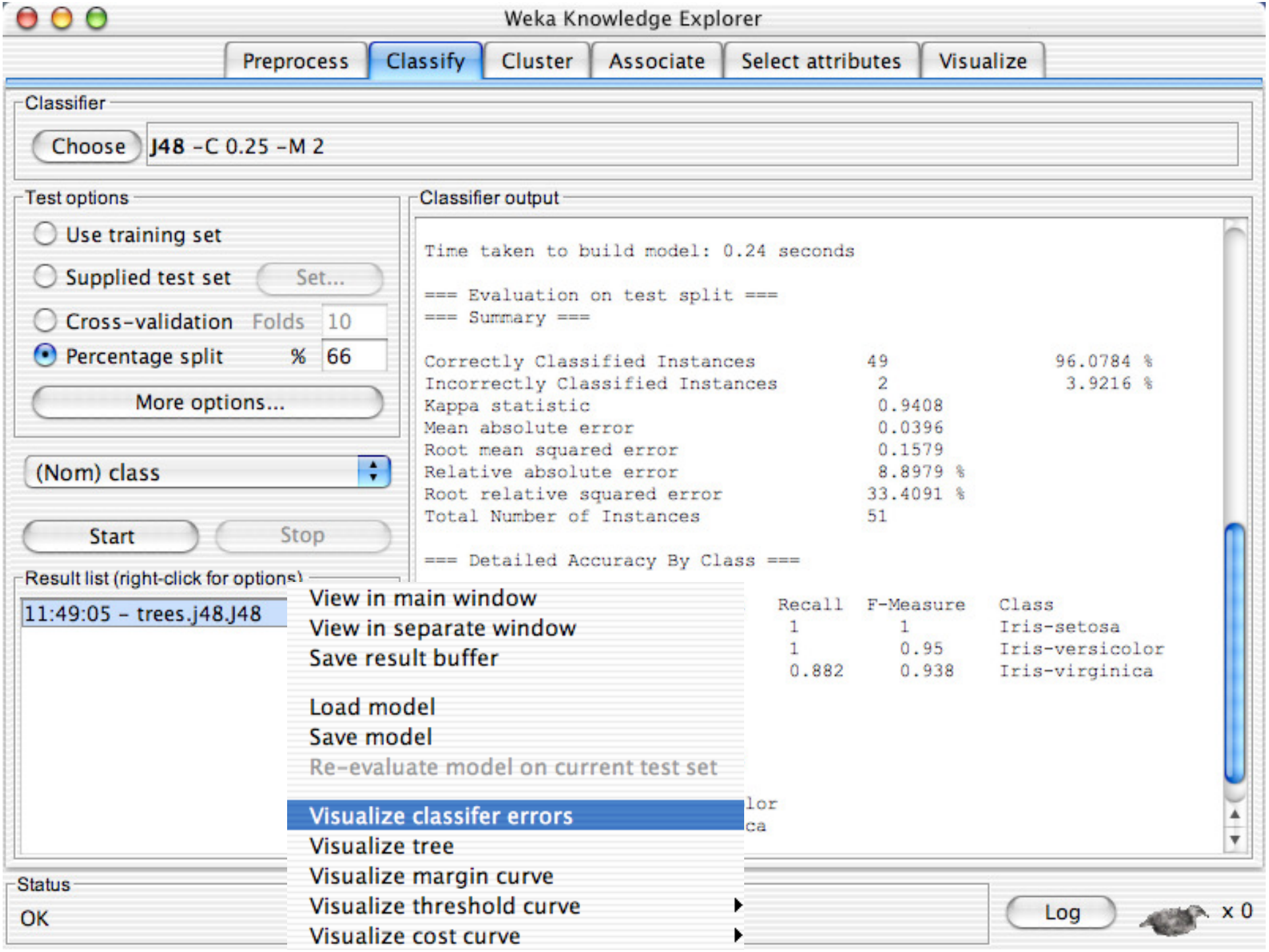

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
11:49:05 - trees.j48.J48
Classifier output
=== Run information ===
Scheme: weka.classifiers.trees.j48.J48 -C 0.25 -M 2
Relation: iris
Instances: 150
Attributes: 5
sepallength
sepalwidth
petallength
petalwidth
class
Test mode: split 66% train, remainder test
=== Classifier model (full training set) ===
J48 pruned tree
petalwidth <= 0.6: Iris-setosa (50.0)
petalwidth > 0.6
| petalwidth <= 1.7
| | petallength <= 4.9: Iris-versicolor (48.0/1.0)
| | petallength > 4.9
| | | petalwidth <= 1.5: Iris-virginica (3.0)
| | | petalwidth > 1.5: Iris-versicolor (3.0/1.0)
| petalwidth > 1.7: Iris-virginica (46.0/1.0)
Number of Leaves : 5
Status
OK
Log
x 0

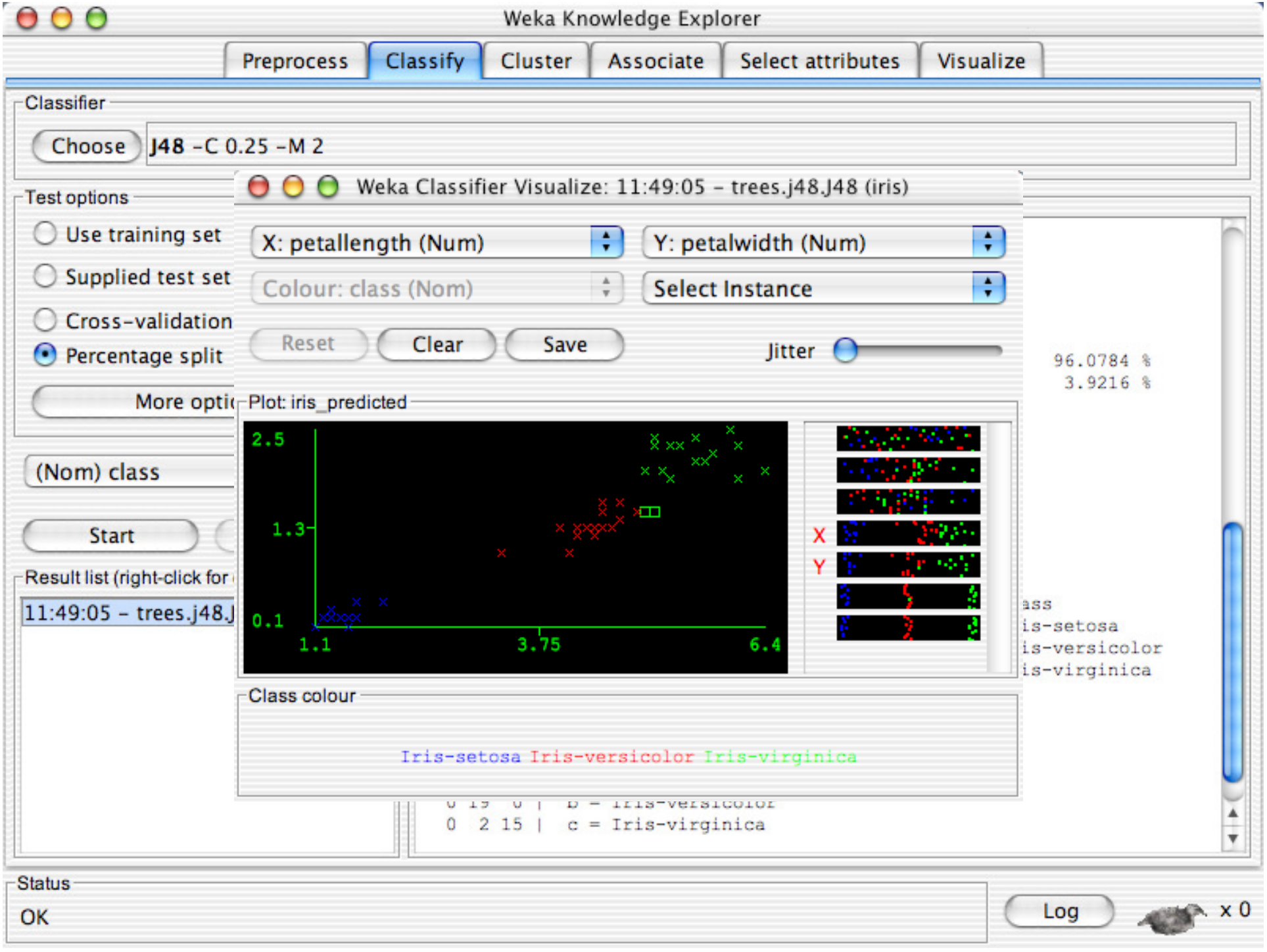

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
11:49:05 - trees.j48.J48
Classifier output
Time taken to build model: 0.24 seconds
=== Evaluation on test split ===
=== Summary ===
Correctly Classified Instances 49 96.0784 %
Incorrectly Classified Instances 2 3.9216 %
Kappa statistic 0.9408
Mean absolute error 0.0396
Root mean squared error 0.1579
Relative absolute error 8.8979 %
Root relative squared error 33.4091 %
Total Number of Instances 51
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure Class
1 0 1 1 1 Iris-setosa
1 0.063 0.905 1 0.95 Iris-versicolor
0.882 0 1 0.882 0.938 Iris-virginica
=== Confusion Matrix ===
a b c <-- classified as
15 0 0 | a = Iris-setosa
0 19 0 | b = Iris-versicolor
0 2 15 | c = Iris-virginica
Status
OK
Log
x 0

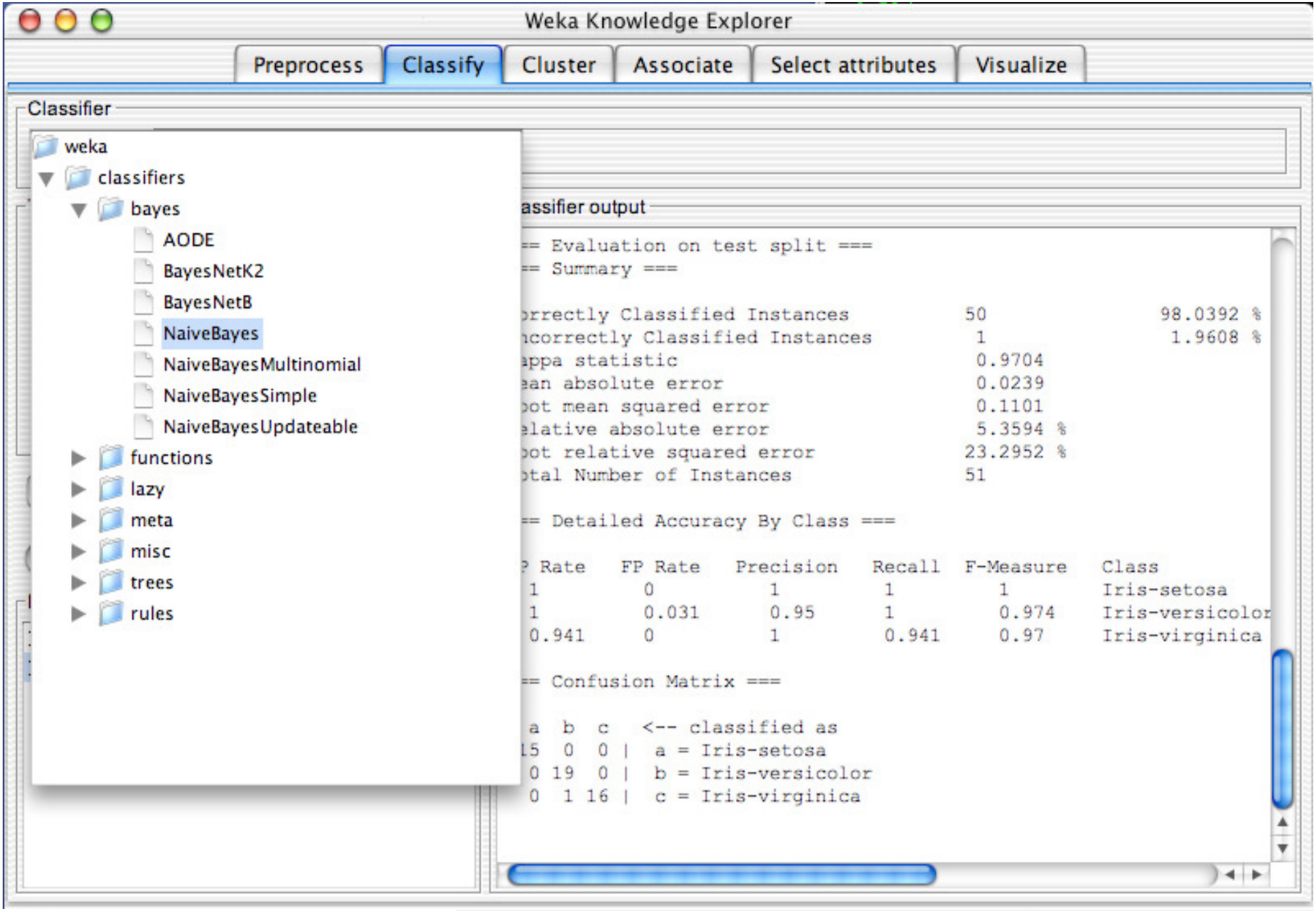

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
11:49:05 - trees.j48.J48
Classifier output
Time taken to build model: 0.24 seconds
=== Evaluation on test split ===
=== Summary ===
Correctly Classified Instances 49 96.0784 %
Incorrectly Classified Instances 2 3.9216 %
Kappa statistic 0.9408
Mean absolute error 0.0396
Root mean squared error 0.1579
Relative absolute error 8.8979 %
Root relative squared error 33.4091 %
Total Number of Instances 51
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure Class
1 0 1 1 1 Iris-setosa
1 0.063 0.905 1 0.95 Iris-versicolor
0.882 0 1 0.882 0.938 Iris-virginica
=== Confusion Matrix ===
a b c <-- classified as
15 0 0 | a = Iris-setosa
0 19 0 | b = Iris-versicolor
0 2 15 | c = Iris-virginica
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
11:49:05 - trees.j48.J48
Classifier output
Time taken to build model: 0.24 seconds
=== Evaluation on test split ===
=== Summary ===
Correctly Classified Instances 49 96.0784 %
Incorrectly Classified Instances 2 3.9216 %
Kappa statistic 0.9408
Mean absolute error 0.0396
Root mean squared error 0.1579
Relative absolute error 8.8979 %
Root relative squared error 33.4091 %
Total Number of Instances 51
=== Detailed Accuracy By Class ===
Recall F-Measure Class
1 1 Iris-setosa
1 0.95 Iris-versicolor
0.882 0.938 Iris-virginica
View in main window
View in separate window
Save result buffer
Load model
Save model
Re-evaluate model on current test set
Visualize classifer errors
Visualize tree
Visualize margin curve
Visualize threshold curve
Visualize cost curve
Status
OK
Log
x 0

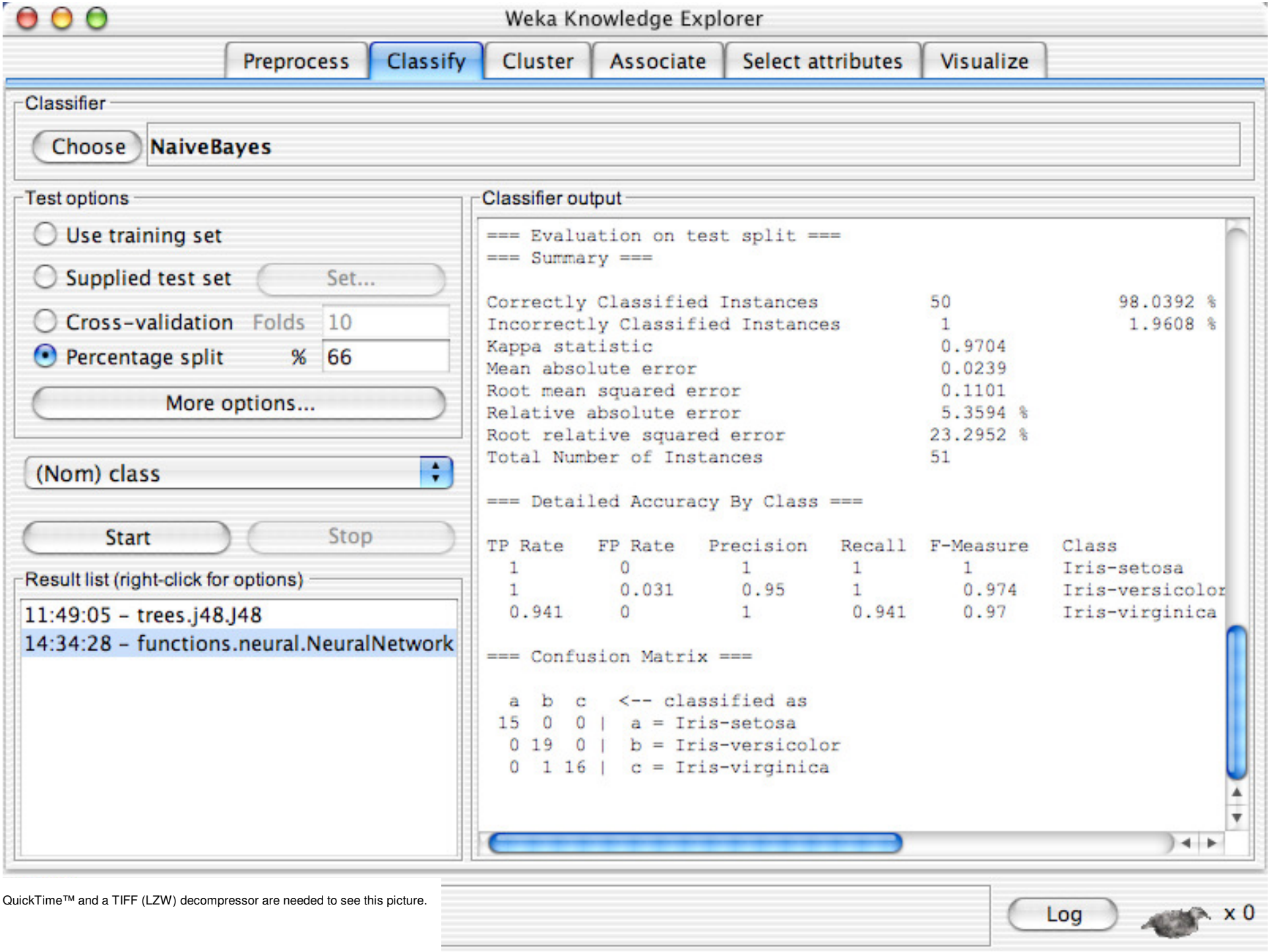

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Cross-validation
Percentage split
More optic
(Nom) class
Start
Result list (right-click for
11:49:05 - trees.j48.J
Status
OK
Log
x 0
Weka Classifier Tree Visualizer: 11:49:05 - trees.j48.J48 (iris)
Tree View
petalwidth
<= 0.6
> 0.6
Iris-setosa (50.0)
petalwidth
<= 1.7
> 1.7
petallength
Iris-virginica (46.0/1.0)
<= 4.9
> 4.9
Iris-versicolor (48.0/1.0)
petalwidth
<= 1.5
> 1.5
Iris-virginica (3.0)
Iris-versicolor (3.0/1.0)
96.0784 %
3.9216 %
ass
is-setosa
is-versicolor
is-virginica
0 19 0 | b = Iris-versicolor
0 2 15 | c = Iris-virginica


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
11:49:05 - trees.j48.J48
Classifier output
Time taken to build model: 0.24 seconds
=== Evaluation on test split ===
=== Summary ===
Correctly Classified Instances 49 96.0784 %
Incorrectly Classified Instances 2 3.9216 %
Kappa statistic 0.9408
Mean absolute error 0.0396
Root mean squared error 0.1579
Relative absolute error 8.8979 %
Root relative squared error 33.4091 %
Total Number of Instances 51
=== Detailed Accuracy By Class ===
Recall F-Measure Class
1 1 Iris-setosa
1 0.95 Iris-versicolor
0.882 0.938 Iris-virginica
View in main window
View in separate window
Save result buffer
Load model
Save model
Re-evaluate model on current test set
Visualize classifer errors
Visualize tree
Visualize margin curve
Visualize threshold curve
Visualize cost curve
Status
OK
Log
x 0

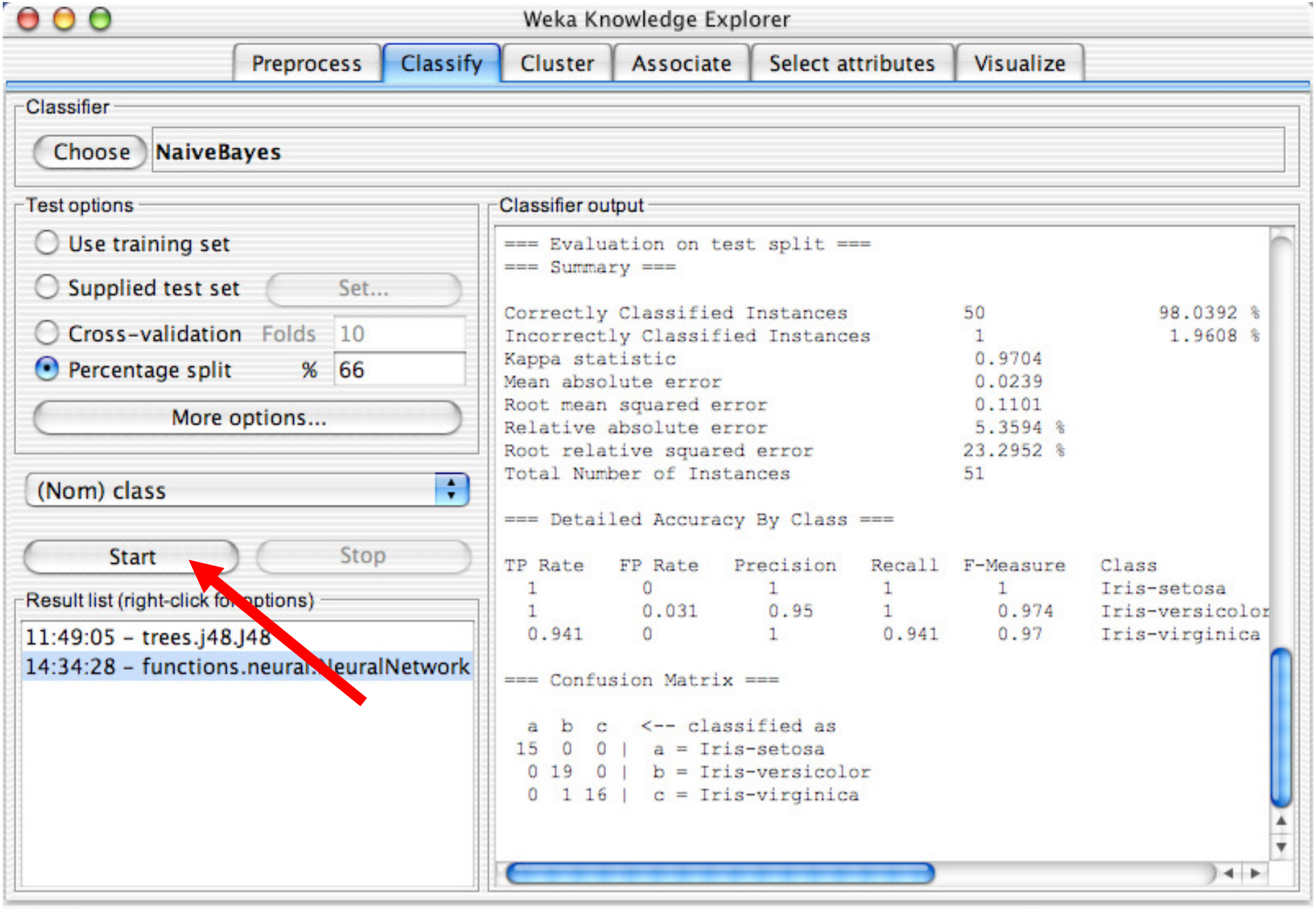

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
J48 -C 0.25 -M 2
Test options
Use training set
Supplied test set
Cross-validation
Percentage split
More optic
(Nom) class
Start
Result list (right-click for
11:49:05 - trees.j48.J
Weka Classifier Visualize: 11:49:05 - trees.j48.J48 (iris)
X: petallength (Num)
Y: petalwidth (Num)
Colour: class (Nom)
Select Instance
Reset
Clear
Save
Jitter
Plot: iris_predicted
2.5
1.3
0.1
1.1
3.75
6.4
X
Y
Class colour
Iris-setosa Iris-versicolor Iris-virginica
96.0784 %
3.9216 %
ass
is-setosa
is-versicolor
is-virginica
0 2 15 | c = Iris-virginica
Status
OK
Log
x 0



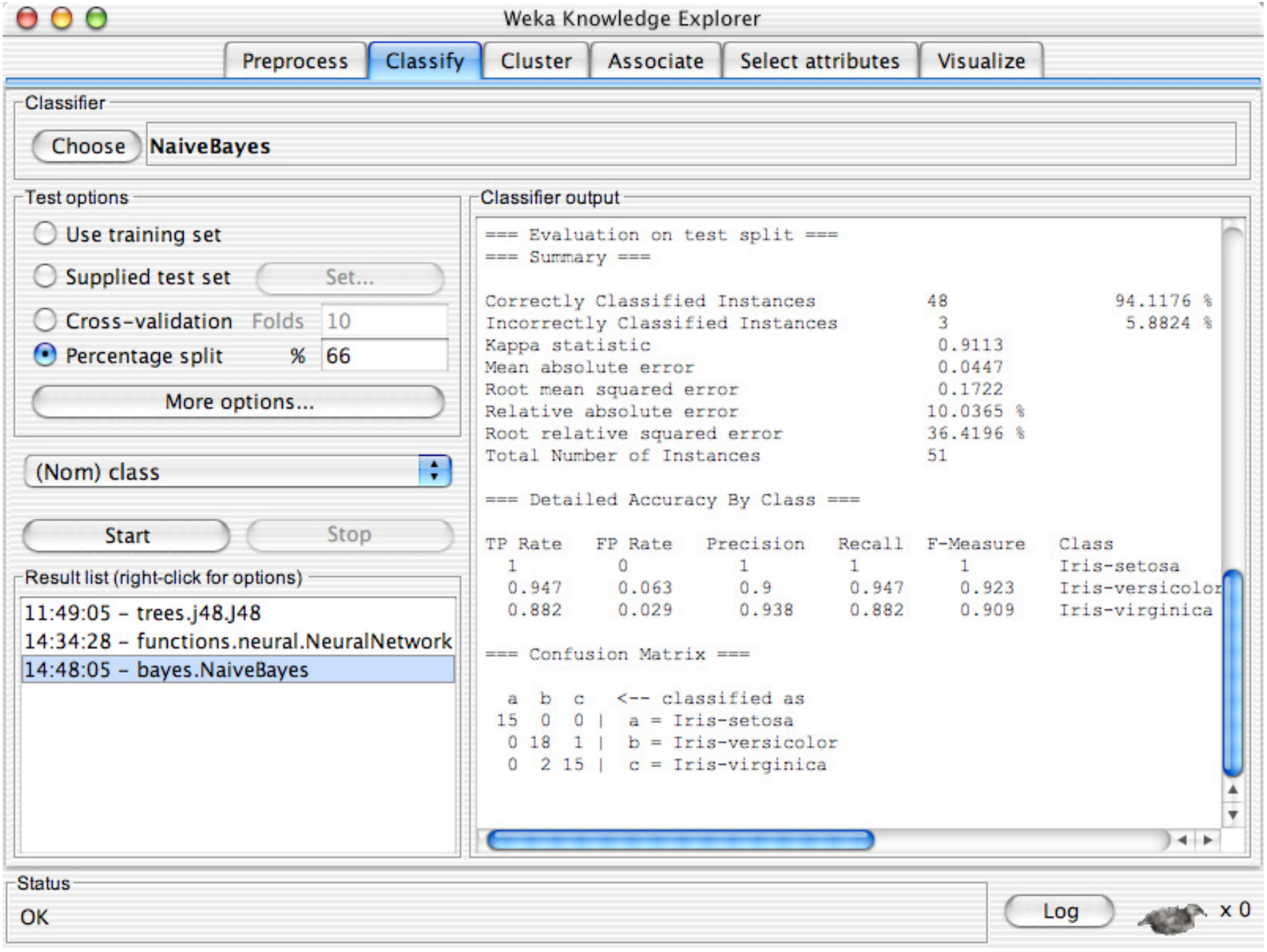
QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

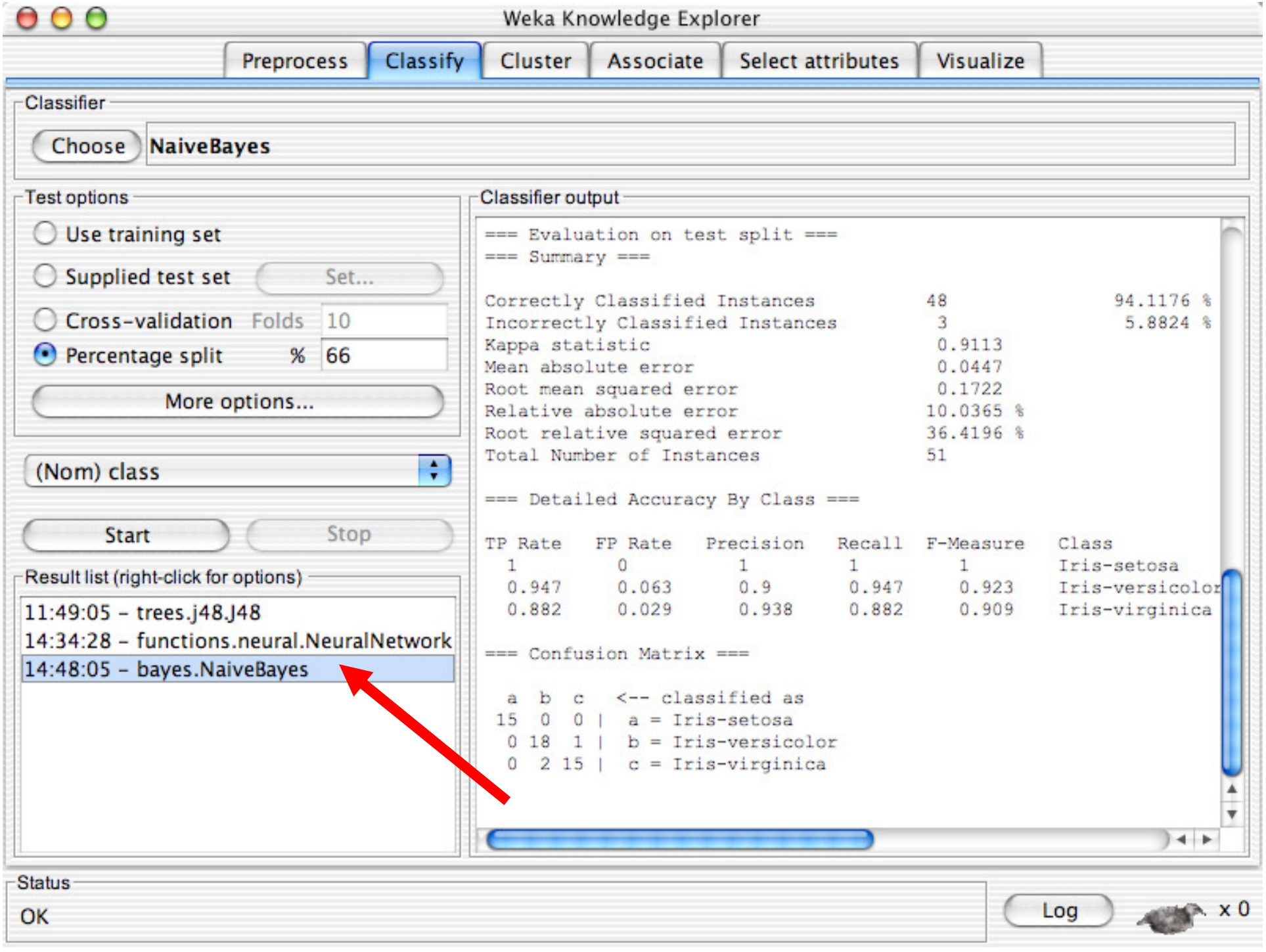


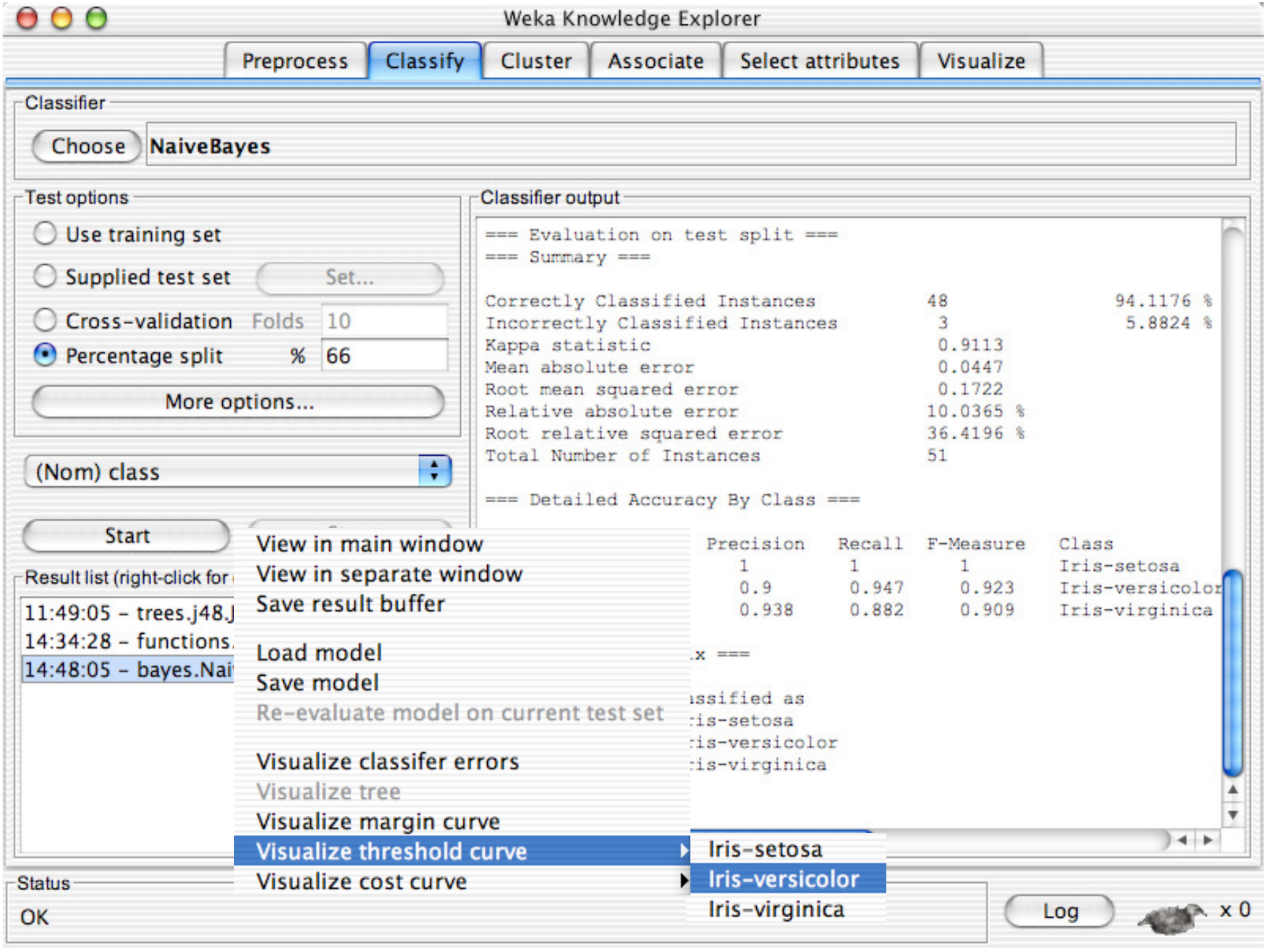
QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

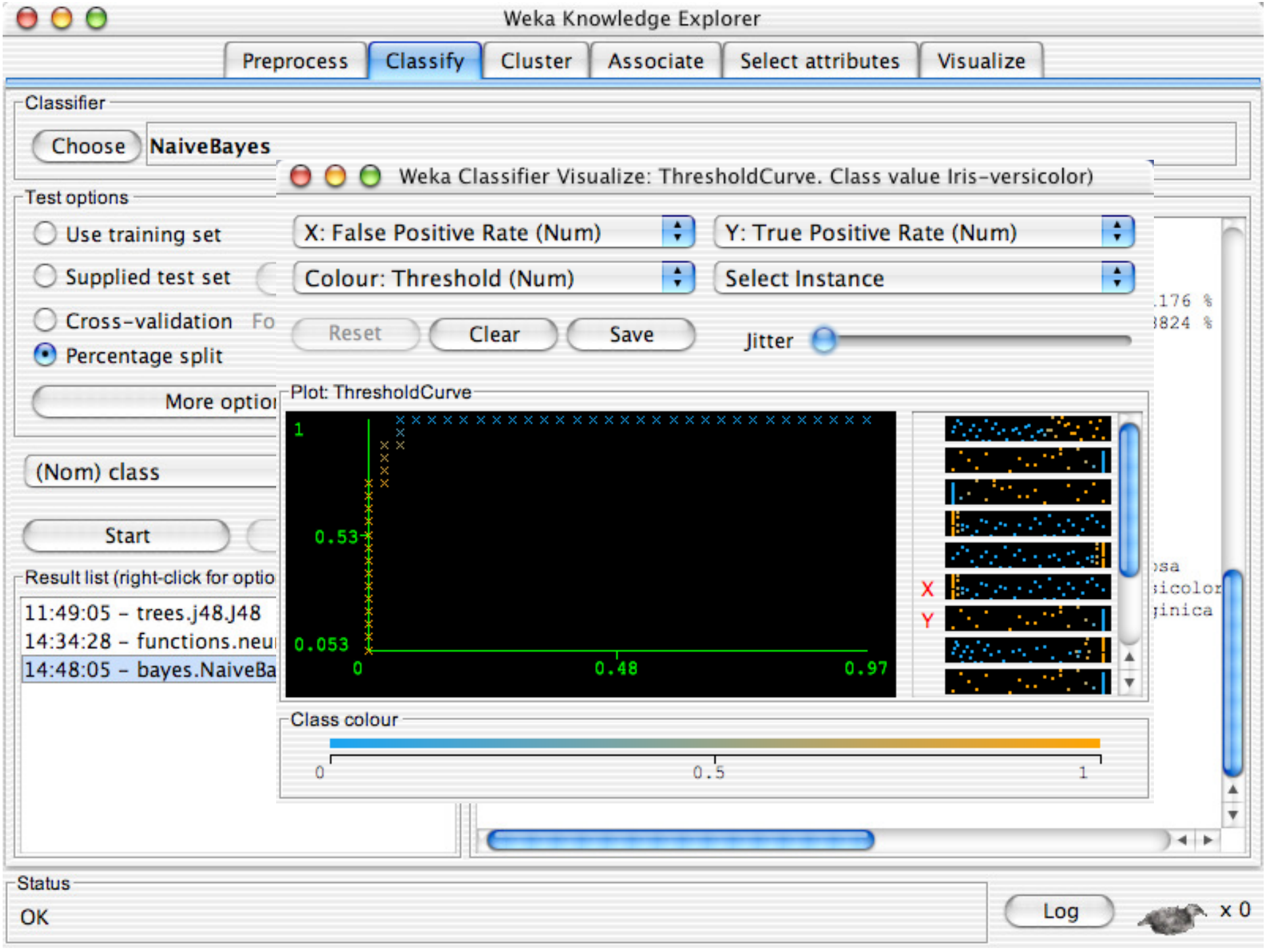


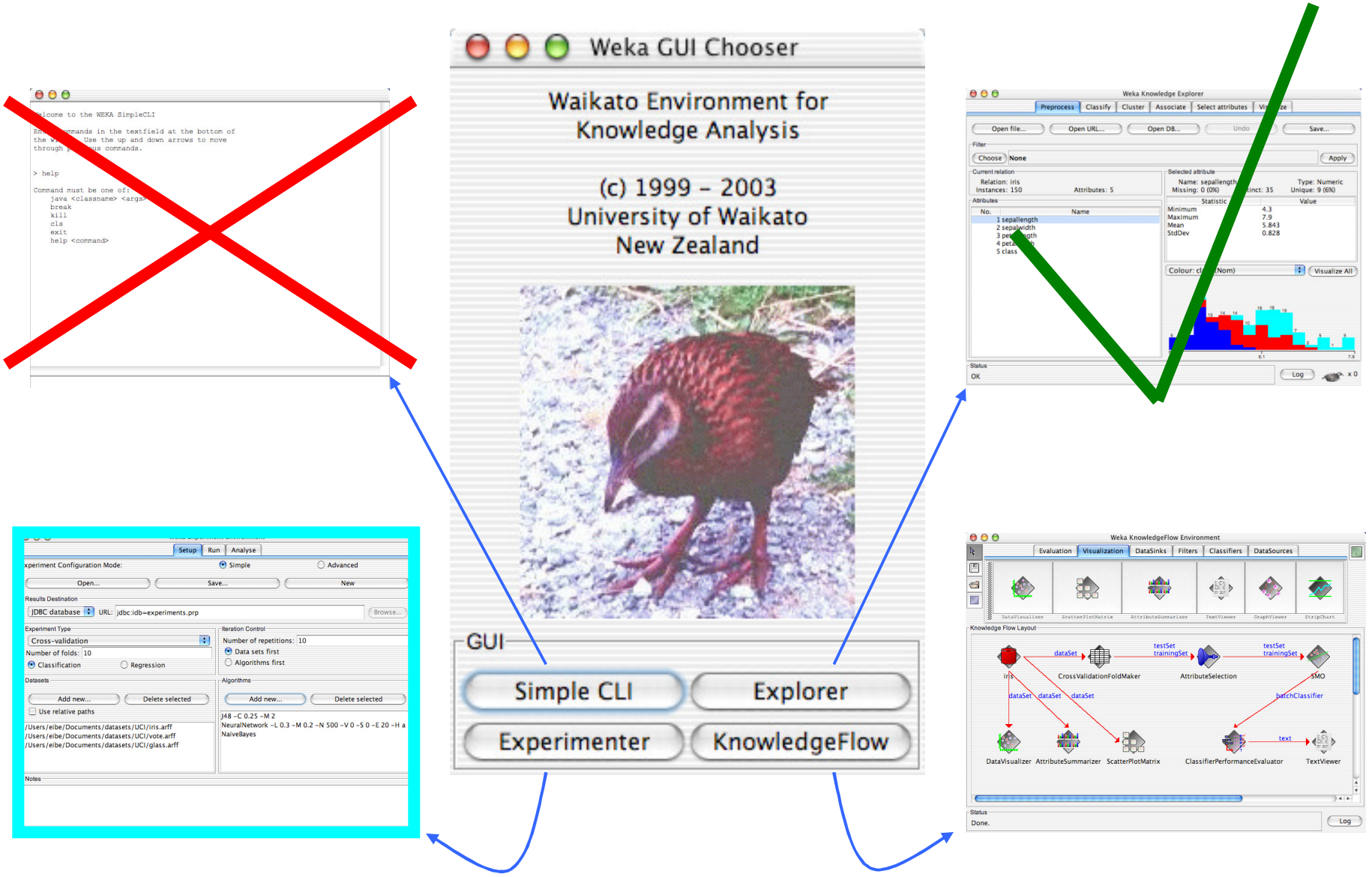
QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
NaiveBayes
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
11:49:05 - trees.j48.J48
14:34:28 - functions.neural.NeuralNetwork
14:48:05 - bayes.NaiveBayes
Classifier output
=== Evaluation on test split ===
=== Summary ===
Correctly Classified Instances 48 94.1176 %
Incorrectly Classified Instances 3 5.8824 %
Kappa statistic 0.9113
Mean absolute error 0.0447
Root mean squared error 0.1722
Relative absolute error 10.0365 %
Root relative squared error 36.4196 %
Total Number of Instances 51
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure Class
1 0 1 1 1 Iris-setosa
0.947 0.063 0.9 0.947 0.923 Iris-versicolor
0.882 0.029 0.938 0.882 0.909 Iris-virginica
=== Confusion Matrix ===
a b c <-- classified as
15 0 0 | a = Iris-setosa
0 18 1 | b = Iris-versicolor
0 2 15 | c = Iris-virginica
Status
OK
Log
x 0


Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
NaiveBayes
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Stop
Result list (right-click for options)
11:49:05 - trees.j48.J48
14:34:28 - functions.neural.NeuralNetwork
14:48:05 - bayes.NaiveBayes
Classifier output
=== Evaluation on test split ===
=== Summary ===
Correctly Classified Instances 48 94.1176 %
Incorrectly Classified Instances 3 5.8824 %
Kappa statistic 0.9113
Mean absolute error 0.0447
Root mean squared error 0.1722
Relative absolute error 10.0365 %
Root relative squared error 36.4196 %
Total Number of Instances 51
=== Detailed Accuracy By Class ===
TP Rate FP Rate Precision Recall F-Measure Class
1 0 1 1 1 Iris-setosa
0.947 0.063 0.9 0.947 0.923 Iris-versicolor
0.882 0.029 0.938 0.882 0.909 Iris-virginica
=== Confusion Matrix ===
a b c <-- classified as
15 0 0 | a = Iris-setosa
0 18 1 | b = Iris-versicolor
0 2 15 | c = Iris-virginica
Status
OK
Log
x 0

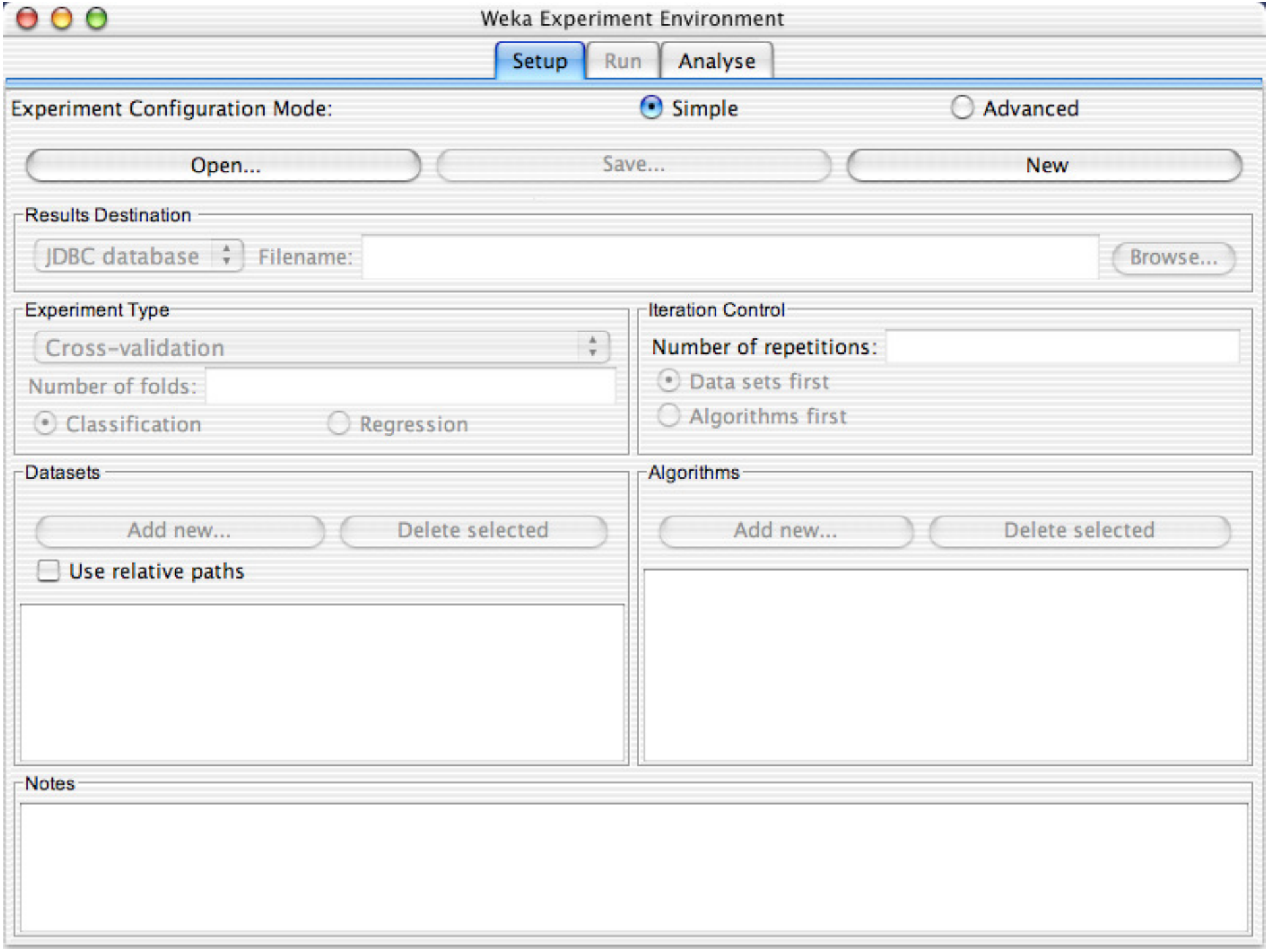

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
NaiveBayes
Test options
Use training set
Supplied test set
Set...
Cross-validation
Folds
10
Percentage split
%
66
More options...
(Nom) class
Start
Result list (right-click for
11:49:05 - trees.j48.J
14:34:28 - functions.
14:48:05 - bayes.Nai
Classifier output
=== Evaluation on test split ===
=== Summary ===
Correctly Classified Instances 48 94.1176 %
Incorrectly Classified Instances 3 5.8824 %
Kappa statistic 0.9113
Mean absolute error 0.0447
Root mean squared error 0.1722
Relative absolute error 10.0365 %
Root relative squared error 36.4196 %
Total Number of Instances 51
=== Detailed Accuracy By Class ===
Precision Recall F-Measure Class
1 1 1 Iris-setosa
0.9 0.947 0.923 Iris-versicolor
0.938 0.882 0.909 Iris-virginica
View in main window
View in separate window
Save result buffer
Load model
Save model
Re-evaluate model on current test set
Visualize classifer errors
Visualize tree
Visualize margin curve
Visualize threshold curve
Visualize cost curve
Iris-setosa
Iris-versicolor
Iris-virginica
Status
OK
Log
x 0

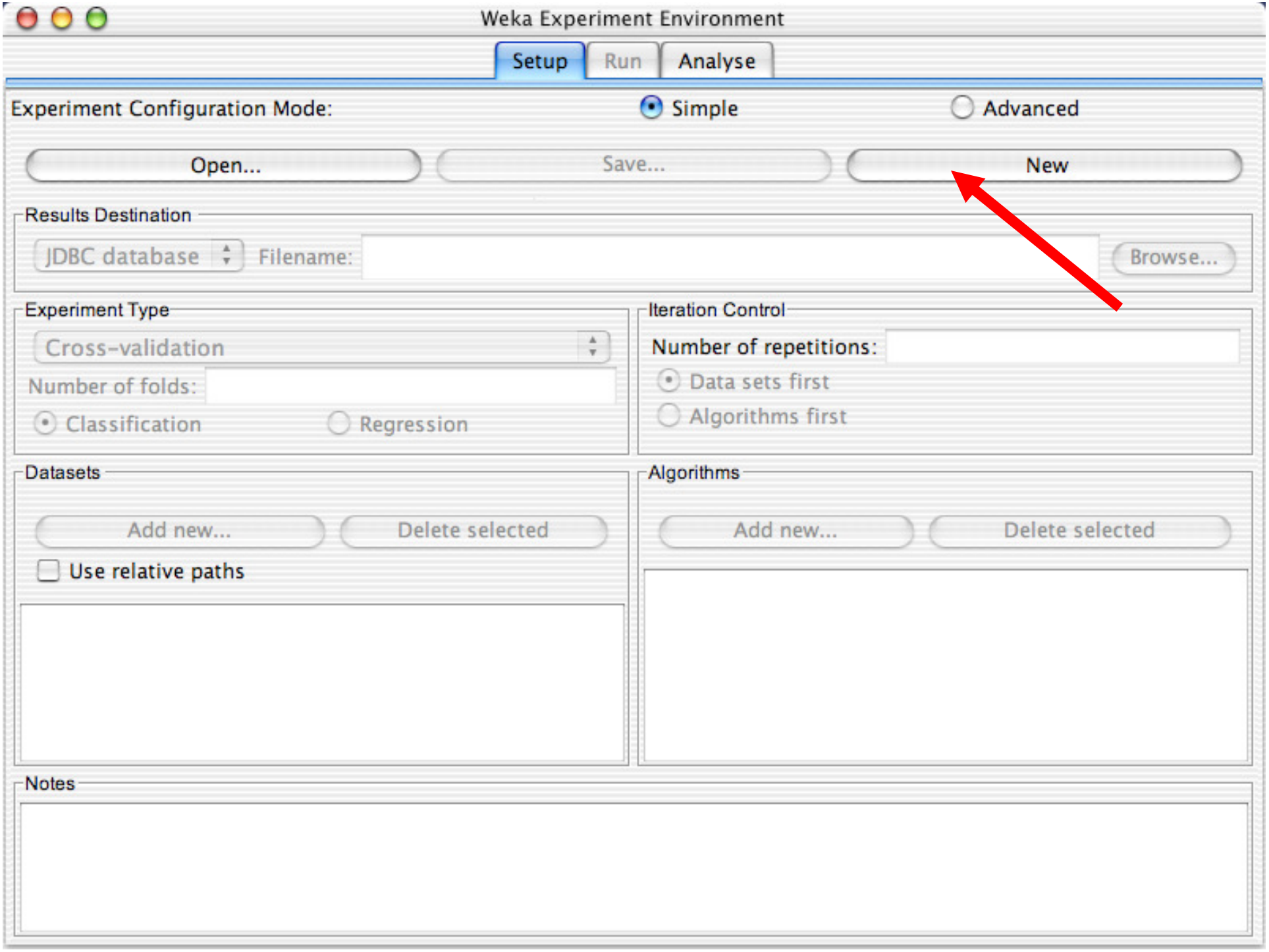

Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Visualize
Classifier
Choose
NaiveBayes
Weka Classifier Visualize: ThresholdCurve. Class value Iris-versicolor)
Test options
Use training set
Supplied test set
Cross-validation
Percentage split
More optio
X: False Positive Rate (Num)
Y: True Positive Rate (Num)
Colour: Threshold (Num)
Select Instance
Reset
Clear
Save
Jitter
Plot: ThresholdCurve
1
0.53
0.053
0
0.48
0.97
X
Y
(Nom) class
Start
Result list (right-click for optio
11:49:05 - trees.j48.J48
14:34:28 - functions.neu
14:48:05 - bayes.NaiveBa
Class colour
0
0.5
1
Status
OK
Log
x 0


Weka GUI Chooser
Waikato Environment for Knowledge Analysis
(c) 1999 - 2003
University of Waikato
New Zealand
GUI
Simple CLI
Explorer
Experimenter
KnowledgeFlow

Performing experiments

- Experimenter makes it easy to compare the performance of different learning schemes
- For classification and regression problems
- Results can be written into file or database
- Evaluation options: cross-validation, learning curve, hold-out
- Can also iterate over different parameter settings
- Significance-testing built in!


Weka Experiment Environment
Setup
Run
Analyse
Experiment Configuration Mode:
Simple
Advanced
Open...
Save...
New
Results Destination
JDBC database
Filename:
Browse...
Experiment Type
Cross-validation
Number of folds:
Classification
Regression
Iteration Control
Number of repetitions:
Data sets first
Algorithms first
Datasets
Add new...
Delete selected
Use relative paths
Algorithms
Add new...
Delete selected
Notes


Weka Experiment Environment
Setup
Run
Analyse
Experiment Configuration Mode:
Simple
Advanced
Open...
Save...
New
Results Destination
JDBC database
Filename:
Browse...
Experiment Type
Cross-validation
Number of folds:
Classification
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Iteration Control
Number of repetitions:
Data sets first
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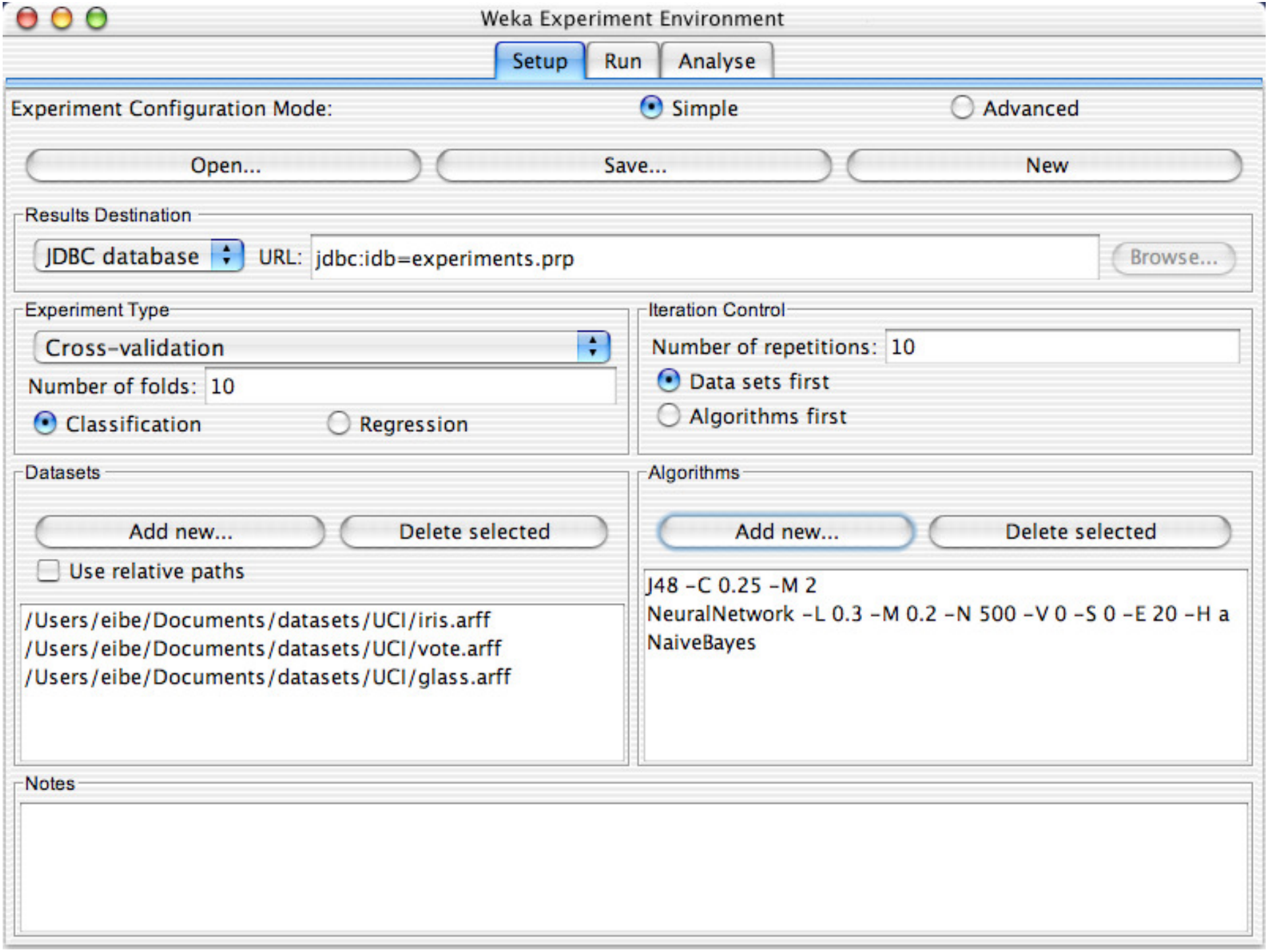
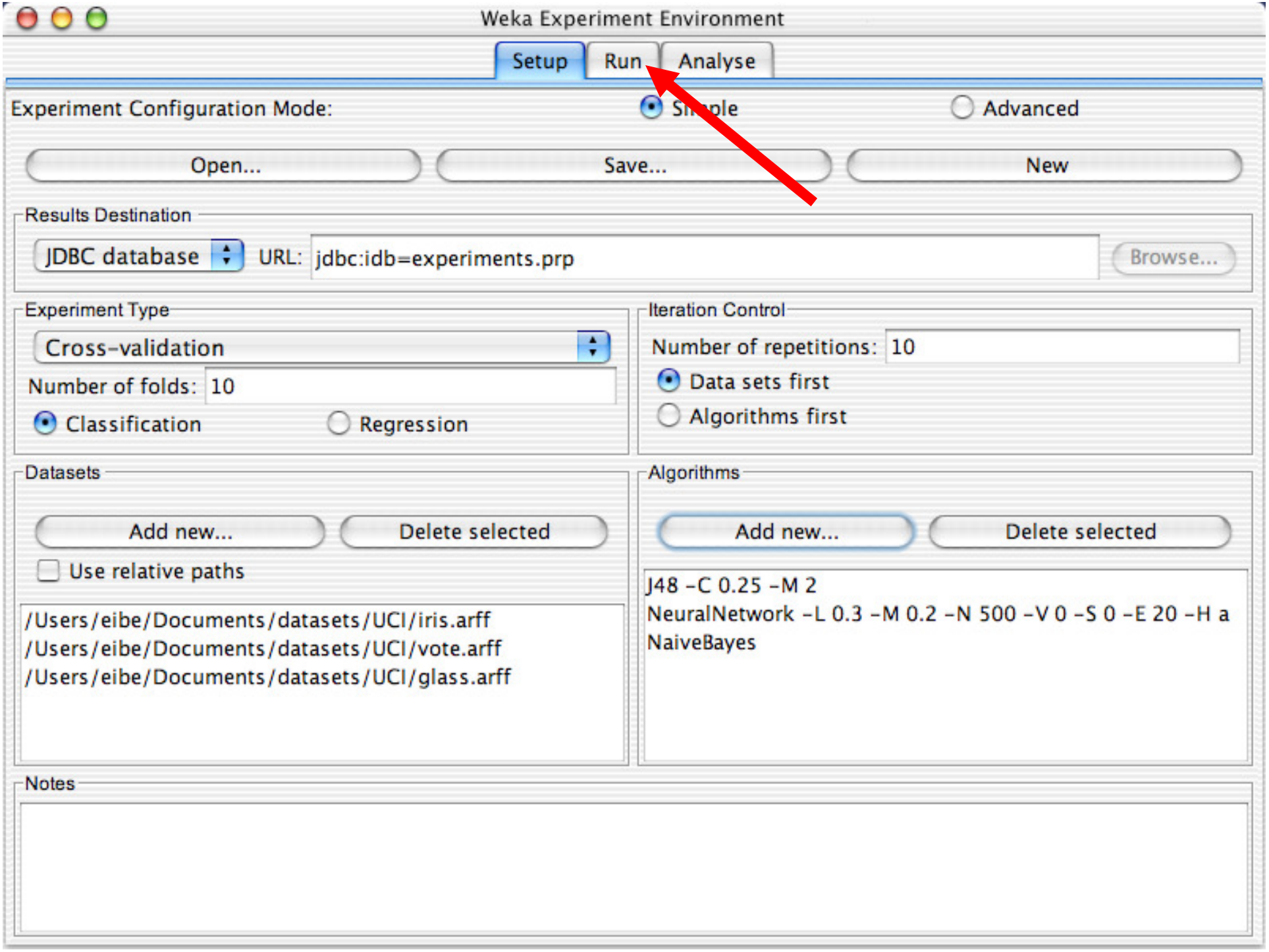
Add new...
Delete selected
Use relative paths
Algorithms
Add new...
Delete selected
Notes


Weka Experiment Environment
Setup
Run
Analyse
Experiment Configuration Mode:
Simple
Advanced
Open...
Save...
New
Results Destination
JDBC database
URL:
jdbc:idb=experiments.prp
Browse...
Experiment Type
Cross-validation
Number of folds:
10
Classification
Regression
Iteration Control
Number of repetitions:
10
Data sets first
Algorithms first
Datasets
Add new...
Delete selected
Use relative paths
/Users/eibe/Documents/datasets/UCI/iris.arff
/Users/eibe/Documents/datasets/UCI/vote.arff
/Users/eibe/Documents/datasets/UCI/glass.arff
Algorithms
Add new...
Delete selected
J48 -C 0.25 -M 2
NeuralNetwork -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H a
NaiveBayes
Notes


Weka Experiment Environment
Setup
Run
Analyse
Experiment Configuration Mode:
Simple
Advanced
Open...
Save...
New
Results Destination
JDBC database
URL:
jdbc:idb=experiments.prp
Browse...
Experiment Type
Cross-validation
Number of folds:
10
Classification
Regression
Iteration Control
Number of repetitions:
10
Data sets first
Algorithms first
Datasets
Add new...
Delete selected
Use relative paths
/Users/eibe/Documents/datasets/UCI/iris.arff
/Users/eibe/Documents/datasets/UCI/vote.arff
/Users/eibe/Documents/datasets/UCI/glass.arff
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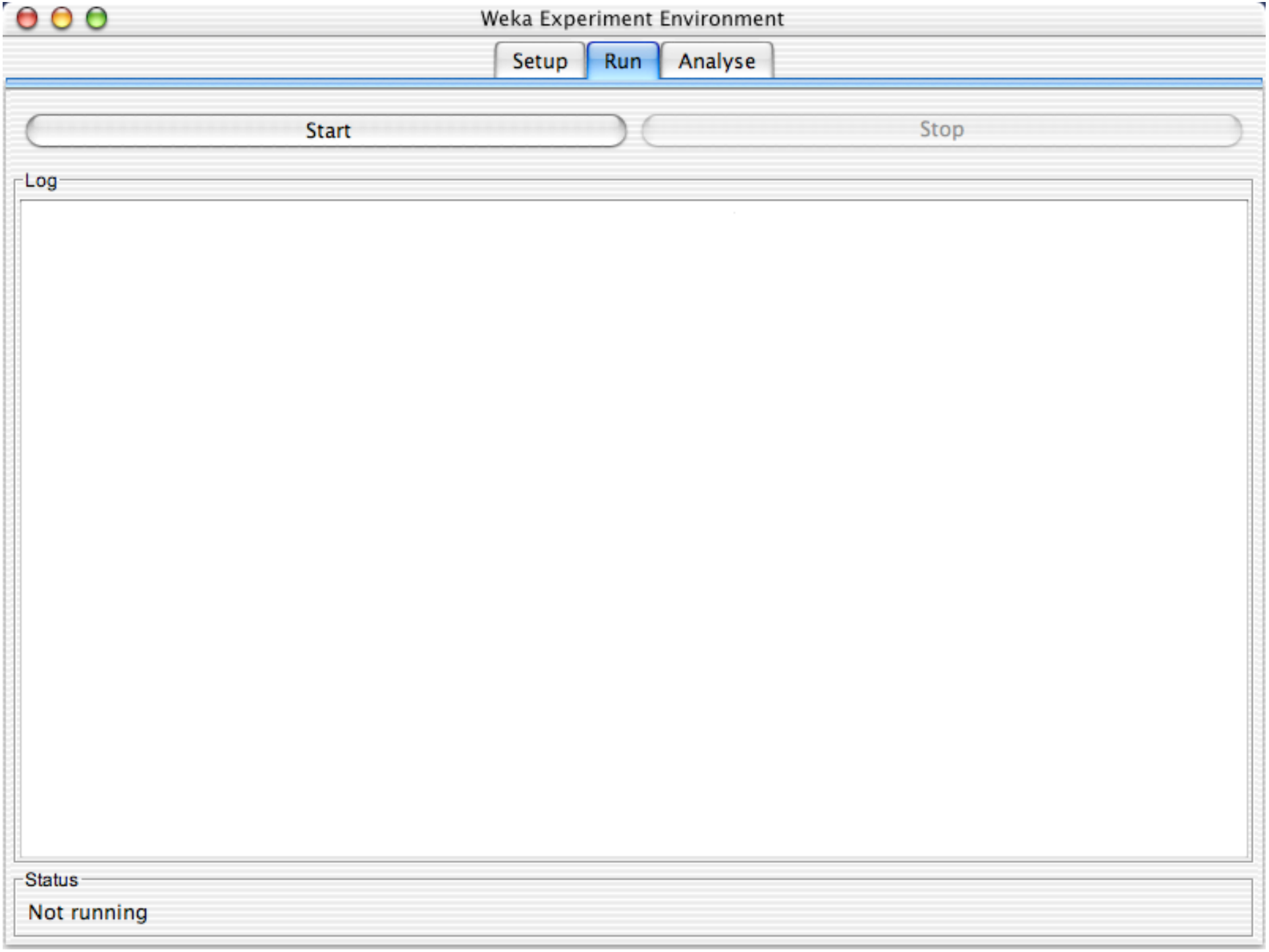
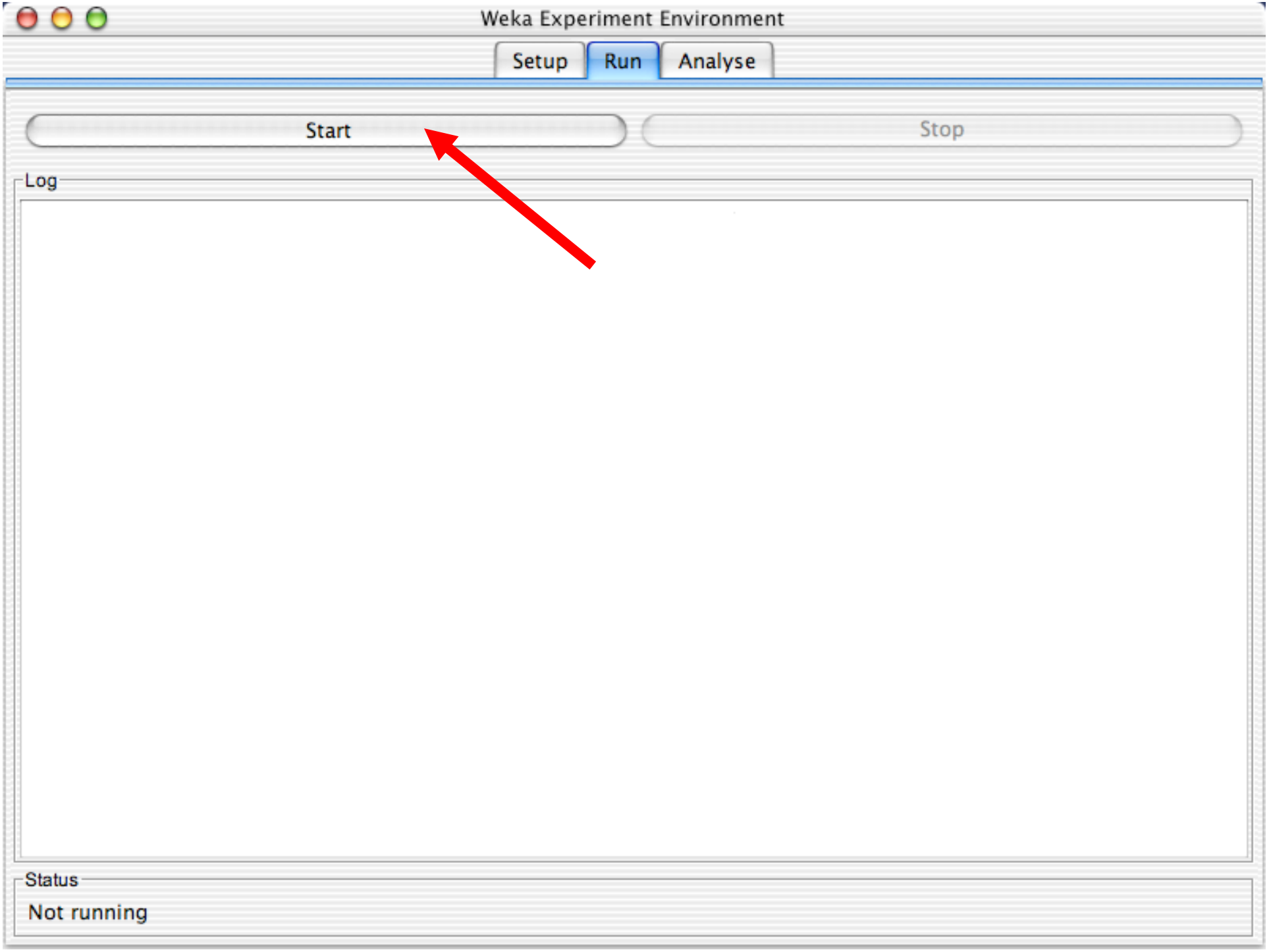
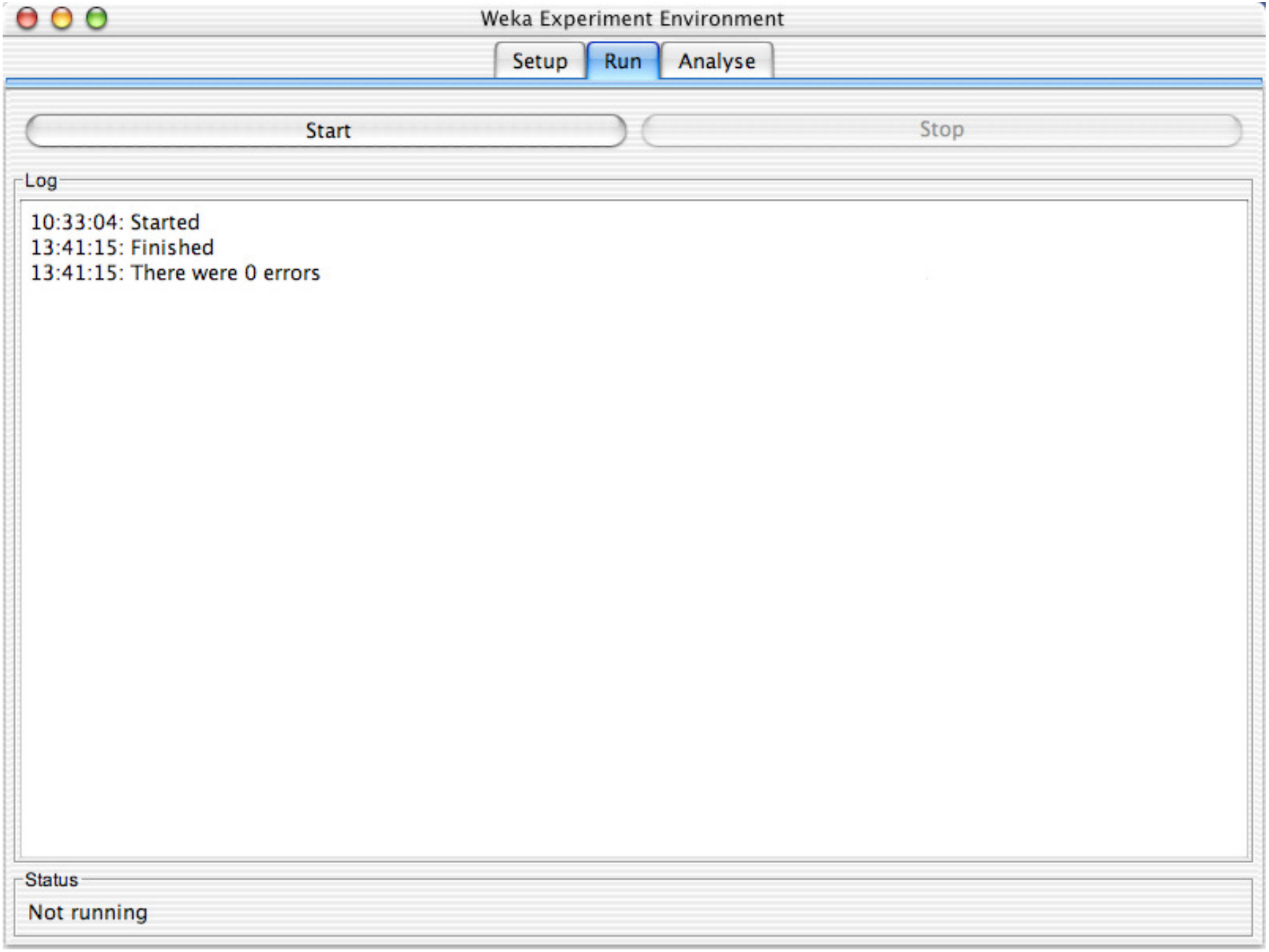
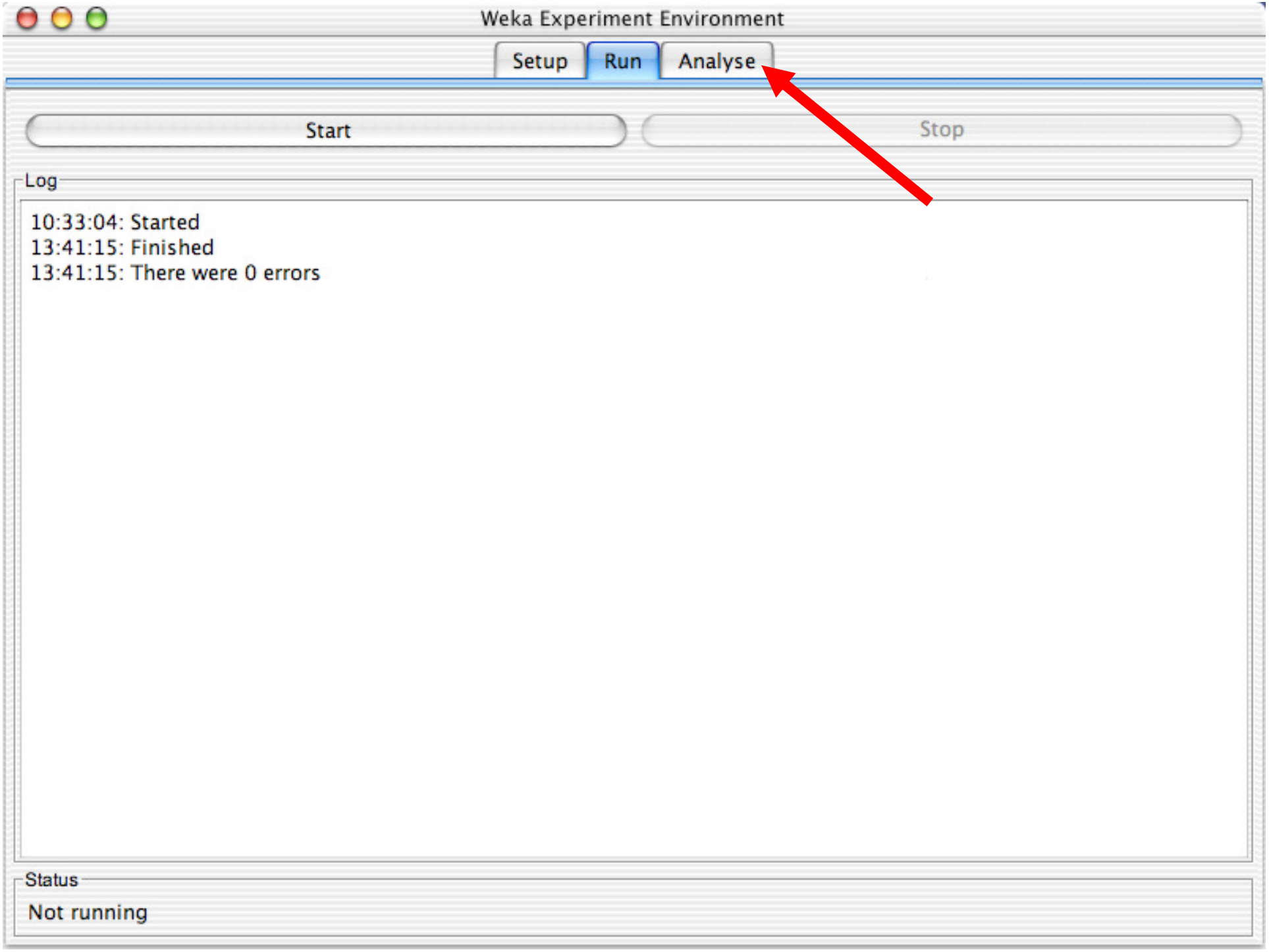
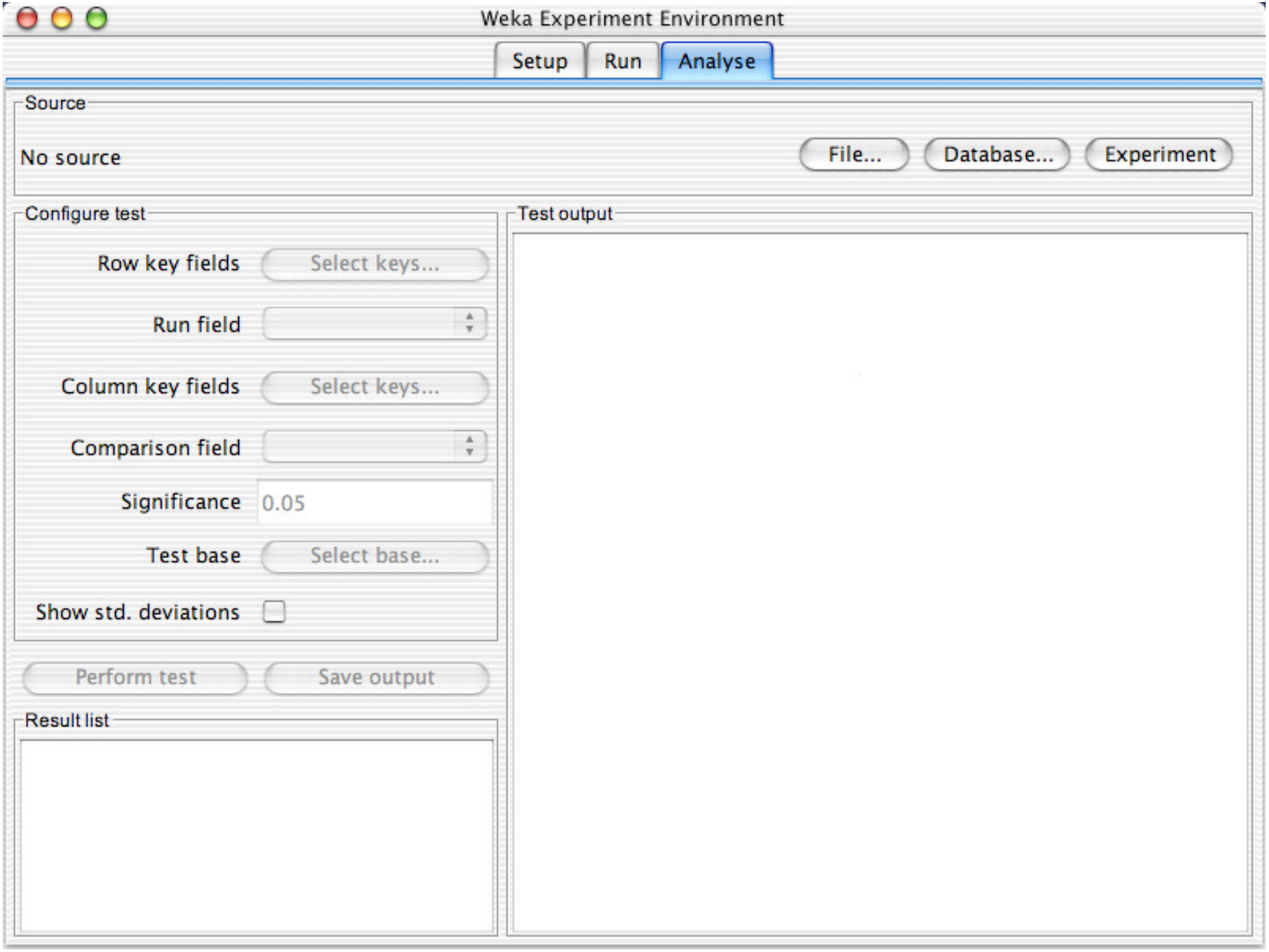
NaiveBayes
Notes

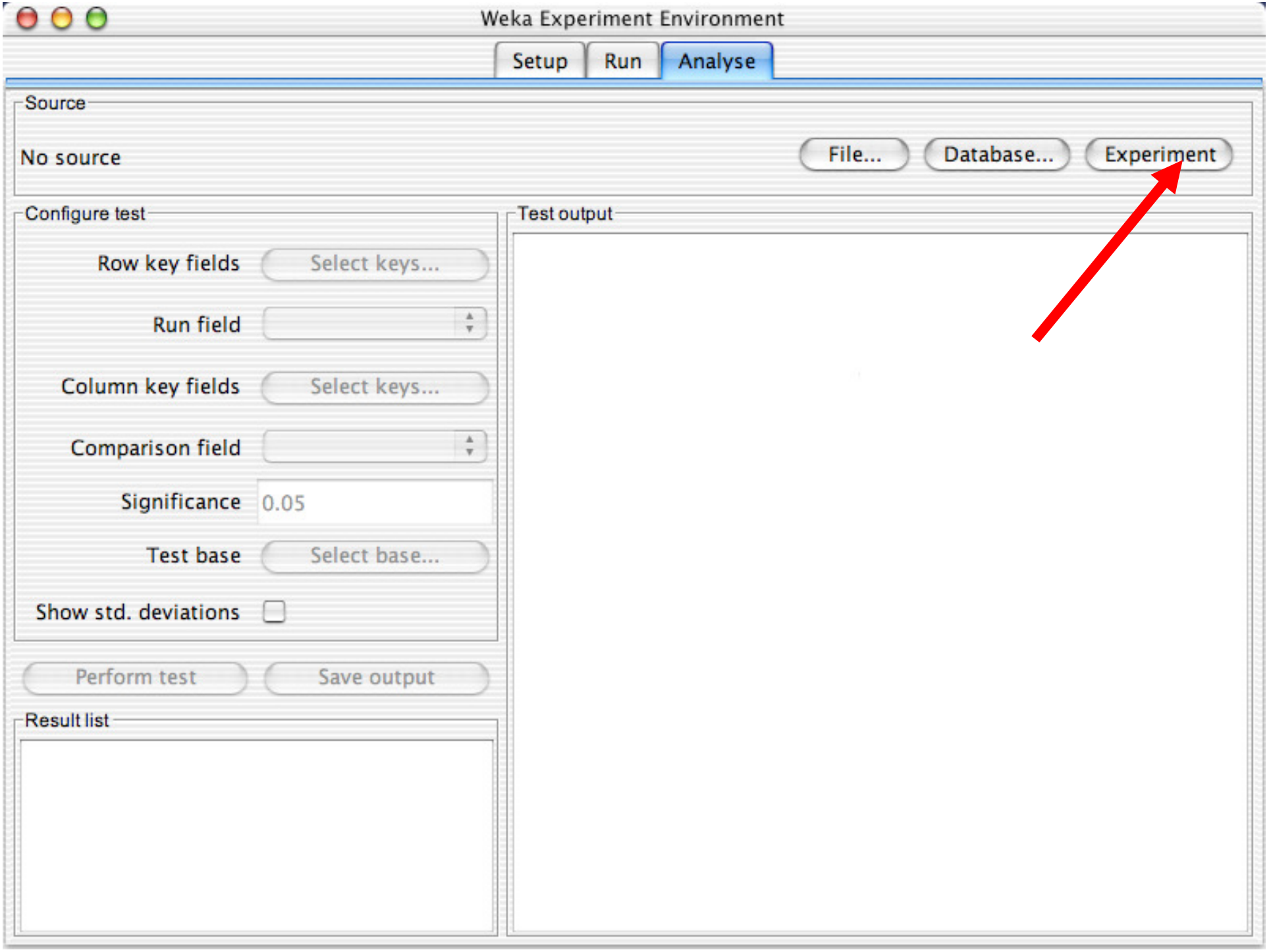

Weka Experiment Environment
Setup
Run
Analyse
Start
Stop
Log
Status
Not running

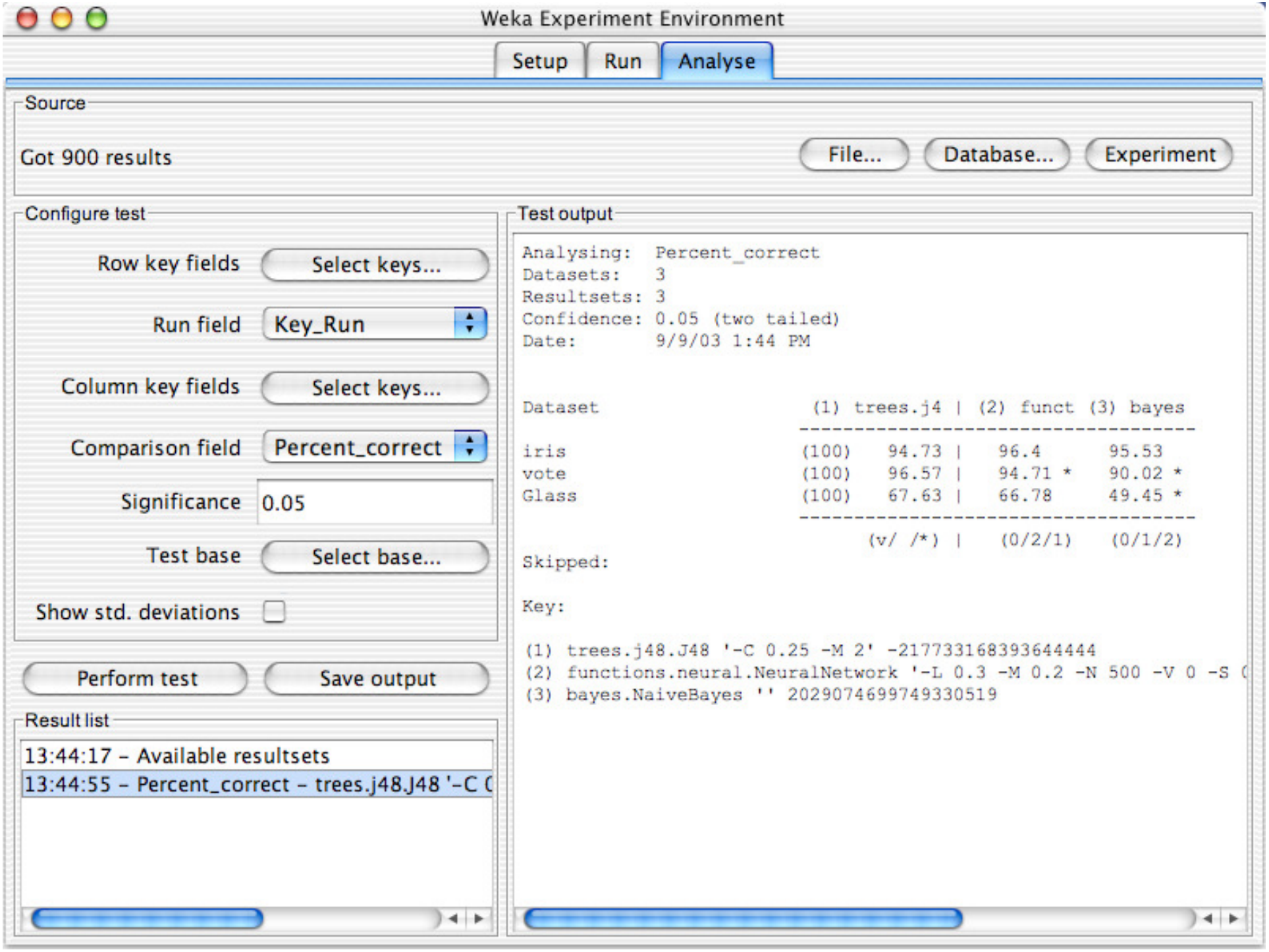

Weka Experiment Environment
Setup
Run
Analyse
Start
Stop
Log
Status
Not running

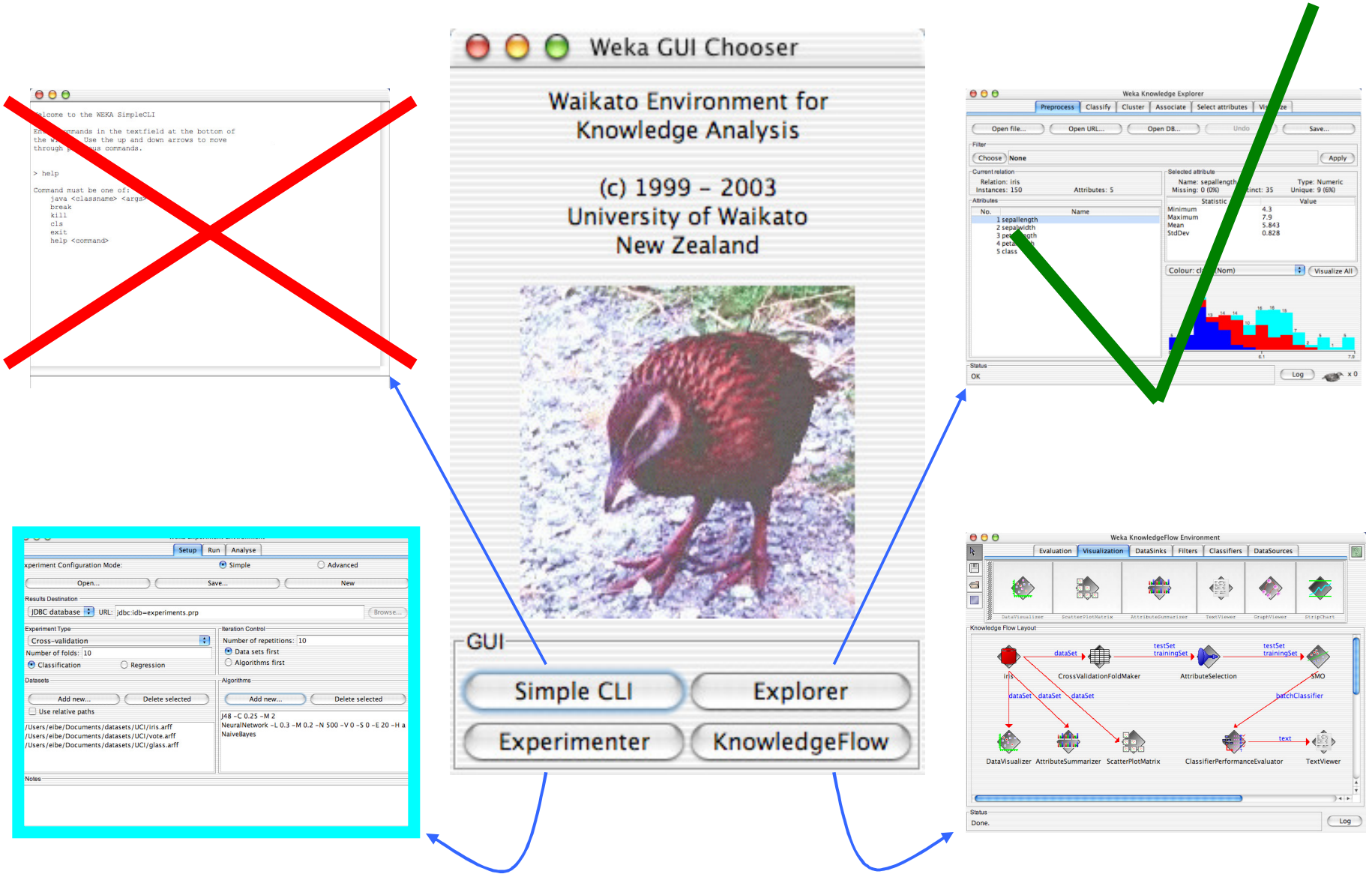

Weka Experiment Environment
Setup
Run
Analyse
Start
Stop
Log
10:33:04: Started
13:41:15: Finished
13:41:15: There were 0 errors
Status
Not running


Weka Experiment Environment
Setup
Run
Analyse
Start
Stop
Log
10:33:04: Started
13:41:15: Finished
13:41:15: There were 0 errors
Status
Not running


Weka Experiment Environment
Setup
Run
Analyse
Source
No source
File...
Database...
Experiment
Configure test
Row key fields
Select keys...
Run field
Column key fields
Select keys...
Comparison field
Significance
0.05
Test base
Select base...
Show std. deviations
Perform test
Save output
Result list
Test output


Weka Experiment Environment
Setup
Run
Analyse
Source
No source
File...
Database...
Experiment
Configure test
Row key fields
Select keys...
Run field
Column key fields
Select keys...
Comparison field
Significance
0.05
Test base
Select base...
Show std. deviations
Perform test
Save output
Result list
Test output


Weka Experiment Environment
Setup
Run
Analyse
Source
Got 900 results
File...
Database...
Experiment
Configure test
Row key fields
Select keys...
Run field
Key_Run
Column key fields
Select keys...
Comparison field
Percent_correct
Significance
0.05
Test base
Select base...
Show std. deviations
Perform test
Save output
Result list
13:44:17 - Available resultsets
13:44:55 - Percent_correct - trees.j48.J48 '-C
Test output
Analysing: Percent_correct
Datasets: 3
Resultsets: 3
Confidence: 0.05 (two tailed)
Date: 9/9/03 1:44 PM
Dataset (1) trees.j4 | (2) funct (3) bayes
iris (100) 94.73 | 96.4 95.53
vote (100) 96.57 | 94.71 * 90.02 *
Glass (100) 67.63 | 66.78 49.45 *
(v/ /*) | (0/2/1) (0/1/2)
Skipped:
Key:
(1) trees.j48.J48 '-C 0.25 -M 2' -217733168393644444
(2) functions.neural.NeuralNetwork '-L 0.3 -M 0.2 -N 500 -V 0 -S
(3) bayes.NaiveBayes '' 2029074699749330519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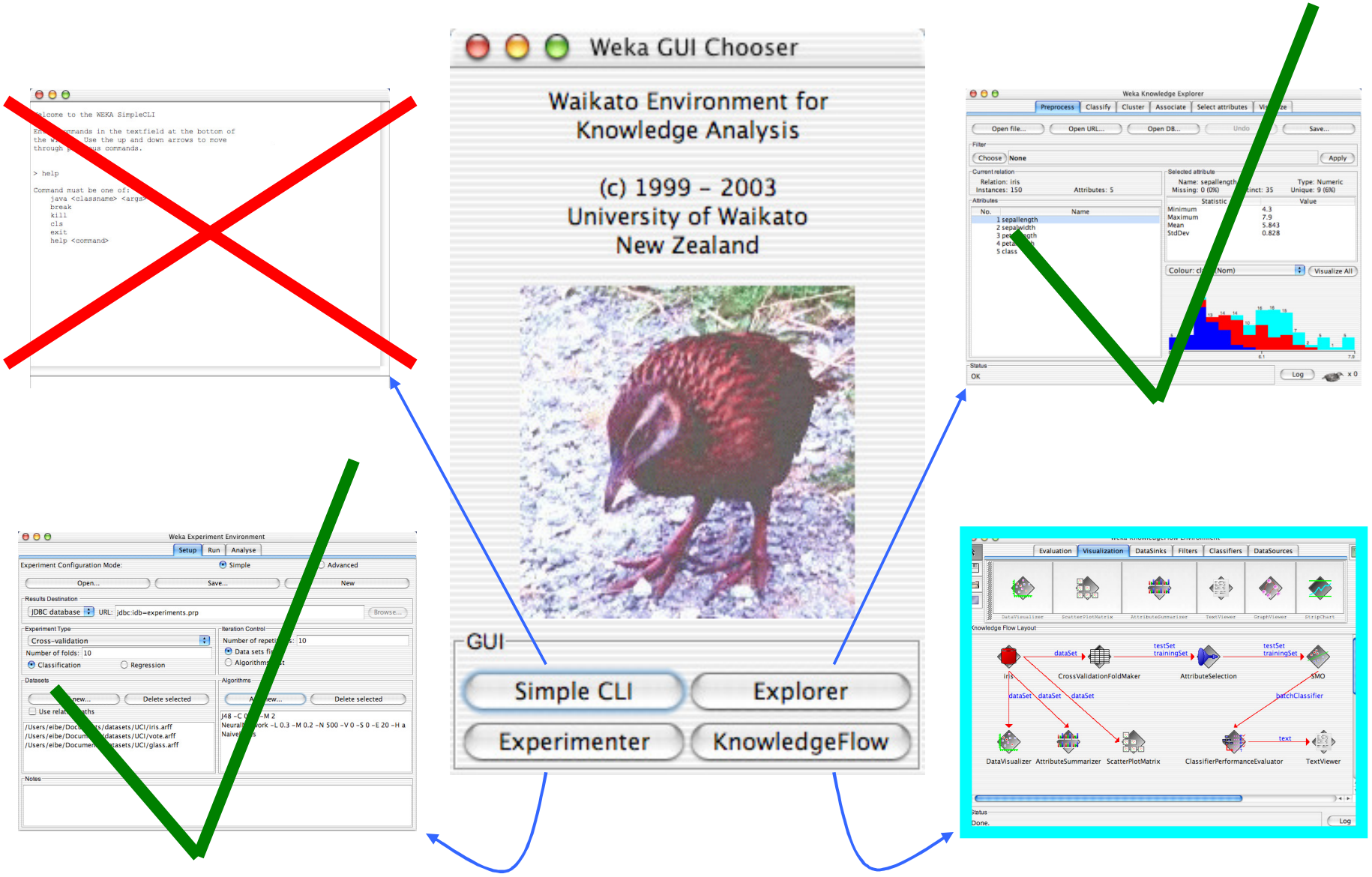
KnowledgeFlow
Weka Knowledge Explorer
Preprocess
Classify
Cluster
Associate
Select attributes
Open file...
Open URL...
Open DB...
Undo
Save...
Apply
Visualize All
Status
OK
Log
Setup
Run
Analyse
Simple
Advanced
Open...
Save...
New
Cross-validation
Number of folds: 10
Classification
Regression
Data sets first
Algorithms first
Add new...
Delete selected
Use relative paths
/Users/eibe/Documents/datasets/UCI/iris.arff
/Users/eibe/Documents/datasets/UCI/vote.arff
/Users/eibe/Documents/datasets/UCI/glass.arff
J48 -C 0.25 -M 2
NeuralNetwork -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H a
NaiveBayes
Notes
Weka KnowledgeFlow Environment
Evaluation
Visualization
DataSinks
Filters
Classifiers
DataSources
Knowledge Flow Layout
dataSet
testSet
trainingSet
batchClassifier
text
CrossValidationFoldMaker
AttributeSelection
SMO
DataVisualizer
AttributeSummarizer
ScatterPlotMatrix
ClassifierPerformanceEvaluator
TextViewer
Done.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The Knowledge Flow GUI

- New graphical user interface for WEKA
- Java-Beans-based interface for setting up and running machine learning experiments
- Data sources, classifiers, etc. are beans and can be connected graphically
- Data “flows” through components: e.g.,

  “data source” -> “filter” -> “classifier” -> “evaluator”
- Layouts can be saved and loaded again later

Conclusion: try it yourself!

- WEKA is available at

  http://www.cs.waikato.ac.nz/ml/weka
- Also has a list of projects based on WEKA
- WEKA contributors:

  Abdelaziz Mahoui, Alexander K. Seewald, Ashraf M. Kibriya, Bernhard Pfahringer , Brent Martin, Peter Flach, Eibe Frank ,Gabi Schmidberger ,Ian H. Witten , J. Lindgren, Janice Boughton, Jason Wells, Len Trigg, Lucio de Souza Coelho, Malcolm Ware, Mark Hall ,Remco Bouckaert , Richard Kirkby, Shane Butler, Shane Legg, Stuart Inglis, Sylvain Roy, Tony Voyle, Xin Xu, Yong Wang, Zhihai Wang