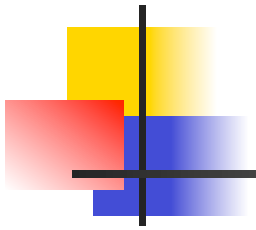
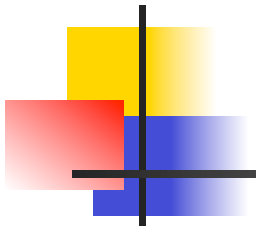


WEKA
Waikato Environment for Knowledge Analysis

Attribute Selection

Prof. Pietro Ducange

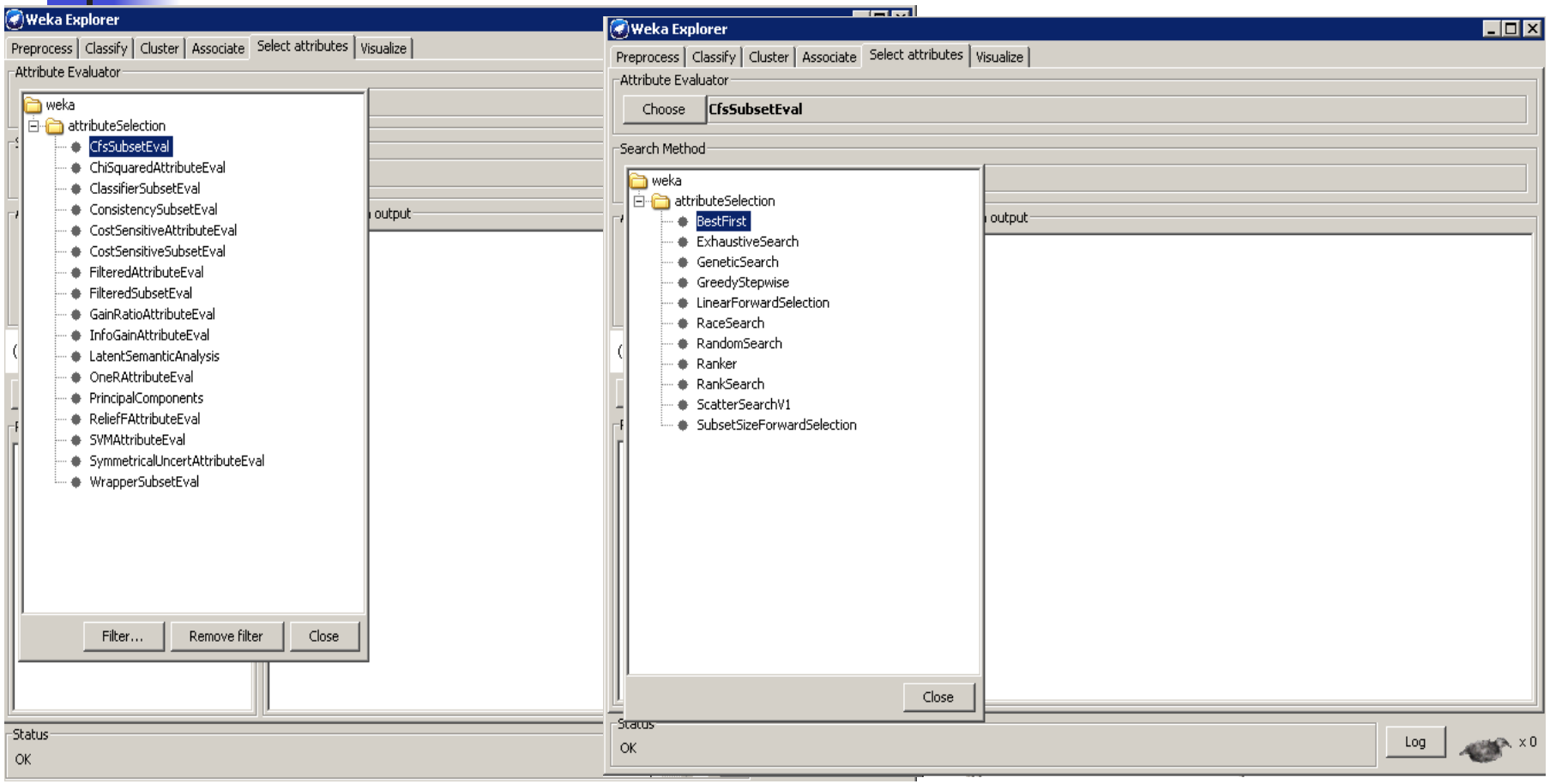


Attribute Selection (1)

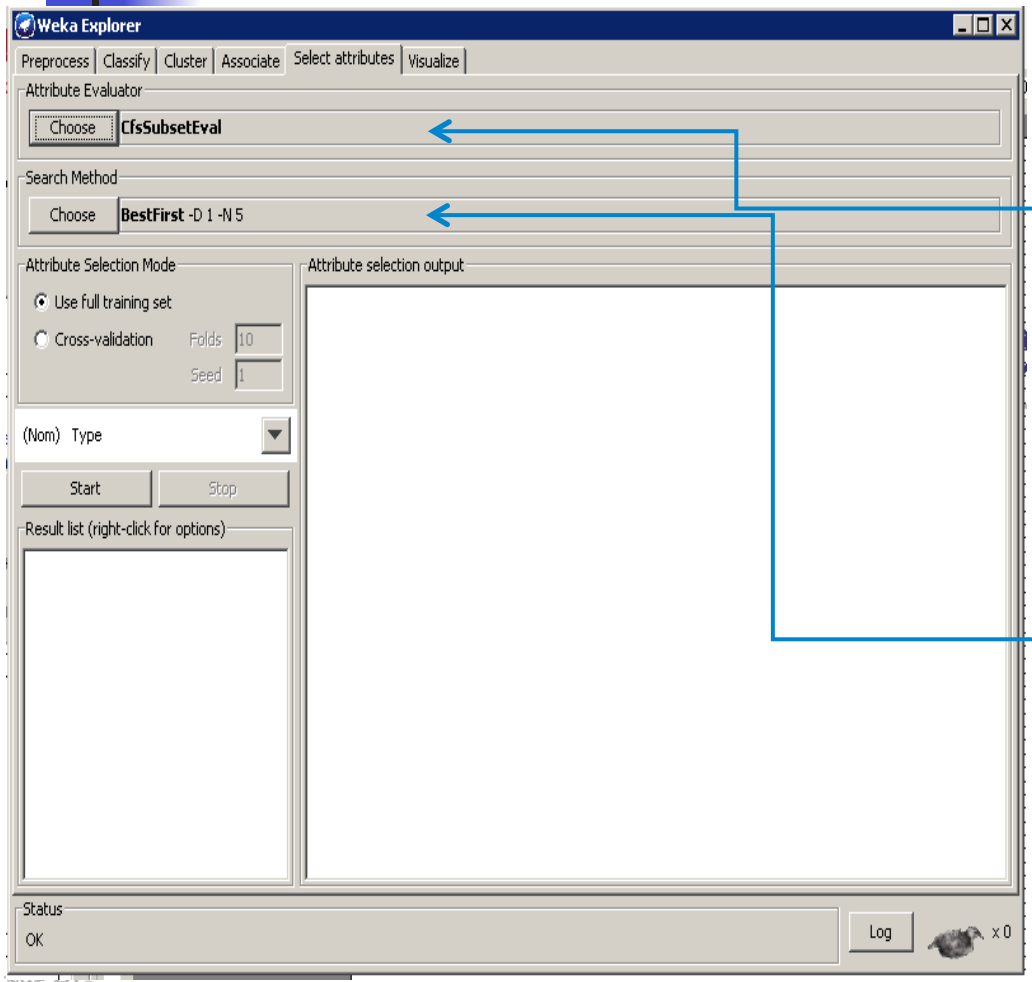
- Attribute selection involves searching through all possible combinations of attributes in the data to find which subset of attributes works best for prediction.
- Attribute selection consists basically of two different types of algorithms:

- **evaluator** – determines the merit of single attributes or subsets of attributes
- **search algorithm** – the search heuristic

Attribute Selection (2)

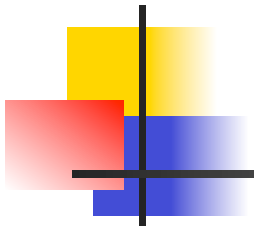


Attribute Selection: First Example (1)



Evaluates the worth of a subset of attributes by considering the individual predictive ability of each feature along with the degree of redundancy between them

Searches the space of attribute subsets by greedy hill climbing augmented with a backtracking facility. Forward or Backward Search can be selected



Attribute Selection: First Example (2)

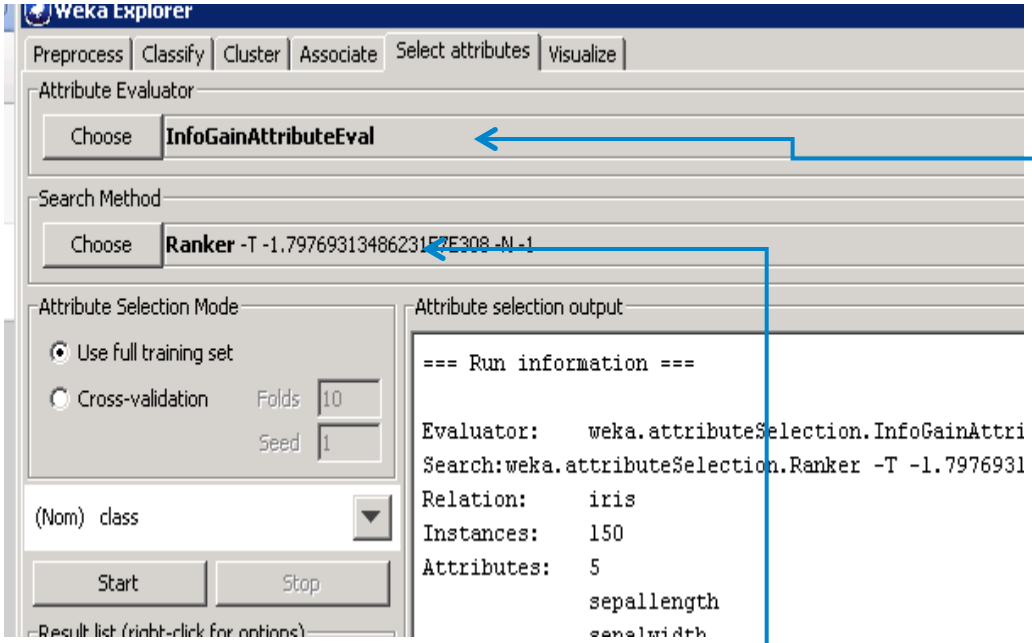
=== Attribute Selection on all input data ===

Search Method:
Best first.
Start set: no attributes
Search direction: forward
Stale search after 5 node expansions
Total number of subsets evaluated: 12
Merit of best subset found: 0.887

Attribute Subset Evaluator (supervised, Class (nominal): 5 class):
CFS Subset Evaluator
Including locally predictive attributes

Selected attributes: 3,4 : 2
petallength
petalwidth

Attribute Selection: Second Example (1)



Evaluates the worth of an attribute by measuring the information gain with respect to the class

Ranks attributes by their individual evaluations. A selection threshold can be fixed

Attribute Selection: Second Example (2)

=== Attribute Selection on all input data ===

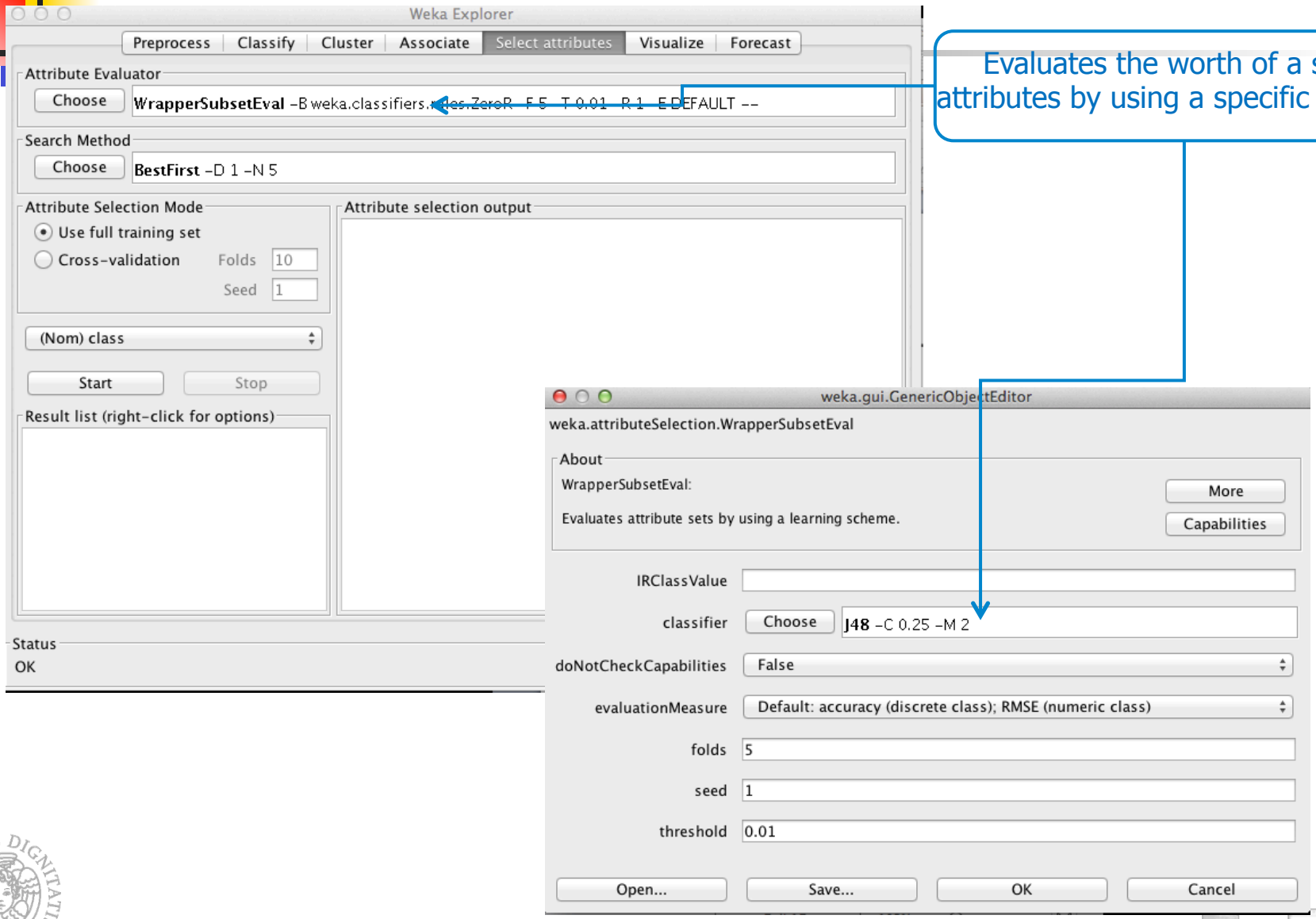
Search Method:
Attribute ranking.

Attribute Evaluator (supervised, Class (nominal): 5 class):
Information Gain Ranking Filter

Ranked attributes:
1.418 3 petallength
1.378 4 petalwidth
0.698 1 sepallength
0.376 2 sepalwidth

Selected attributes: 3,4,1,2 : 4

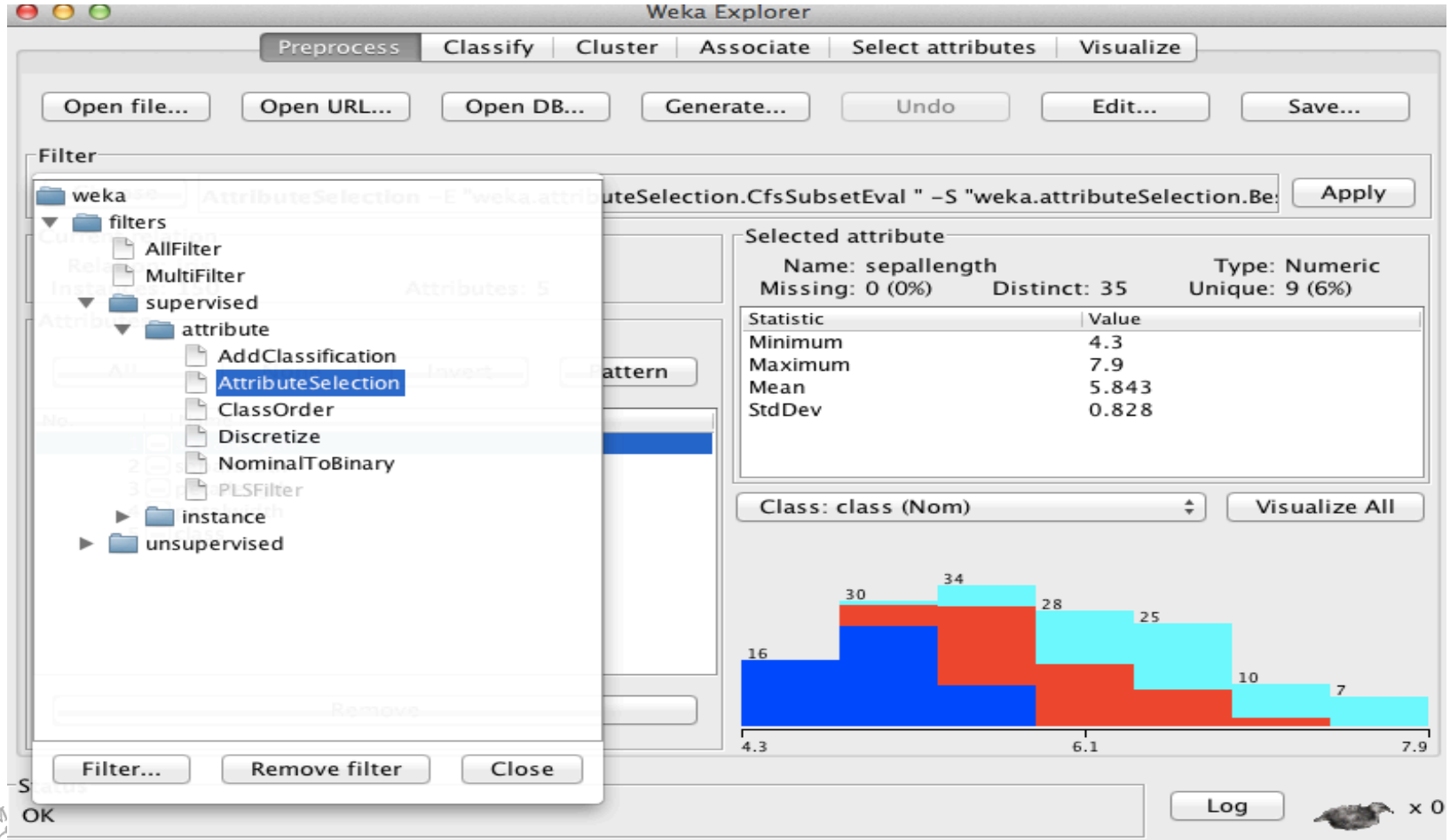
Attribute Selection: Wrapper Method (2)



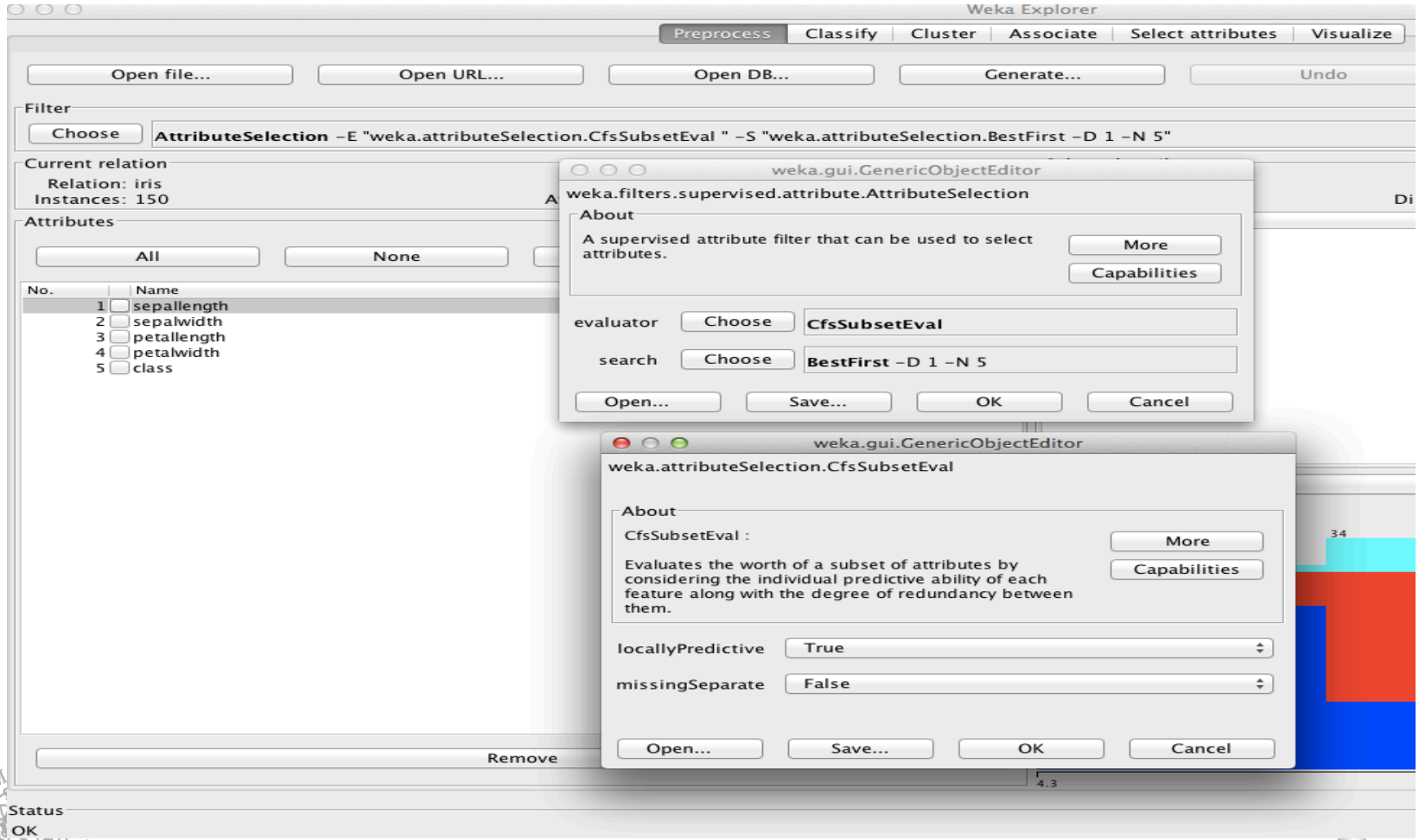
Attribute Selection: Wrapper Method (2)

```
=== Attribute Selection on all input data ===

Search Method:
        Best first.
        Start set: no attributes
        Search direction: forward
        Stale search after 5 node expansions
        Total number of subsets evaluated: 11
        Merit of best subset found:    0.947

Attribute Subset Evaluator (supervised, Class (nominal): 5 class):
        Wrapper Subset Evaluator
        Learning scheme: weka.classifiers.trees.J48
        Scheme options: -C 0.25 -M 2
        Subset evaluation: classification accuracy
        Number of folds for accuracy estimation: 5

Selected attributes: 4 : 1
                     petalwidth
```

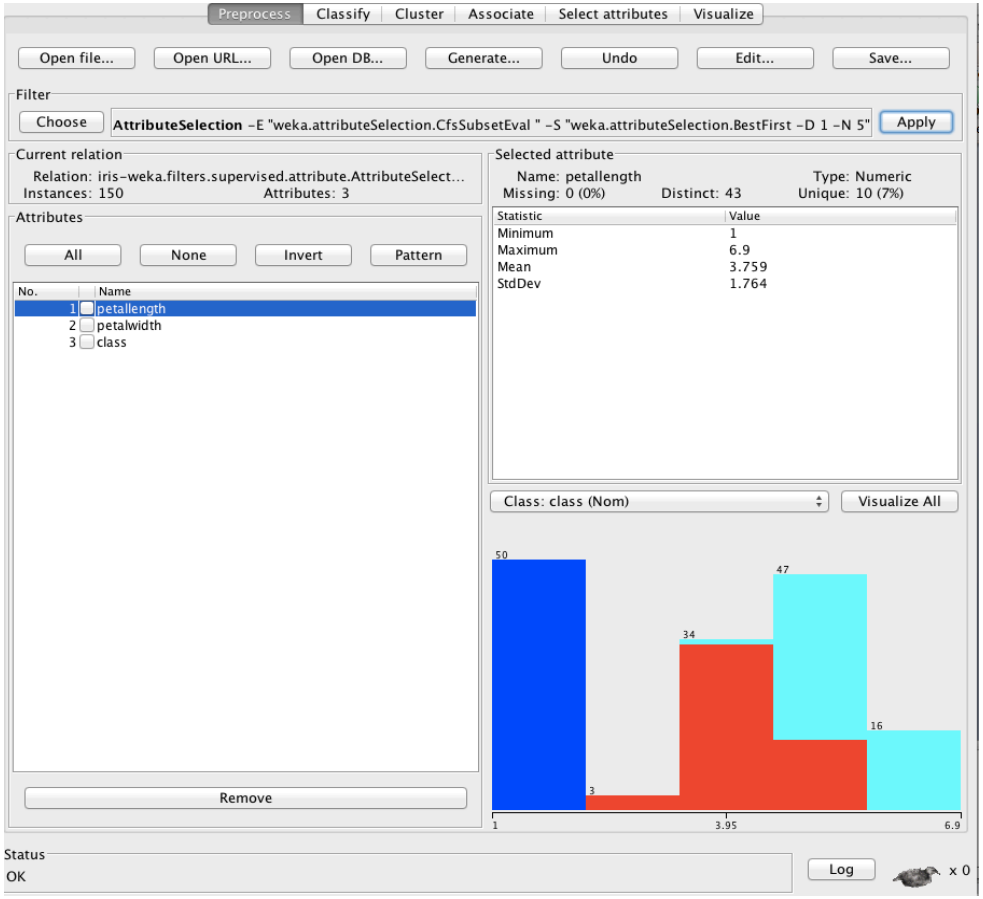
Attribute Selection as a Filter



Attribute Selection as a Filter (setting parameters)



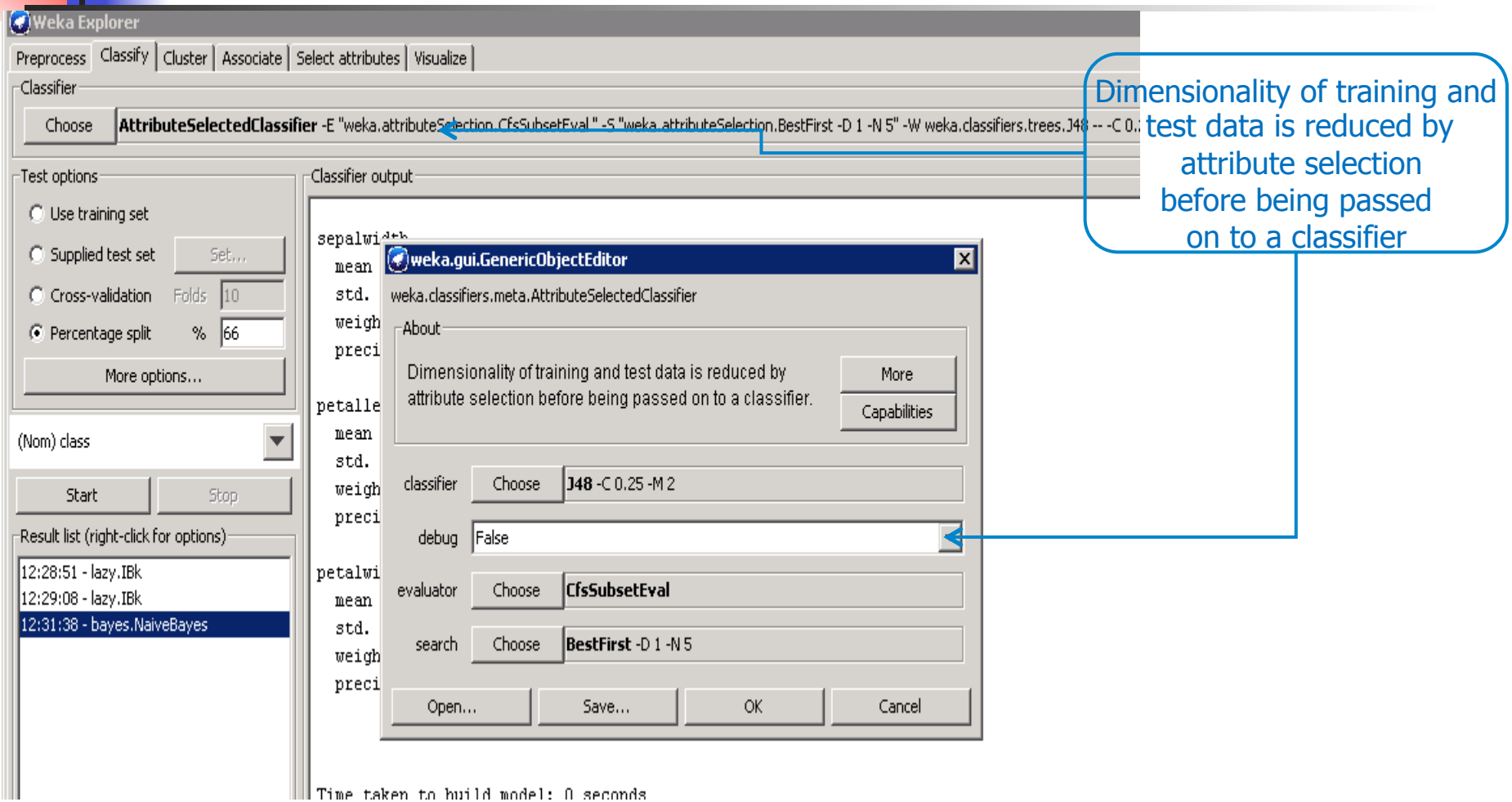
Attribute Selection as a Filter (results)



Now we can switch to the classify module and perform a cross validation analysis....

...Is it a correct way to act?

Classification and Attribute Selection (1)



Dimensionality of training and test data is reduced by attribute selection before being passed on to a classifier

Classification and Attribute Selection (2)

Selected attributes: 3,4 : 2
petallength
petalwidth

=== 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	

Command Line Attribute Selection: An Example

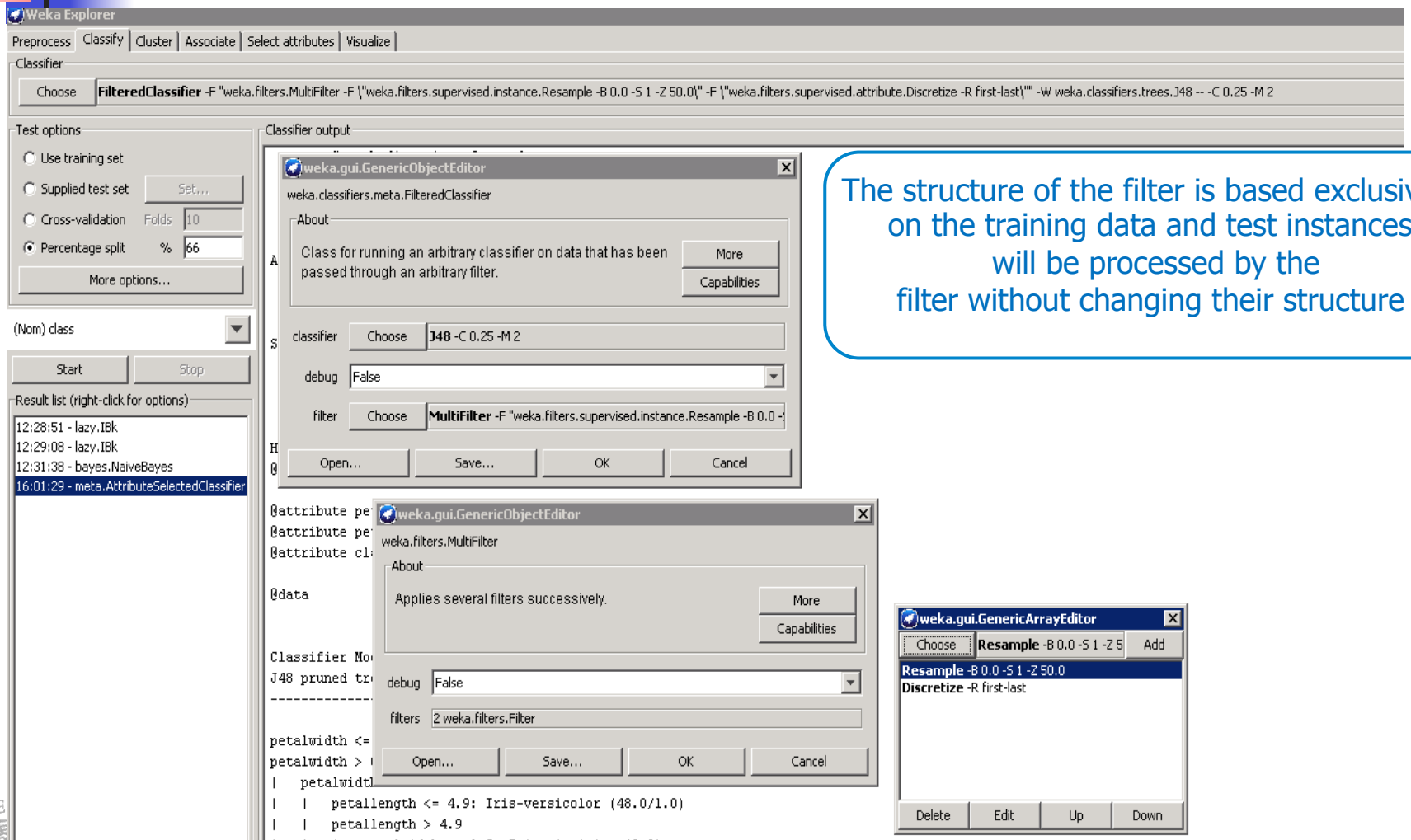
- Generating new training and test files

```
java weka.filters.supervised.attribute.AttributeSelection \
-E "weka.attributeSelection.CfsSubsetEval " \
-S "weka.attributeSelection.BestFirst -D 1 -N 5" \
-b \
-i <Training.arff> \
-o <TrainingSel.arff> \
-r <Test.arff> \
-s <TestSel.arff>
```

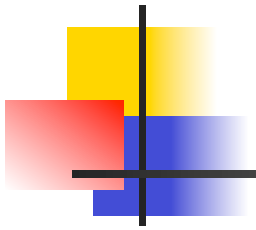
- Generating and testing a classifier

```
java weka.classifiers.trees.J48 -t TrainingSel.arff –T TestSel.arff
```

Classification and Filtering Data (1)



The structure of the filter is based exclusively on the training data and test instances will be processed by the filter without changing their structure



Exercise II

Perform the classification by using the three different meta classifiers (select a classification algorithm and three different attribute selection methods) and the Pima Diabets dataset with a 5-fold cross validation.

Which is the best attribute selection method?