Trainable Weka Segmentation - How to compare classifiers

QR for this page

From Fiji

Contents

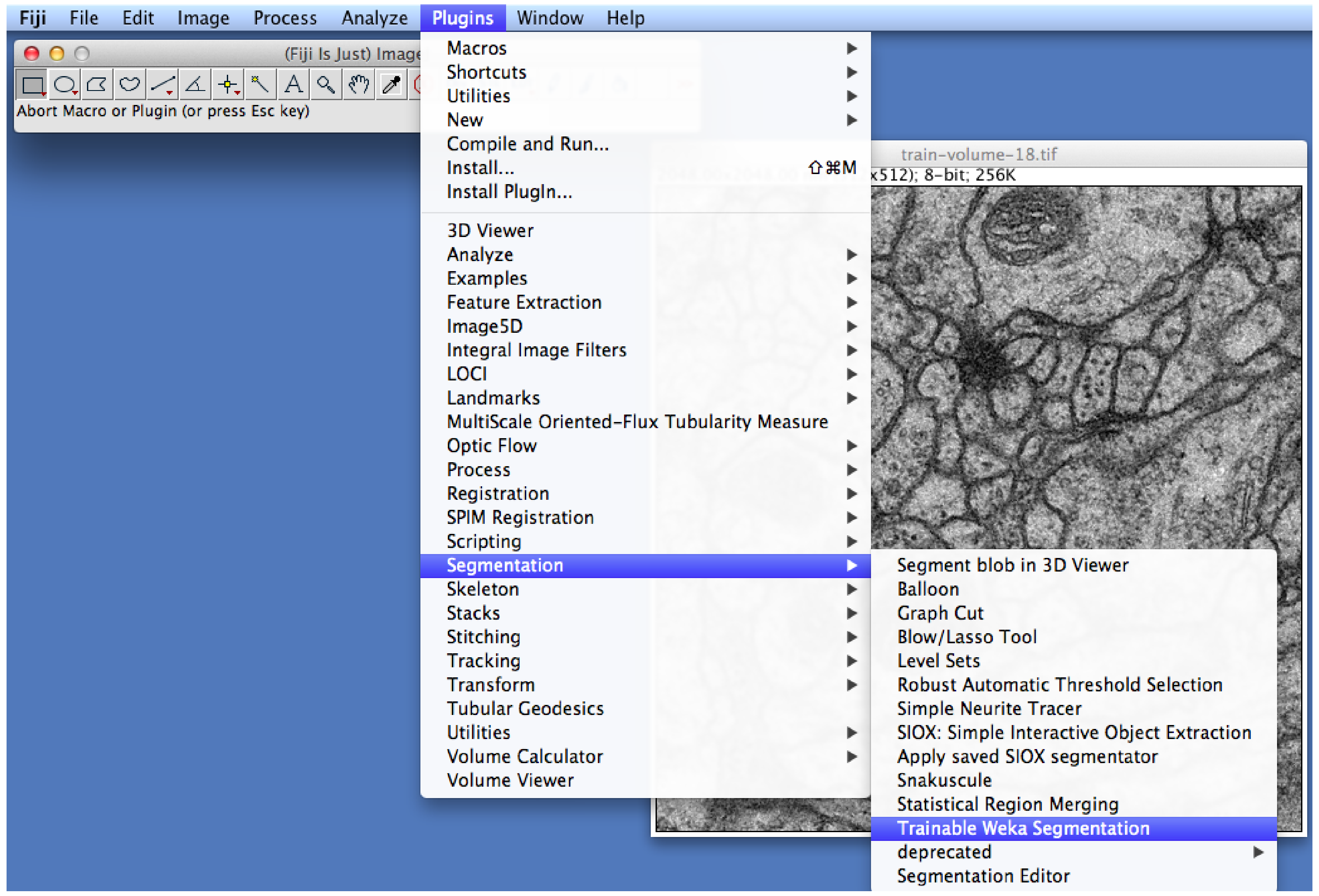
Introduction

In this tutorial we describe step by step **how to compare the performance of different classifiers** in the same segmentation problem using the Trainable Weka Segmentation plugin.

Most of the information contained here has been extracted from the WEKA manual for version 3.7.3 (http://iweb.dl.sourceforge.net/project/weka/documentation/3.7.x/WekaManual-3-7-3.pdf), chapter 6.

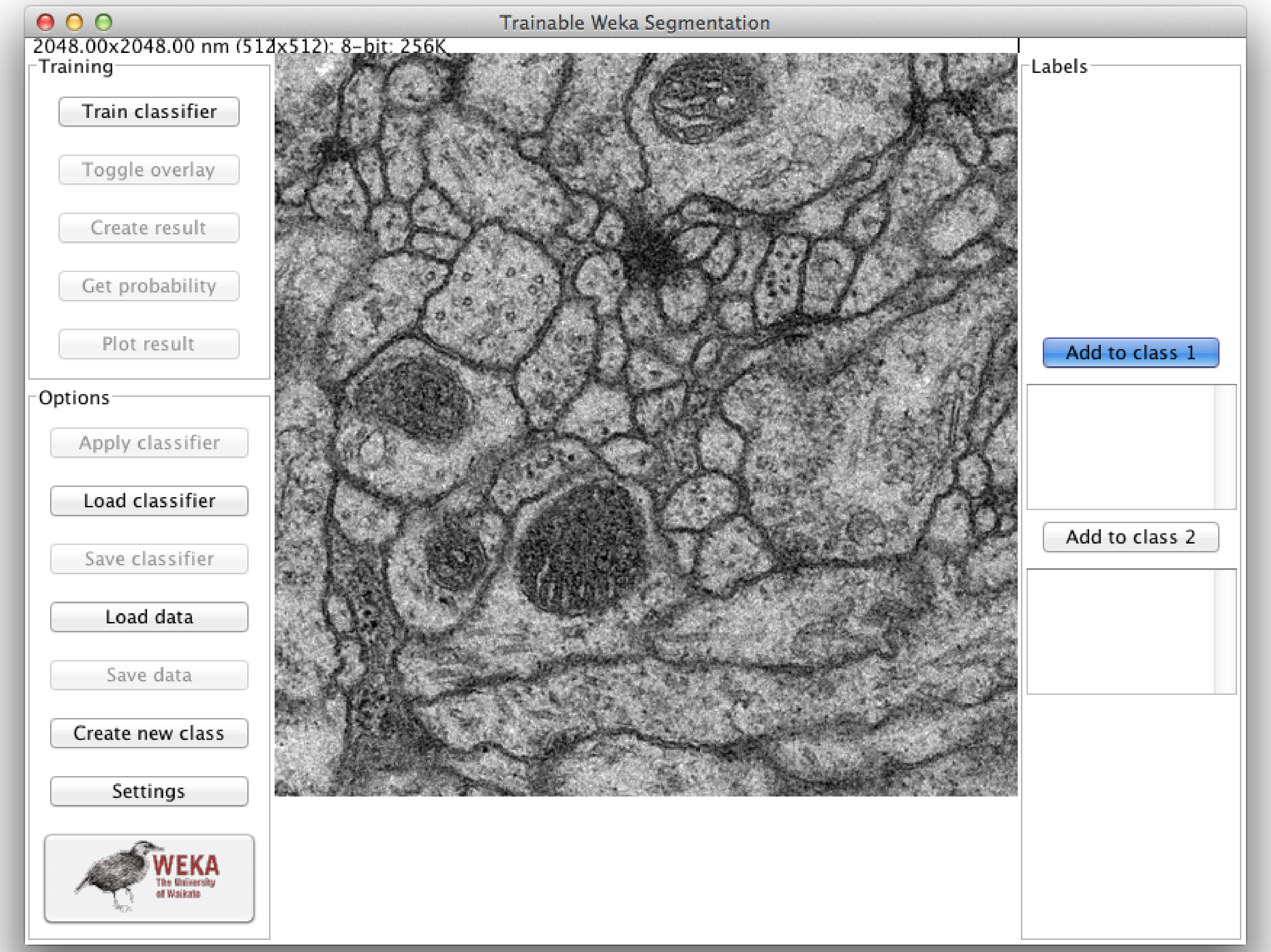
Starting the plugin

To get started, open the 2D image or stack you want to work on and launch the Trainable Weka Segmentation plugin (under Plugins > Segmentation > Trainable Weka Segmentation):



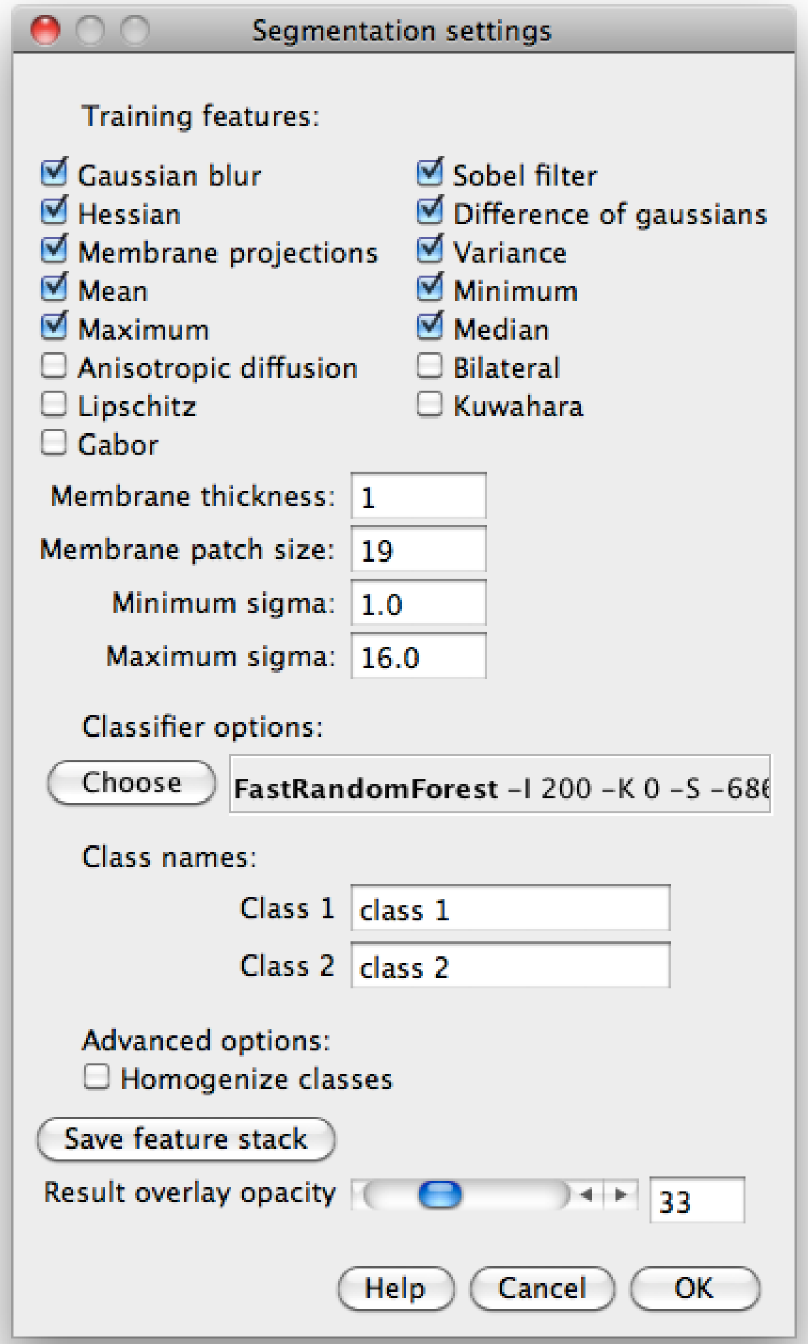
For this tutorial, we used one of the TEM sections from Albert Cardona's public data set.

After loading, the main GUI of the plugin will pop up:



Gathering training samples

First of all, we select the features (filters) that we want to use to perform the segmentation. For that, we will click on "Settings", select the corresponding features on the Settings dialog, and click "OK":



Training features:

- [✓] Gaussian blur
- [✓] Hessian
- [✓] Membrane projections
- [✓] Mean
- [✓] Maximum
- [ ] Anisotropic diffusion
- [ ] Lipschitz
- [ ] Gabor
- [✓] Sobel filter
- [✓] Difference of gaussians
- [✓] Variance
- [✓] Minimum
- [✓] Median
- [ ] Bilateral
- [ ] Kuwahara

Membrane thickness:	1
Membrane patch size:	19
Minimum sigma:	1.0
Maximum sigma:	16.0

Classifier options:

FastRandomForest -I 200 -K 0 -S -68

Class names:

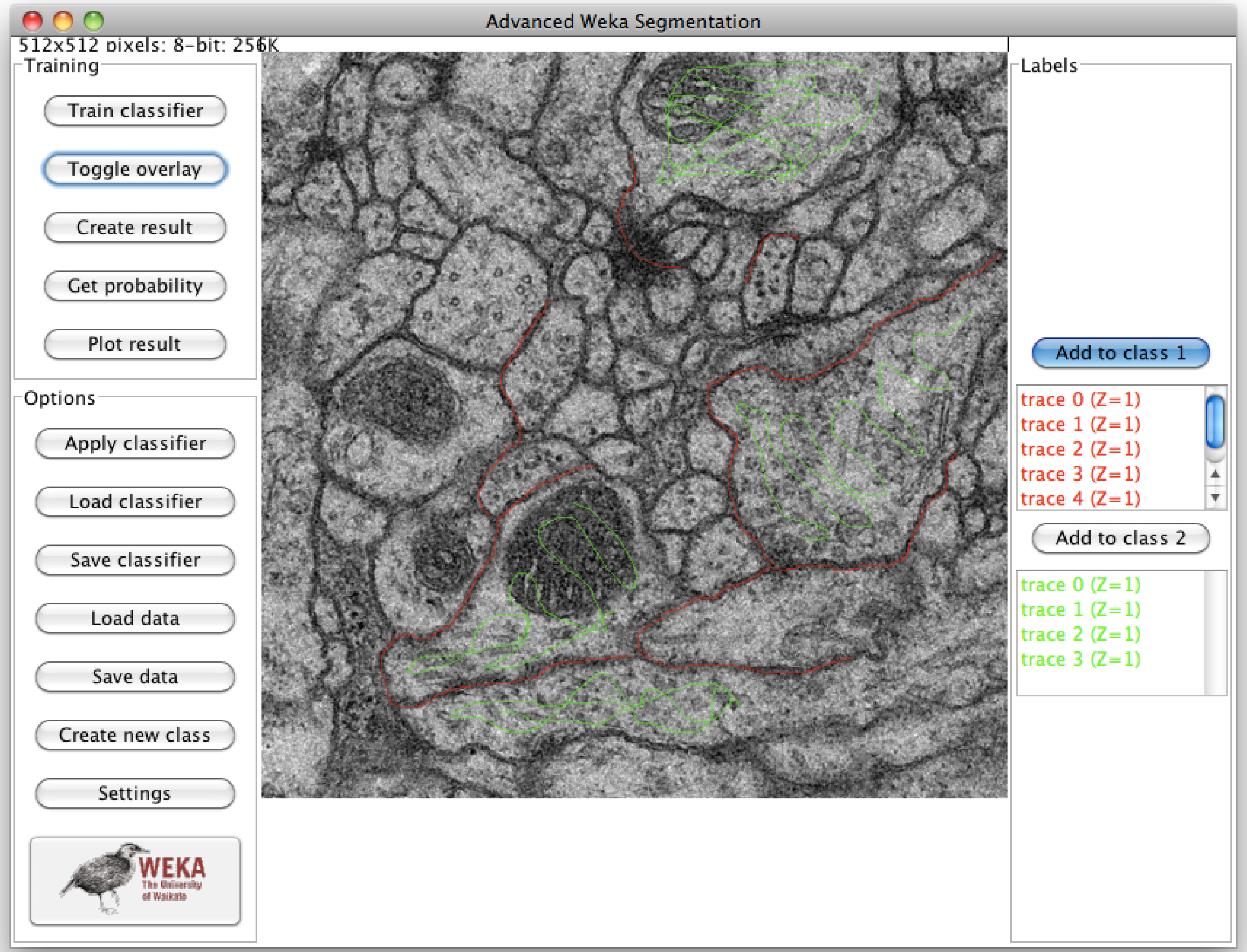
Class 1	class 1
Class 2	class 2

Advanced options:

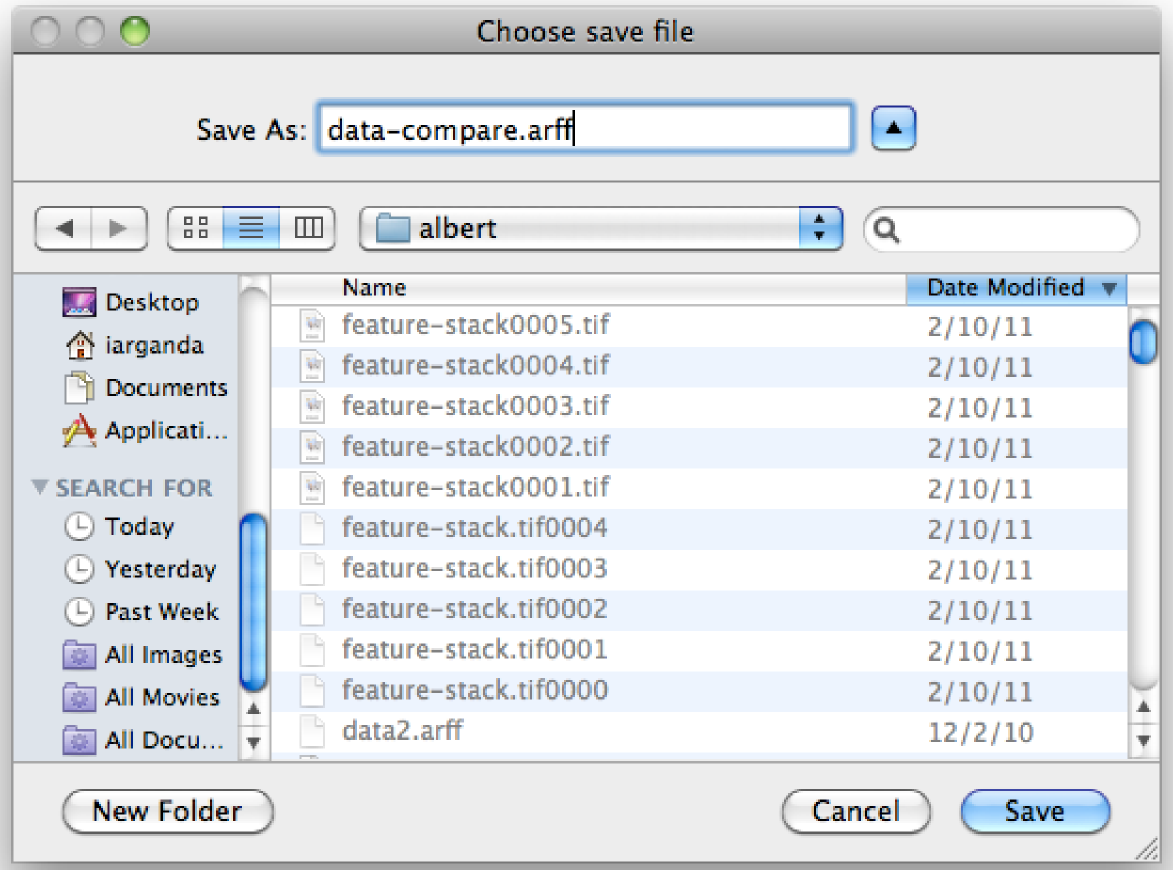
- [ ] Homogenize classes

Result overlay opacity 33

After that, we use the selection tools to trace samples of both classes. By default, the "freehand" line is selected, but you can use any of the available selection tools to mark areas on the image and then add them to any of the classes by click on the "Add to class [1/2]" buttons. In our example, we use the two classes to differentiate between membrane areas (in red, class 1) and the rest of the image (in green, class 2):



Once we are satisfied with the amount of samples, we save the data into an ARFF file, the format WEKA understand. For that, we click on "Save data" and select the output path and file name ("data-compare.arff" in our case):

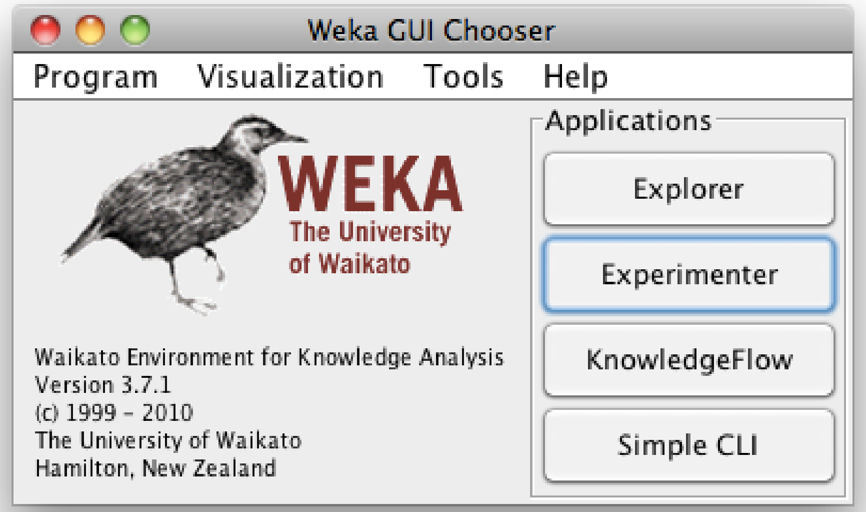


Save As: data-compare.arff

Name	Date Modified
feature-stack0005.tif	2/10/11
feature-stack0004.tif	2/10/11
feature-stack0003.tif	2/10/11
feature-stack0002.tif	2/10/11
feature-stack0001.tif	2/10/11
feature-stack.tif0004	2/10/11
feature-stack.tif0003	2/10/11
feature-stack.tif0002	2/10/11
feature-stack.tif0001	2/10/11
feature-stack.tif0000	2/10/11
data2.arff	12/2/10

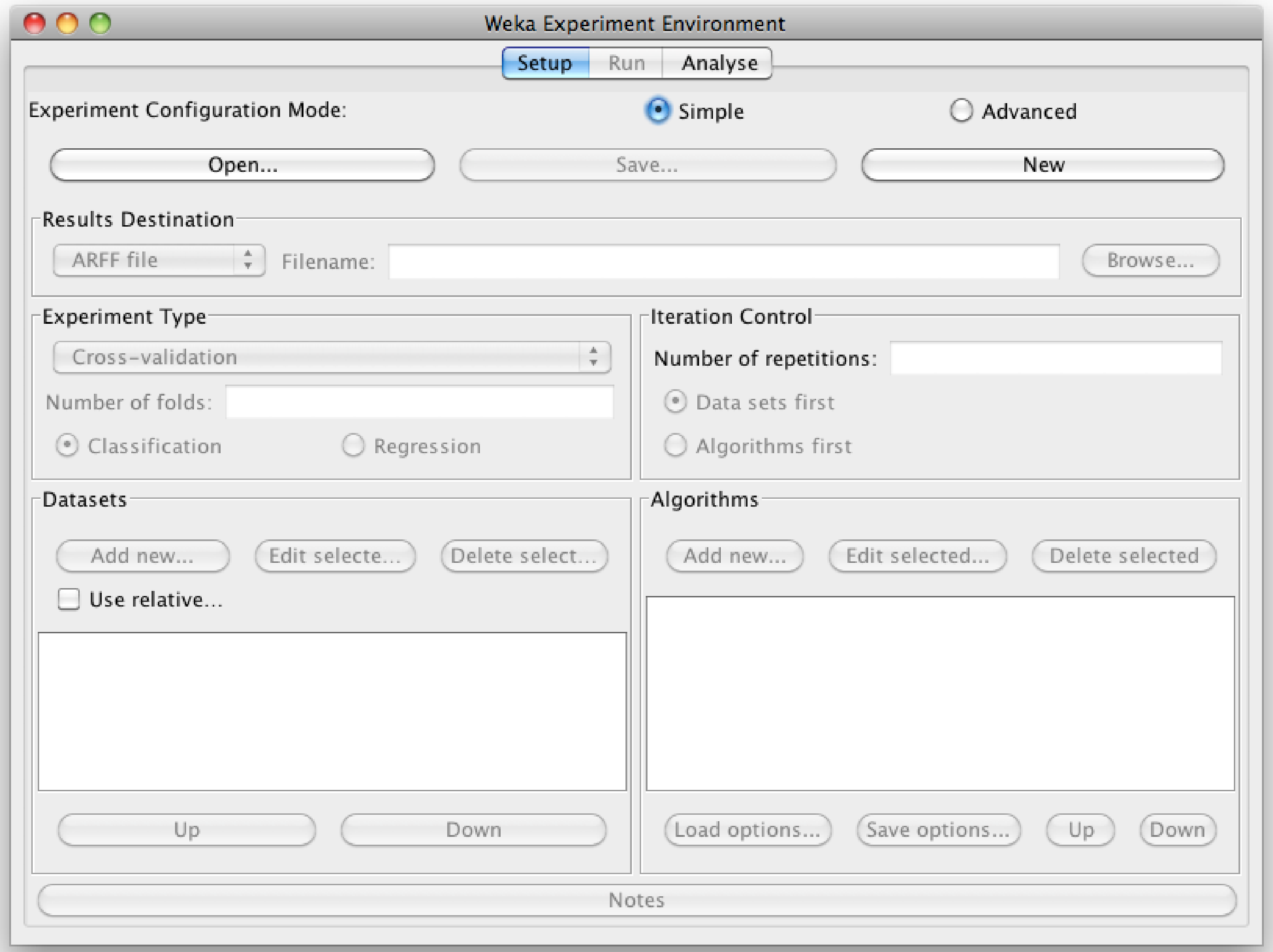
Working with the WEKA Experimenter

In order to use the data we just saved for comparing classifiers, we need to open the WEKA Experimenter. For that, we first click on the WEKA button of the plugin GUI (last button of the left panel). Then the Weka GUI Chooser will pop up:



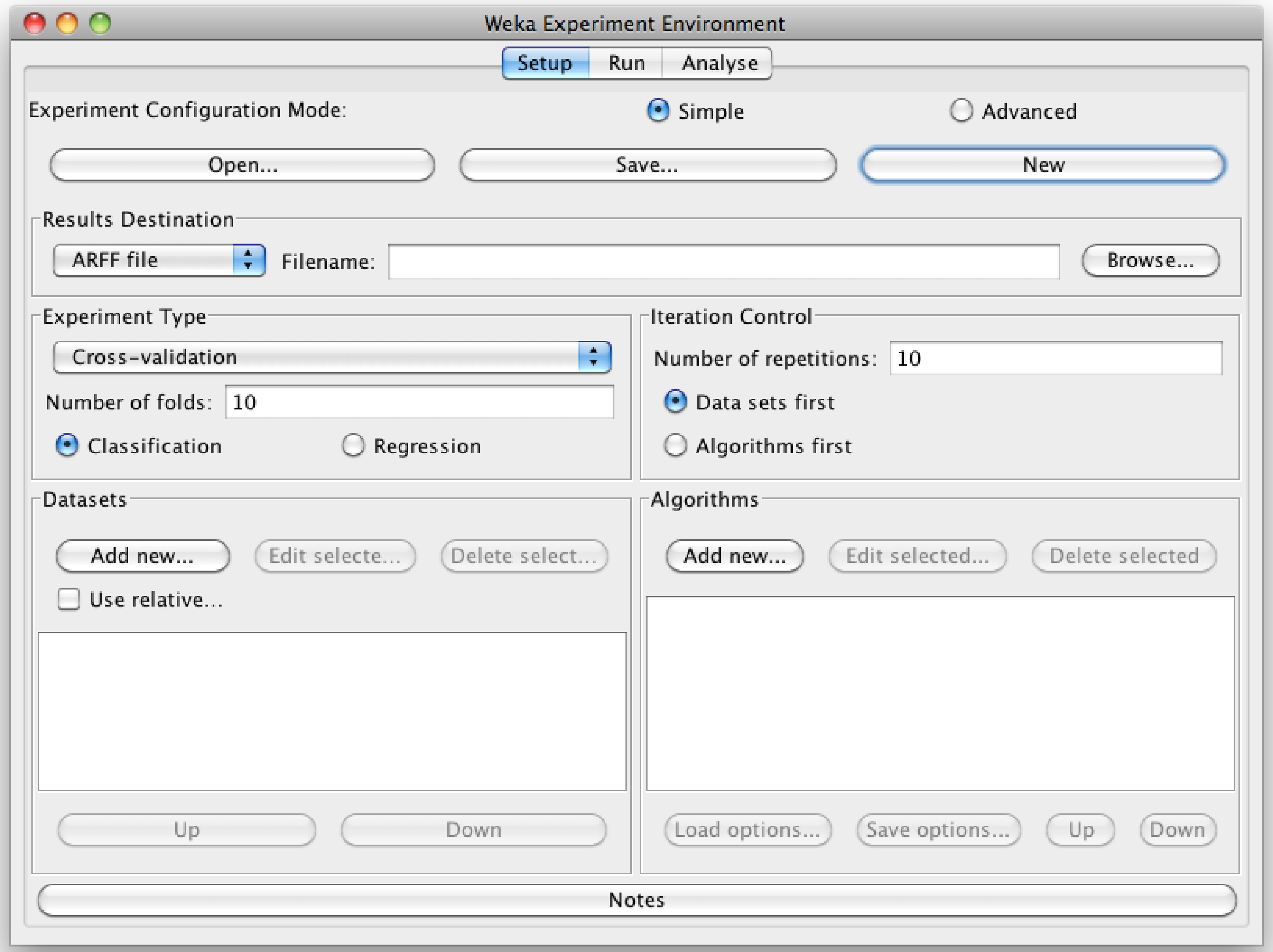
Waikato Environment for Knowledge Analysis
Version 3.7.1
(c) 1999 - 2010
The University of Waikato
Hamilton, New Zealand

We click on "Experimenter" and the Weka Experiment Environment GUI will pop up:



New experiment

In this tutorial we use the "Simple" configuration mode. After clicking *New*, default parameters for an Experiment are defined:


Weka Experiment Environment

Setup | Run | Analyse

Experiment Configuration Mode: [✓ Simple] Advanced

Open... | Save... | New

Results Destination: ARFF file, Filename: (empty), 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... | Edit selecte... | Delete select... | Use relative... | Up | Down

Algorithms: Add new... | Edit selected... | Delete selected | Load options... | Save options... | Up | Down

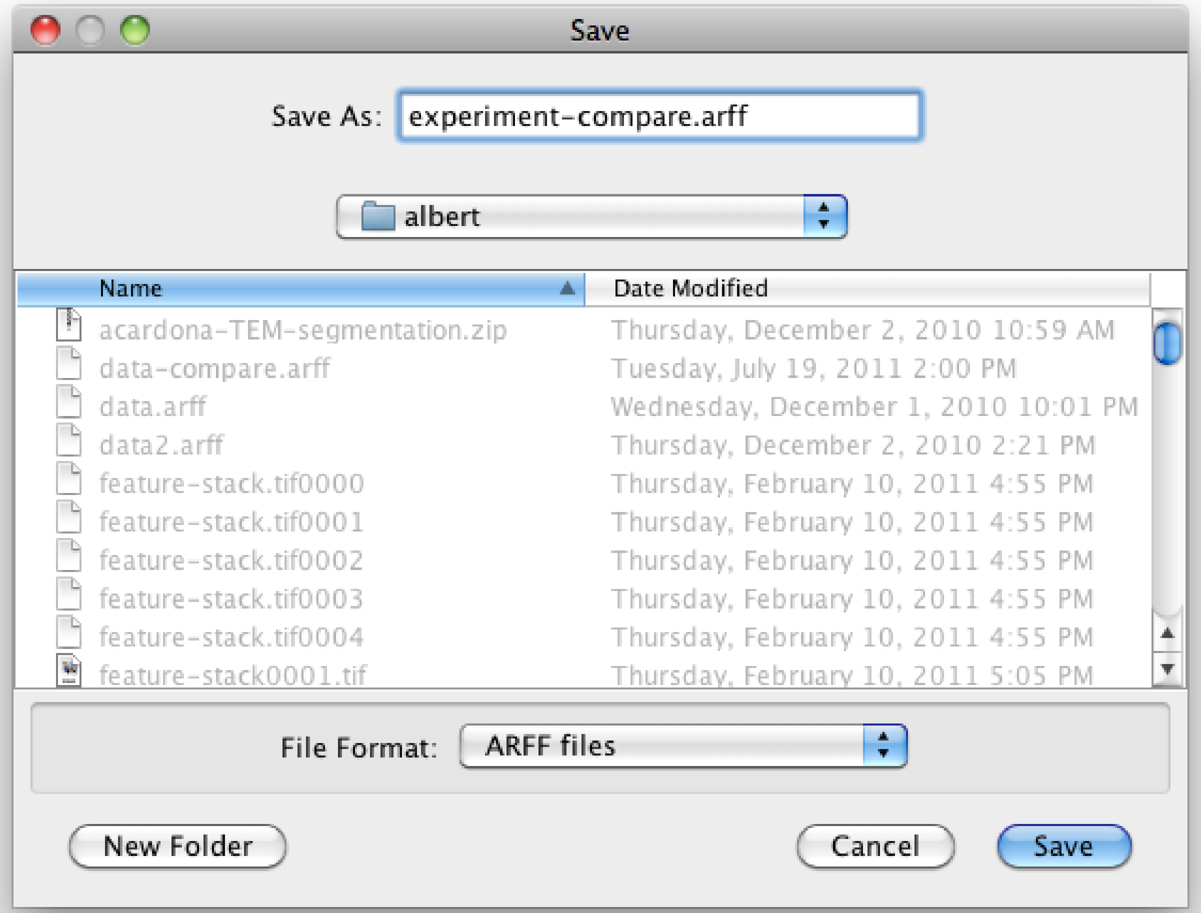
Notes

Results destination

By default, an ARFF file is the destination for the results output. But you can choose between

- ARFF file
- CSV file
- JDBC database

CSV is similar to ARFF, but it can be used to be loaded in an external spreadsheet application. If the file name is left empty a temporary file will be created in the TEMP directory of the system. If one wants to specify an explicit results file, click on *Browse* and choose a filename. In our case, we set the filename to *experiment-compare.arff*:



Save As: experiment-compare.arff

albert

Name	Date Modified
acardona-TEM-segmentation.zip	Thursday, December 2, 2010 10:59 AM
data-compare.arff	Tuesday, July 19, 2011 2:00 PM
data.arff	Wednesday, December 1, 2010 10:01 PM
data2.arff	Thursday, December 2, 2010 2:21 PM
feature-stack.tif0000	Thursday, February 10, 2011 4:55 PM
feature-stack.tif0001	Thursday, February 10, 2011 4:55 PM
feature-stack.tif0002	Thursday, February 10, 2011 4:55 PM
feature-stack.tif0003	Thursday, February 10, 2011 4:55 PM
feature-stack.tif0004	Thursday, February 10, 2011 4:55 PM
feature-stack0001.tif	Thursday, February 10, 2011 5:05 PM

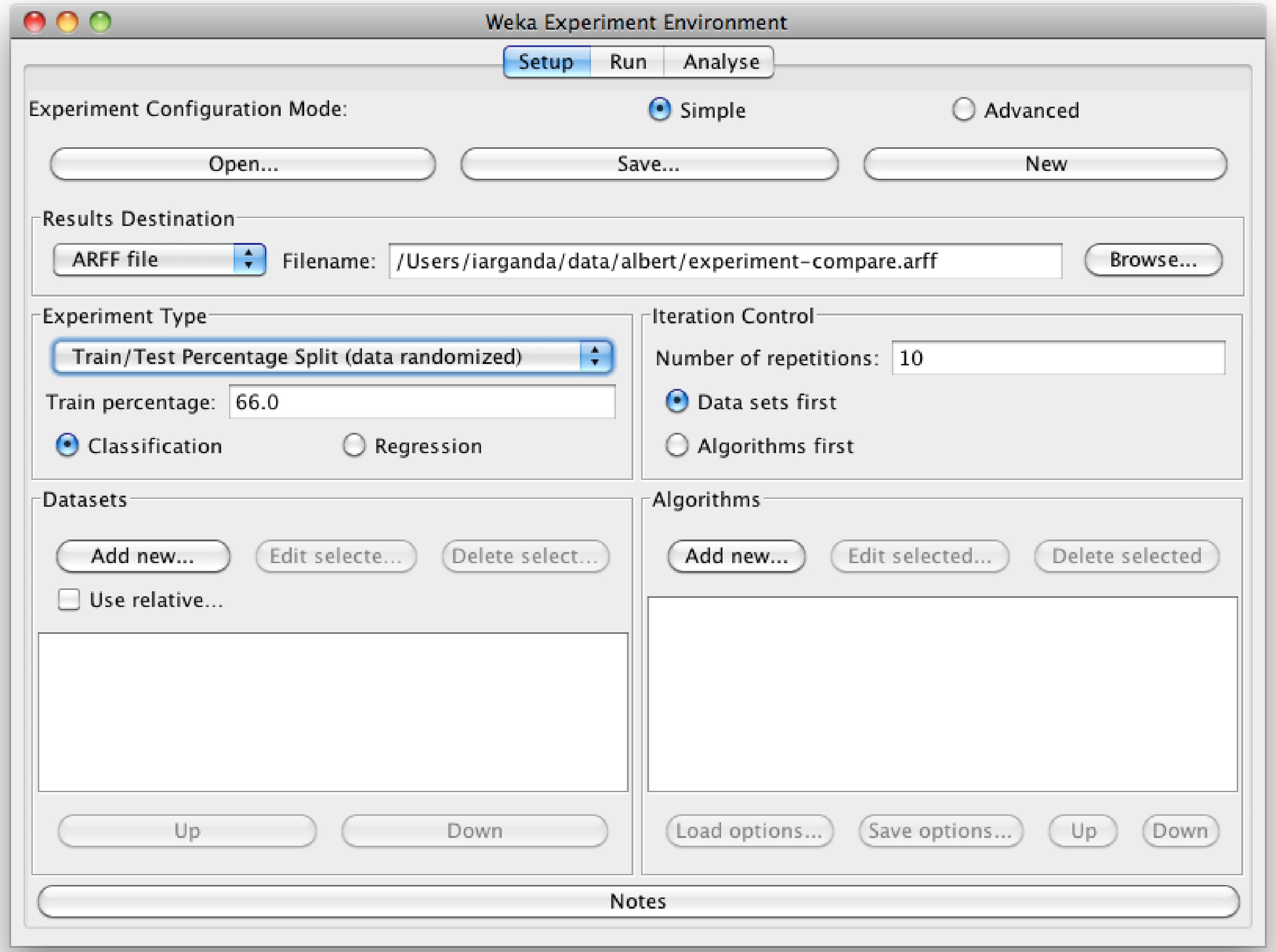
File Format: ARFF files

Click on *Save* and the name will appear in the edit field next to *ARFF file*.

Experiment type

The user can choose between the following three different types

- **Cross-validation (default)** performs stratified cross-validation with the given number of folds.
- **Train/Test Percentage Split (data randomized)** splits a dataset according to the given percentage into a train and a test file (one cannot specify explicit training and test files in the Experimenter), after the order of the data has been randomized and stratified:



Experiment Configuration Mode: [✓ Simple] Advanced

Results Destination
ARFF file Filename: /Users/iarganda/data/albert/experiment-compare.arff

Experiment Type
Train/Test Percentage Split (data randomized)
Train percentage: 66.0
[✓ Classification] Regression

Iteration Control
Number of repetitions: 10
[✓ Data sets first] Algorithms first

Datasets
☐ Use relative...

Algorithms

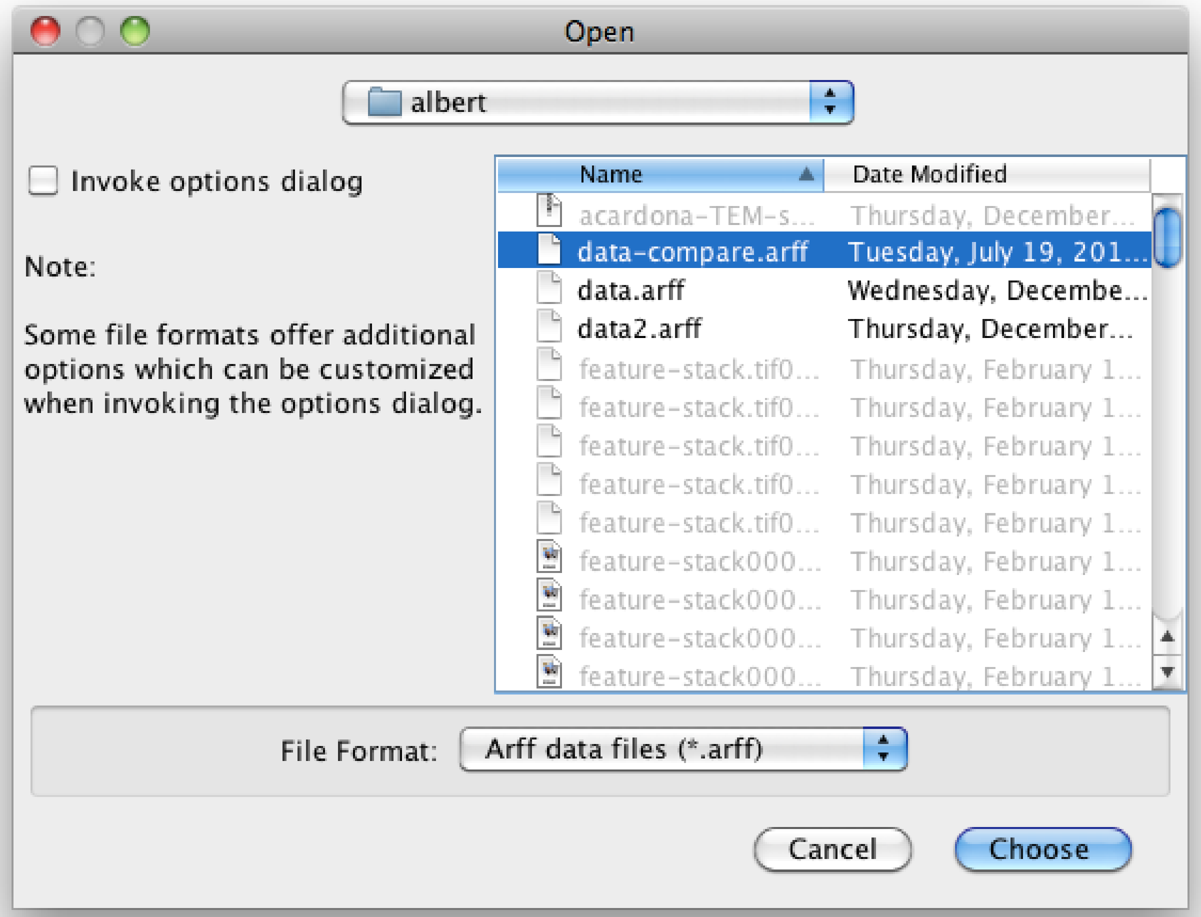
- **Train/Test Percentage Split (order preserved)** because it is impossible to specify an explicit train/test files pair, one can *abuse* this type to *un-merge* previously merged train and test file into the two original files (one only needs to find out the correct percentage).

Additionally, one can choose between *Classification* and *Regression*, depending on the datasets and classifiers one uses. *Classification* is selected by default.

Note: if the percentage splits are used, one has to make sure that the corrected paired *T-Tester* still produces sensible results with the given ratio.

Datasets

One can add dataset files either with an absolute path or with a relative one. The latter makes it often easier to run experiments on different machines, hence one should check *Use relative paths*, before clicking on *Add new...*:


Open
albert
Invoke options dialog
Note:
Some file formats offer additional options which can be customized when invoking the options dialog.
File Format: Arff data files (*.arff)
Cancel
Choose

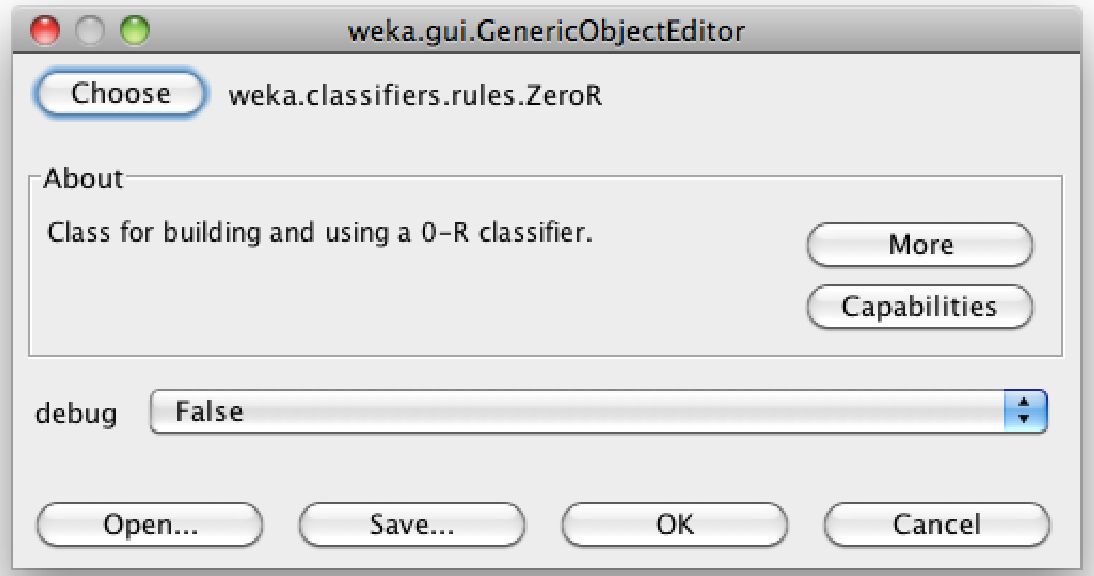
Name	Date Modified
acardona-TEM-s...	Thursday, December...
data-compare.arff	Tuesday, July 19, 201...
data.arff	Wednesday, Decembe...
data2.arff	Thursday, December...
feature-stack.tif0...	Thursday, February 1...
feature-stack.tif0...	Thursday, February 1...
feature-stack.tif0...	Thursday, February 1...
feature-stack.tif0...	Thursday, February 1...
feature-stack.tif0...	Thursday, February 1...
feature-stack000...	Thursday, February 1...
feature-stack000...	Thursday, February 1...
feature-stack000...	Thursday, February 1...
feature-stack000...	Thursday, February 1...

In this example, we open the *albert* directory and choose the *data-compare.arff* dataset.

After clicking *Open* the file will be displayed in the datasets list. If one selects a directory and hits *Open*, then all ARFF files will be added recursively. Files can be deleted from the list by selecting them and then clicking on *Delete selected*.

Algorithms

New algorithms can be added via the *Add new...* button. Opening this dialog for the first time, **ZeroR** is presented, otherwise the one that was selected last:


weka.gui.GenericObjectEditor

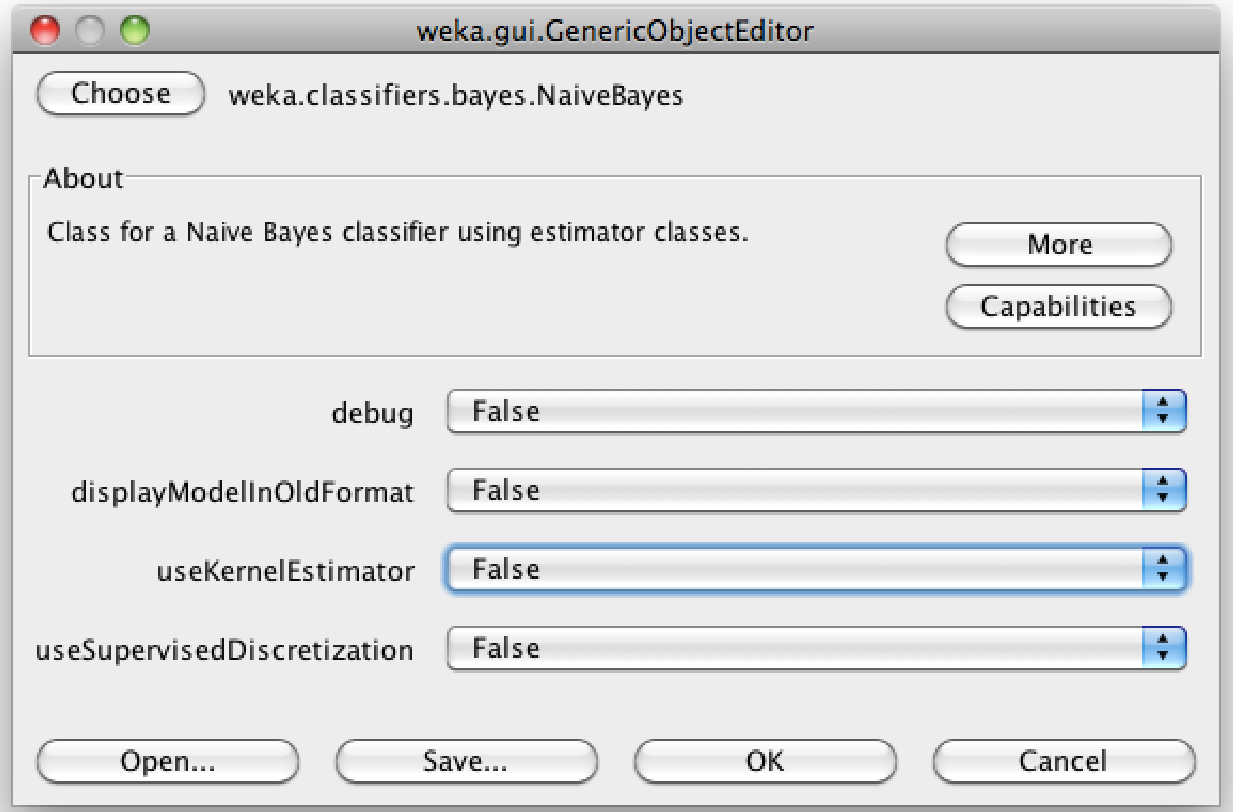
weka.classifiers.rules.ZeroR

About

Class for building and using a 0-R classifier.

debug False

With the *Choose* button one can open the *GenericObjectEditor* and choose another classifier:


weka.gui.GenericObjectEditor

weka.classifiers.bayes.NaiveBayes

About

Class for a Naive Bayes classifier using estimator classes.

debug False

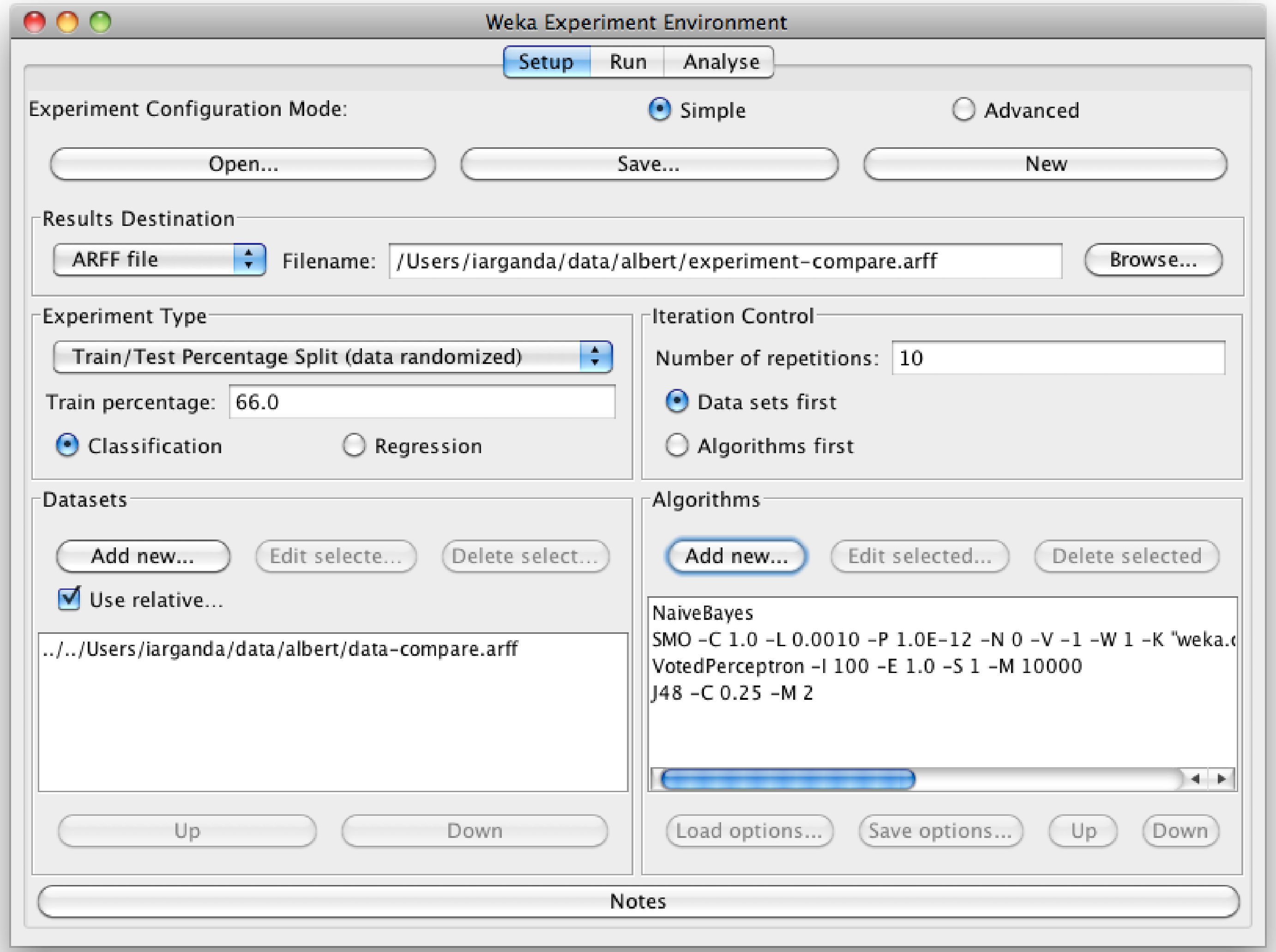
displayModelInOldFormat False

useKernelEstimator False

useSupervisedDiscretization False

The *Filter...* button enables one to highlight classifiers that can handle certain attribute and class types. With the *Remove filter* button all the selected capabilities will get cleared and the highlighting removed again.

Additional algorithms can be added again with the *Add new...* button. After setting the classifier parameters, one clicks on *OK* to add it to the list of algorithms. In our example, we add **NaiveBayes**, **SMO**, **VotedPerceptron** and **J48**:



Experiment Configuration Mode: [✓ Simple] Advanced

Results Destination: ARFF file Filename: /Users/iarganda/data/albert/experiment-compare.arff

Experiment Type: Train/Test Percentage Split (data randomized)

Train percentage: 66.0

[✓ Classification] Regression

Iteration Control: Number of repetitions: 10

[✓ Data sets first] Algorithms first

Datasets: [✓] Use relative...

../../Users/iarganda/data/albert/data-compare.arff

Algorithms:

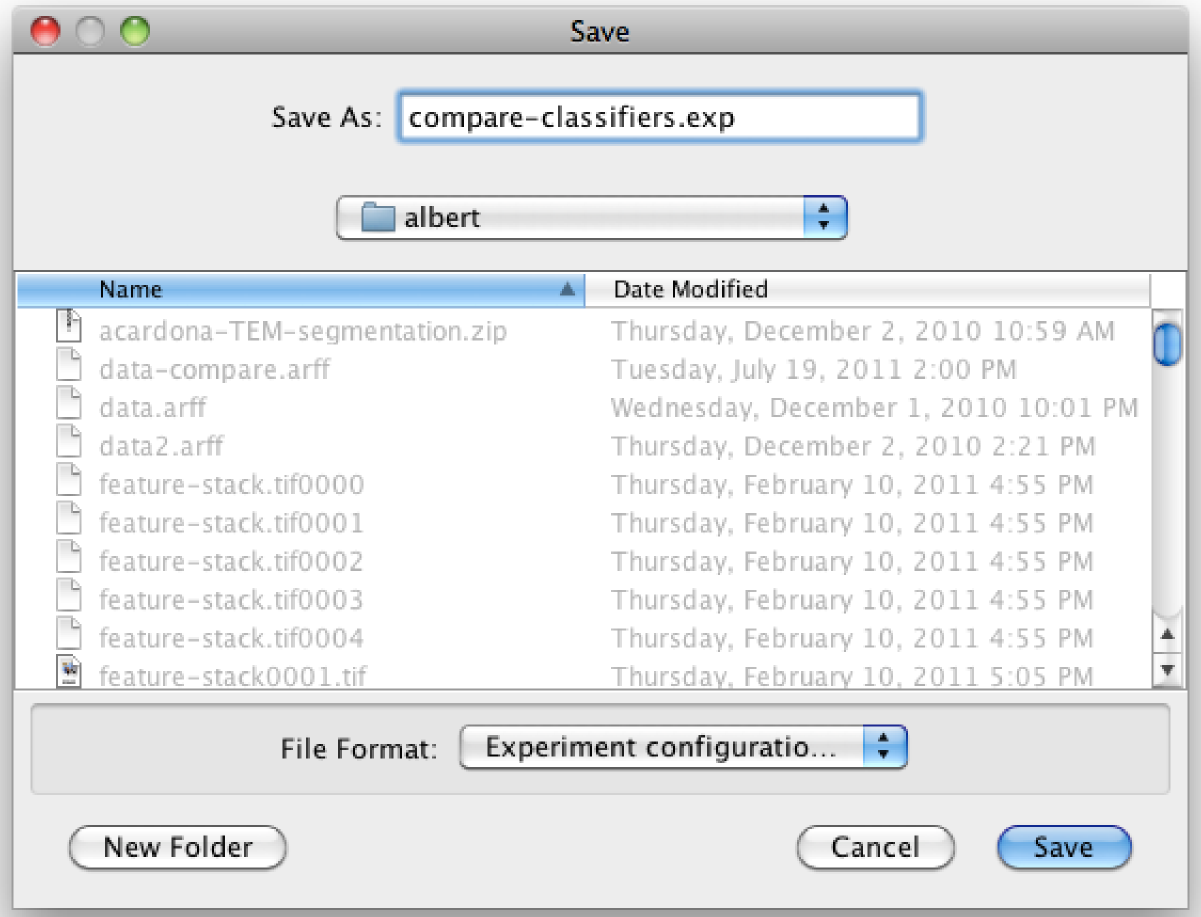
```
NaiveBayes
SMO -C 1.0 -L 0.0010 -P 1.0E-12 -N 0 -V -1 -W 1 -K "weka.c
VotedPerceptron -I 100 -E 1.0 -S 1 -M 10000
J48 -C 0.25 -M 2
```

With the *Load options...* and *Save options...* buttons one can load and save the setup of a selected classifier from and to XML. This is especially useful for highly configured classifiers (e.g., nested meta-classifiers), where the manual setup takes quite some time, and which are used often.

One can also paste classifier settings here by right-clicking (or ⎇ Alt + ⇧ Shift + click) and selecting the appropriate menu point from the popup menu, to either add a new classifier or replace the selected one with a new setup. This is rather useful for transferring a classifier setup from the Weka Explorer over to the Experimenter without having to setup the classifier from scratch.

Saving the setup

For future re-use, one can save the current setup of the experiment to a file by clicking on *Save...* at the top of the window:


Save
Save As: compare-classifiers.exp
albert
Name
Date Modified
File Format: Experiment configuratio...
New Folder
Cancel
Save

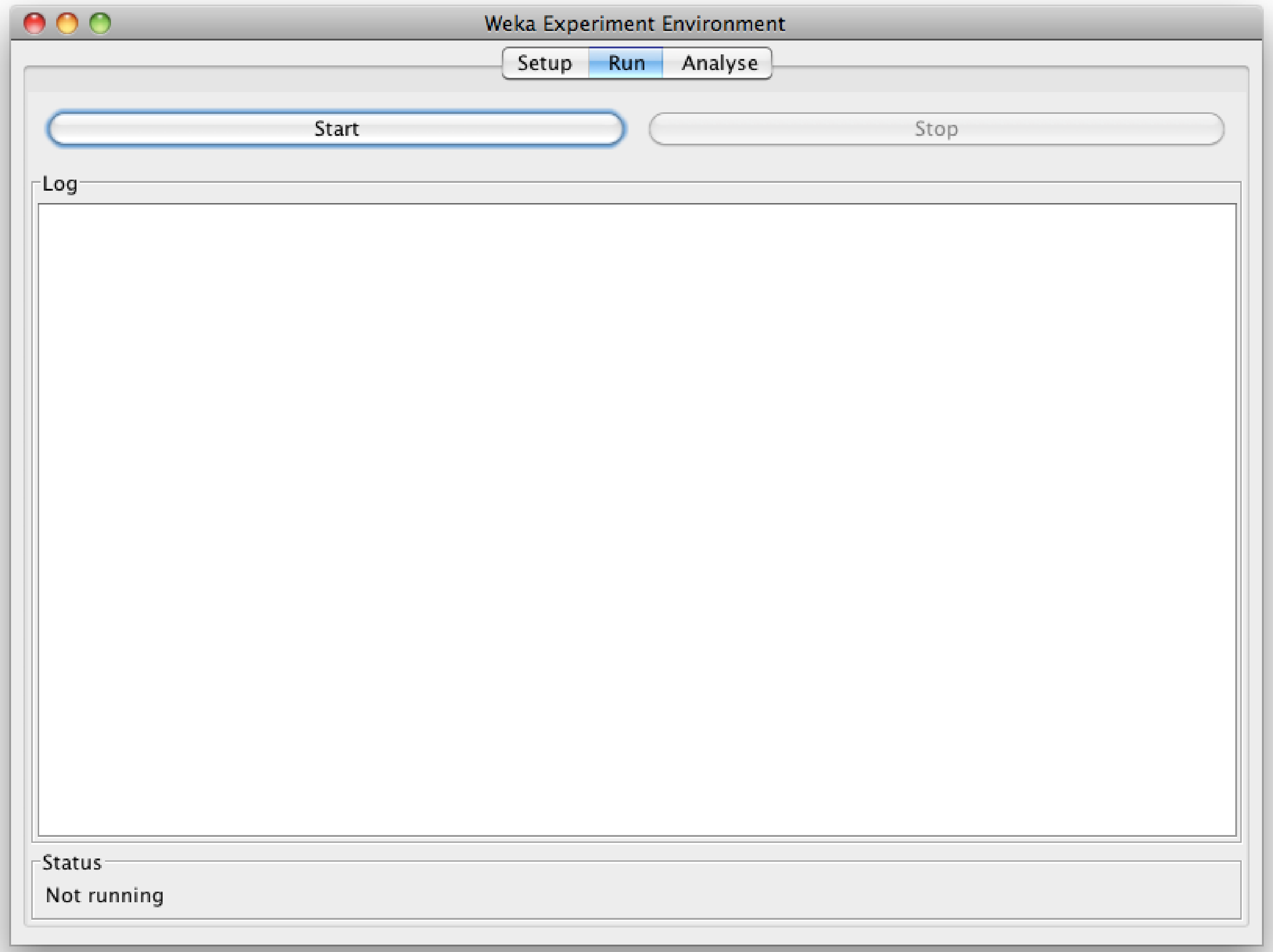
Name	Date Modified
acardona-TEM-segmentation.zip	Thursday, December 2, 2010 10:59 AM
data-compare.arff	Tuesday, July 19, 2011 2:00 PM
data.arff	Wednesday, December 1, 2010 10:01 PM
data2.arff	Thursday, December 2, 2010 2:21 PM
feature-stack.tif0000	Thursday, February 10, 2011 4:55 PM
feature-stack.tif0001	Thursday, February 10, 2011 4:55 PM
feature-stack.tif0002	Thursday, February 10, 2011 4:55 PM
feature-stack.tif0003	Thursday, February 10, 2011 4:55 PM
feature-stack.tif0004	Thursday, February 10, 2011 4:55 PM
feature-stack0001.tif	Thursday, February 10, 2011 5:05 PM

By default, the format of the experiment files is the binary format that Java serialization offers. The drawback of this format is the possible incompatibility between different versions of Weka. A more robust alternative to the binary format is the XML format.

Previously saved experiments can be loaded again via the *Open...* button.

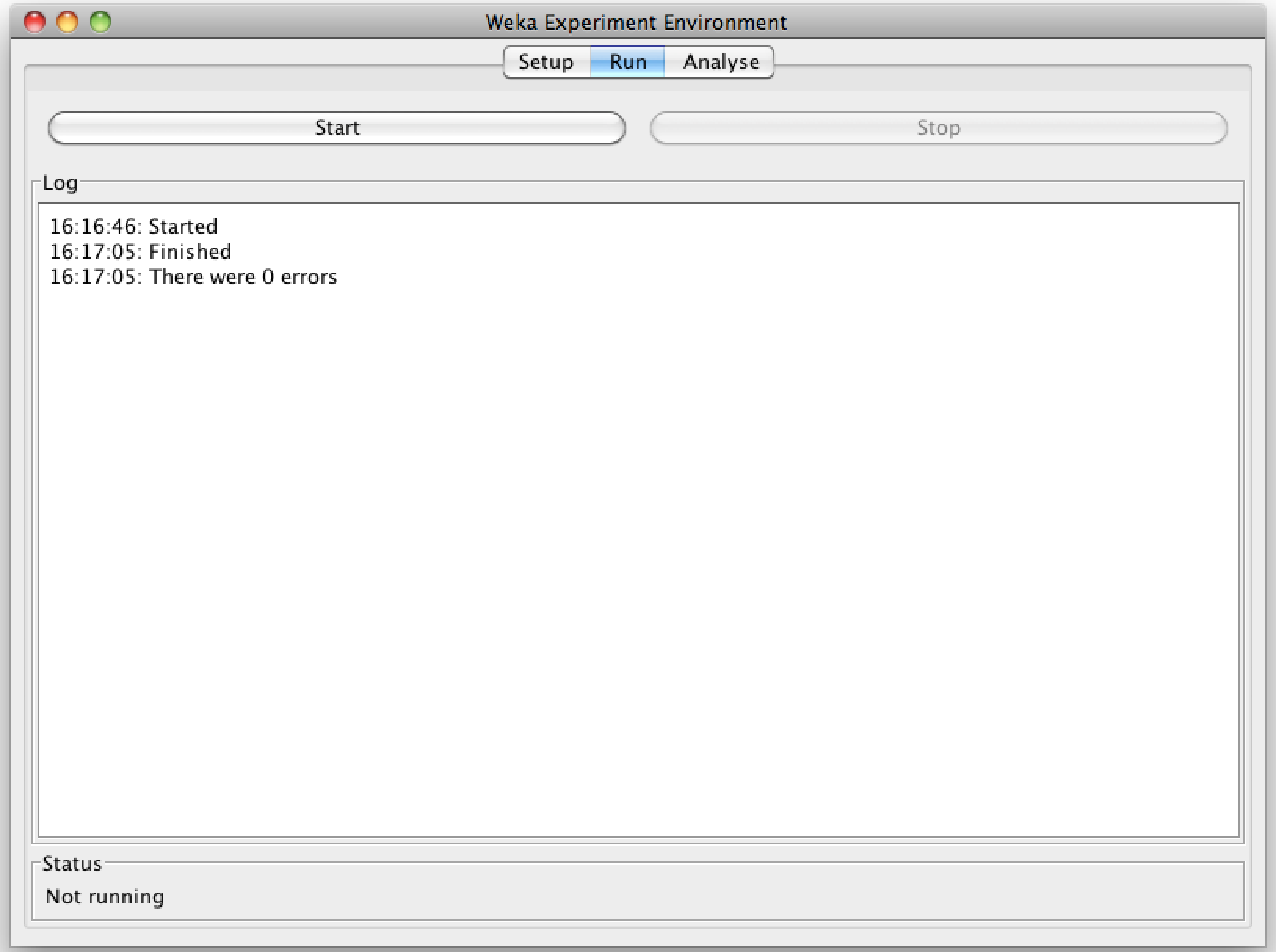
Running an experiment

To run the current experiment, click the *Run* tab at the top of the Experiment Environment window. The current experiment performs 10 runs of Train/Test percentage split (with data randomized) on the TEM image dataset using the **NaiveBayes**, **SMO**, **VotedPerceptron** and **J48** schemes:



Not running

Click *Start* to run the experiment:



```
16:16:46: Started
16:17:05: Finished
16:17:05: There were 0 errors
```

Status: Not running

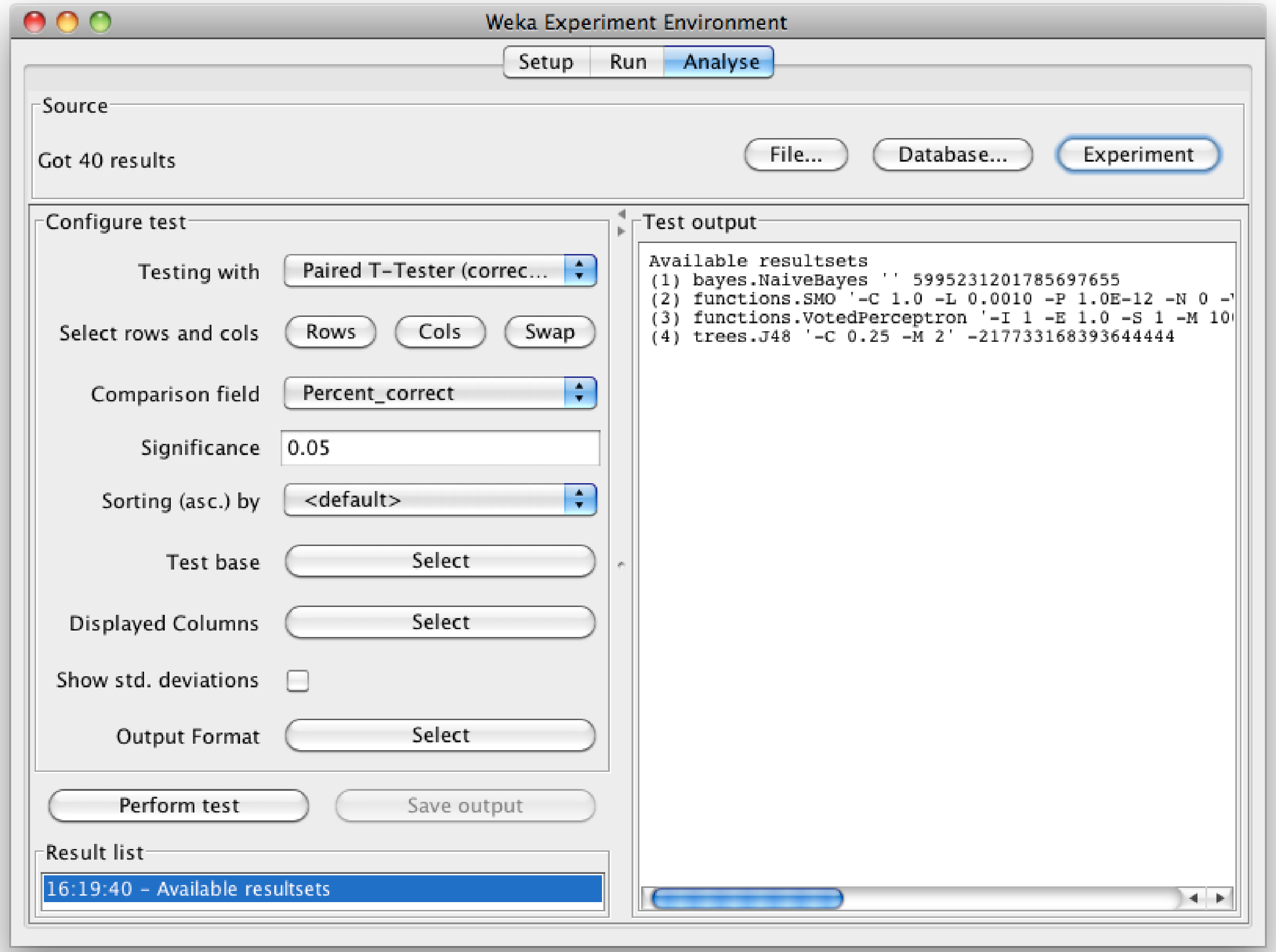
If the experiment was defined correctly, the 3 messages shown above will be displayed in the *Log* panel. The results of the experiment are saved to the dataset *experiment-compare.arff*.

Analysing results

Setup

To analyse the results, select the *Analyse* tab at the top of the Experiment Environment window.

Click on *Experiment* to analyse the results of the current experiment:



Got 40 results

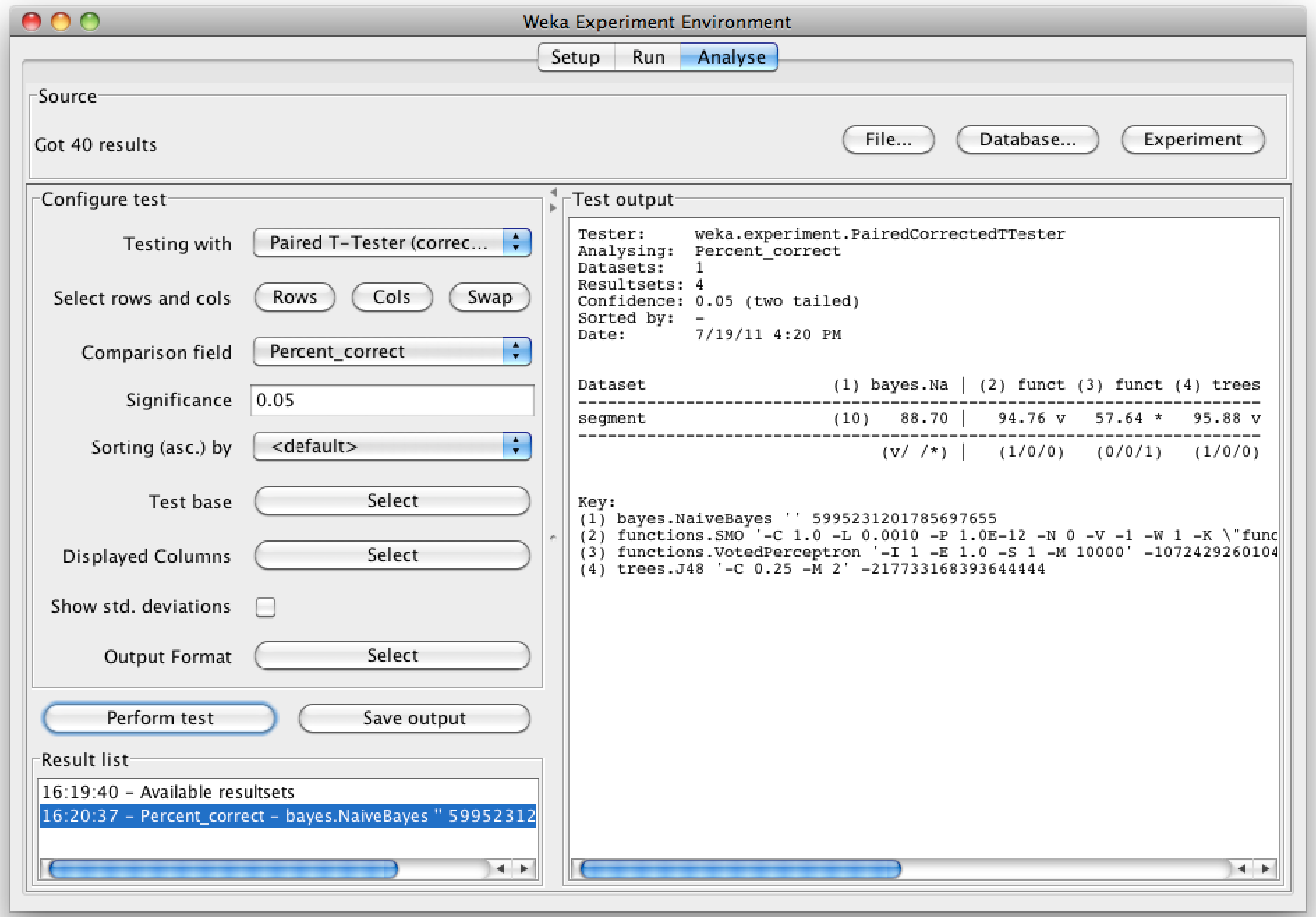
Testing with: Paired T-Tester (correc...
Comparison field: Percent_correct
Significance: 0.05
Sorting (asc.) by: <default>
Show std. deviations: ☐

16:19:40 - Available resultsets

```
Available resultsets
(1) bayes.NaiveBayes '' 5995231201785697655
(2) functions.SMO '-C 1.0 -L 0.0010 -P 1.0E-12 -N 0 -
(3) functions.VotedPerceptron '-I 1 -E 1.0 -S 1 -M 10
(4) trees.J48 '-C 0.25 -M 2' -217733168393644444
```

The number of result lines available (*Got 40 results*) is shown in the *Source* panel. This experiment consisted of 10 runs, for 4 schemes, for 1 dataset, for a total of 40 result lines. Results can also be loaded from an earlier experiment file by clicking *File* and loading the appropriate *.arff* results file.

Select the *Percent correct* attribute from the *Comparison field* and click *Perform test* to generate a comparison of the 4 schemes:



Got 40 results

Testing with: Paired T-Tester (correc...
Comparison field: Percent_correct
Significance: 0.05
Sorting (asc.) by: <default>
Show std. deviations: [ ]

16:19:40 - Available resultsets
16:20:37 - Percent_correct - bayes.NaiveBayes '' 59952312

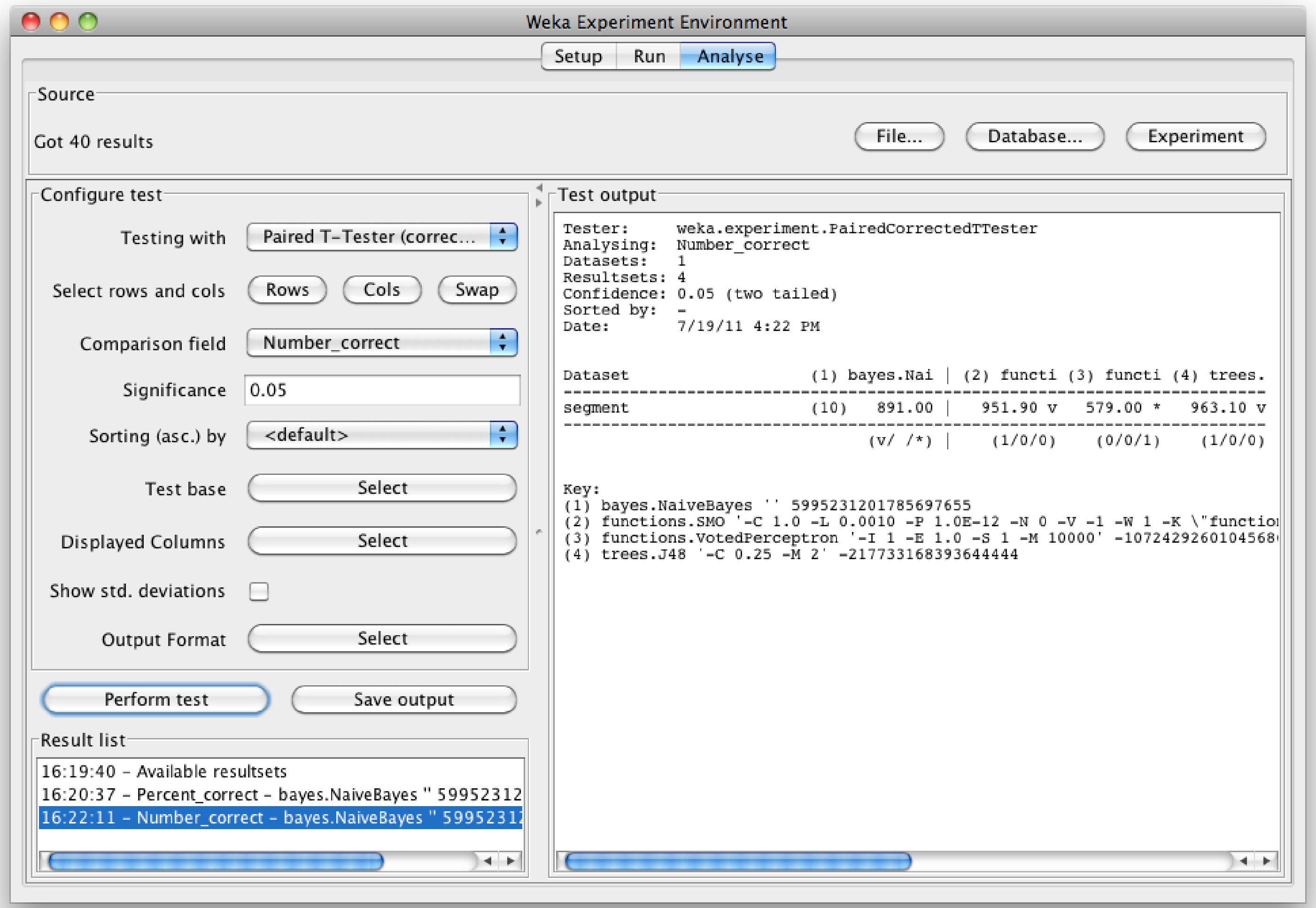
```
Tester:     weka.experiment.PairedCorrectedTTester
Analysing:  Percent_correct
Datasets:   1
Resultsets: 4
Confidence: 0.05 (two tailed)
Sorted by:  -
Date:       7/19/11 4:20 PM


Dataset                   (1) bayes.Na | (2) funct (3) funct (4) trees
-----------------------------------------------------------------------
segment                   (10)   88.70 |   94.76 v   57.64 *   95.88 v
-----------------------------------------------------------------------
                               (v/ /*) |   (1/0/0)   (0/0/1)   (1/0/0)


Key:
(1) bayes.NaiveBayes '' 5995231201785697655
(2) functions.SMO '-C 1.0 -L 0.0010 -P 1.0E-12 -N 0 -V -1 -W 1 -K \"func
(3) functions.VotedPerceptron '-I 1 -E 1.0 -S 1 -M 10000' -1072429260104
(4) trees.J48 '-C 0.25 -M 2' -217733168393644444
```

The schemes used in the experiment are shown in the columns and the datasets used are shown in the rows.

The percentage correct for each of the 4 schemes is shown in each dataset row: **88.70%** for **NaiveBayes**, **94.76%** for **SMO**, **57.64%** for **VotedPerceptron** and **95.88%** for J48. The annotation v or * indicates that a specific result is statistically better (v) or worse (*) than the baseline scheme (in this case, **NaiveBayes**) at the significance level specified (currently 0.05). The results of both **SMO** and **J48** are statistically better than the baseline established by **NaiveBayes**. At the bottom of each column after the first column is a count (xx/ yy/ zz) of the number of times that the scheme was better than (xx), the same as (yy), or worse than (zz), the baseline scheme on the datasets used in the experiment. In this example, there was only one dataset and **SMO** was better than **NaiveBayes** once and never equivalent to or worse than **NaiveBayes** (1/0/0); **J48** was also better than **NaiveBayes** on the dataset, and **VotedPerceptron** was worse.

The standard deviation of the attribute being evaluated can be generated by selecting the *Show std. deviations* check box and hitting *Perform test* again. The value *(10)* at the beginning of the *segment* row represents the number of estimates that are used to calculate the standard deviation (the number of runs in this case).

Selecting *Number correct* as the *comparison field* and clicking *Perform test* generates the average number correct (out of 975 test patterns - 33% of 2954 patterns in the *segment* dataset).



Got 40 results

Testing with: Paired T-Tester (correc...
Comparison field: Number_correct
Significance: 0.05
Sorting (asc.) by: <default>
Show std. deviations: ☐

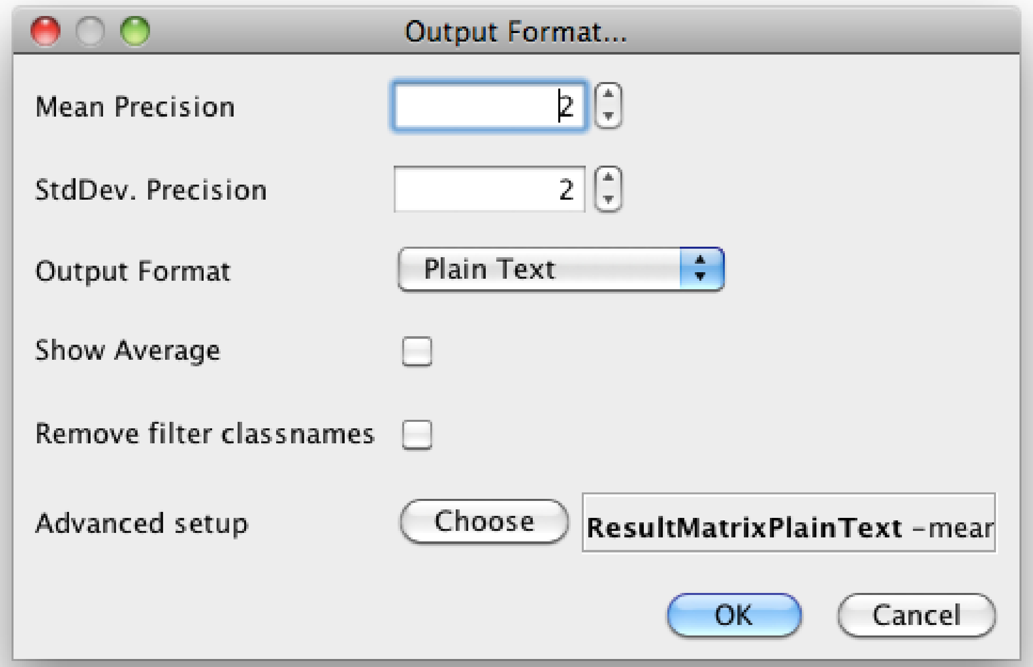
Result list:

16:19:40 – Available resultsets
16:20:37 – Percent_correct – bayes.NaiveBayes '' 59952312
16:22:11 – Number_correct – bayes.NaiveBayes '' 5995231

```
Tester:     weka.experiment.PairedCorrectedTTester
Analysing:  Number_correct
Datasets:   1
Resultsets: 4
Confidence: 0.05 (two tailed)
Sorted by:  -
Date:       7/19/11 4:22 PM


Dataset                   (1) bayes.Nai | (2) functi (3) functi (4) trees.
--------------------------------------------------------------------------
segment                   (10)   891.00 |   951.90 v   579.00 *   963.10 v
--------------------------------------------------------------------------
                                (v/ /*) |    (1/0/0)    (0/0/1)    (1/0/0)


Key:
(1) bayes.NaiveBayes '' 5995231201785697655
(2) functions.SMO '-C 1.0 -L 0.0010 -P 1.0E-12 -N 0 -V -1 -W 1 -K \"functio
(3) functions.VotedPerceptron '-I 1 -E 1.0 -S 1 -M 10000' -1072429260104568
(4) trees.J48 '-C 0.25 -M 2' -217733168393644444
```

Clicking on the button for the *Output format* leads to a dialog that lets you choose the precision for the *mean* and the *std. deviations*, as well as the format of the output. Checking the *Show Average* checkbox adds an additional line to the output listing the average of each column. With the *Remove filter classnames* checkbox one can remove the filter name and options from processed datasets (filter names in Weka can be quite lengthy). The following formats are supported:

- CSV
- GNUPlot
- HTML
- LaTeX
- Plain text (default)
- Significance only

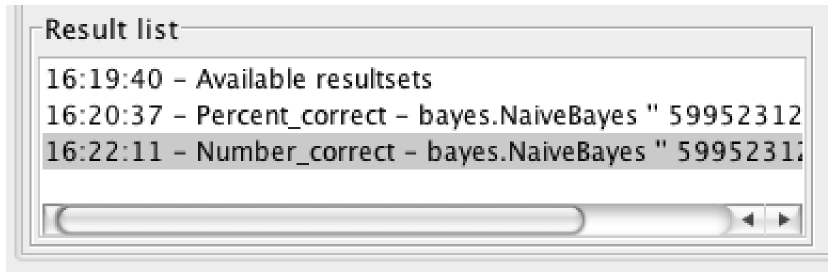


Mean Precision 2
StdDev. Precision 2
Output Format Plain Text
Show Average ☐
Remove filter classnames ☐
Advanced setup ResultMatrixPlainText -mear

To give one more control, the “Advanced setup” allows one to bring up all the options that a result matrix oﬀers. This includes the options described above, plus options like the width of the row names, or whether to enumerate the columns and rows.

Saving the Results

The information displayed in the *Test output* panel is controlled by the currently selected entry in the *Result list* panel. Clicking on an entry causes the results corresponding to that entry to be displayed.



```
16:19:40 - Available resultsets
16:20:37 - Percent_correct - bayes.NaiveBayes '' 59952312
16:22:11 - Number_correct - bayes.NaiveBayes '' 5995231
```

The results shown in the *Test output* panel can be saved to a file by clicking *Save output*. Only one set of results can be saved at a time but Weka permits the user to save all results to the same file by saving them one at a time and using the *Append* option instead of the *Overwrite* option for the second and subsequent saves.

Retrieved from "http://fiji.sc/index.php?title=Trainable_Weka_Segmentation_-_How_to_compare_classifiers&oldid=11623"

Categories: Tutorials | Segmentation | Machine Learning

- This page was last modified on 7 August 2014, at 12:23.