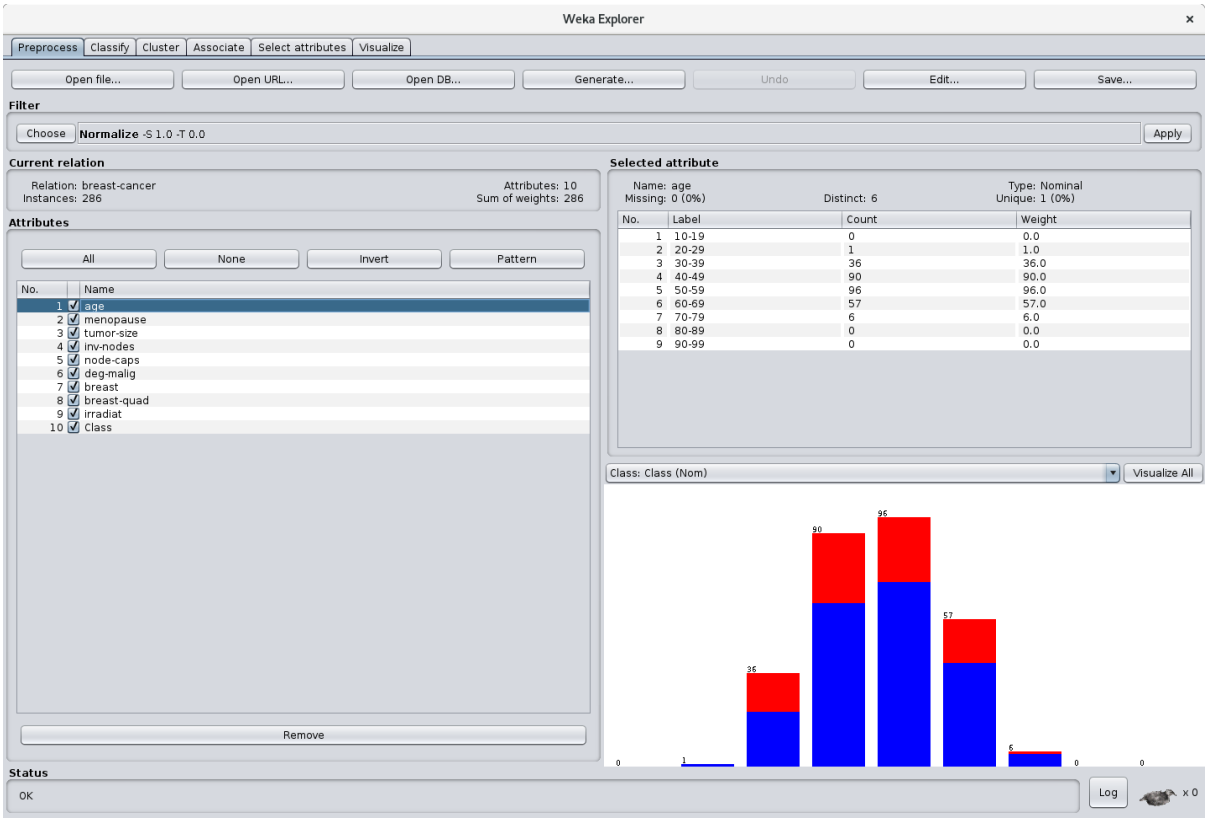
Problem:

The task is to create classifiers for the provided breast cancer dataset. We chose to do this project using the weka data mining software.[1] A J48 decision tree as well as a Naive Bayes classifier should be created.
The goal is to use open source tools to create insight into real world datasets and be able to validate the reliability of the methods.

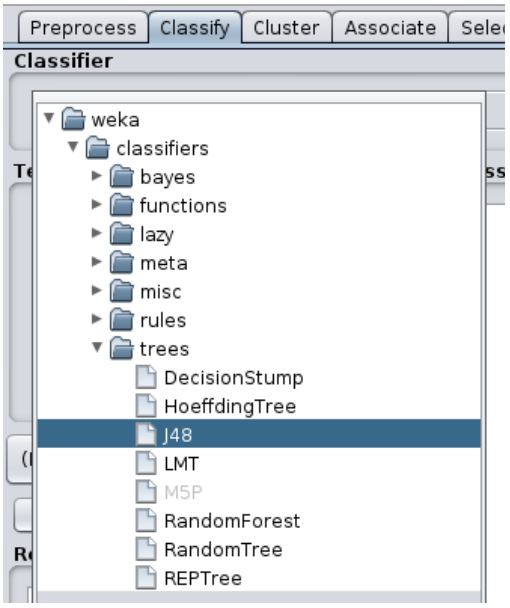
J48 - Weka GUI

When the Weka GUI is opened, the desired dataset can be opened by clicking on “Open File” and choosing the breast-cancer.arff file. The dataset can now be explored and various filters, for example normalisation, can be applied. For this exercise we chose to apply no filter on the dataset.

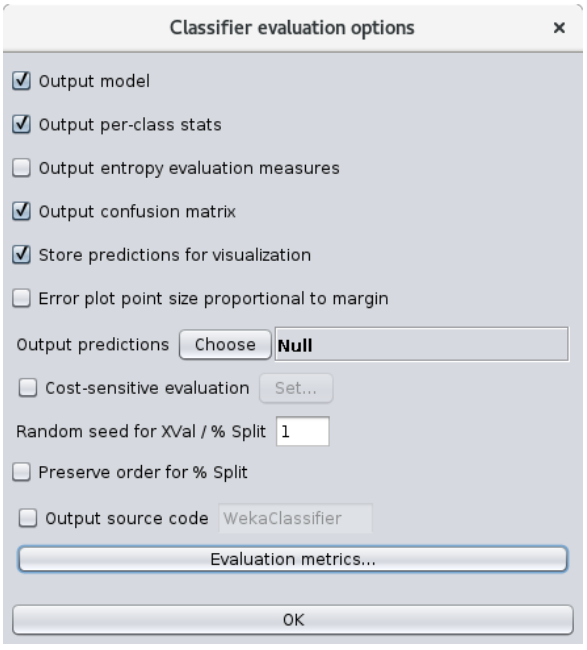


[1] https://www.cs.waikato.ac.nz/ml/weka/

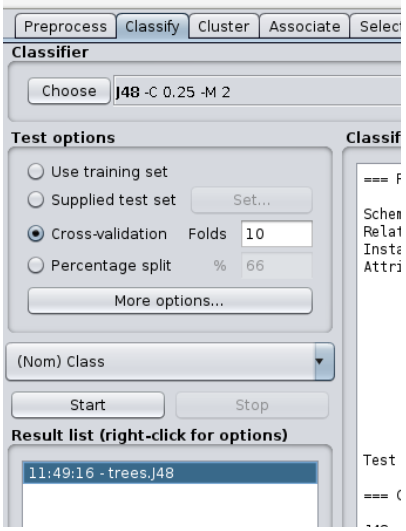
In the tab “Classify” the J48-classifier can be selected under weka > classifiers > trees > J48.



The following classifier evaluation options were chosen:



We use the k-folds cross-validation[2] method to test our classifier with a fold number of 10. The attribute to predict can now be selected. As is shown in the screenshot below, we select the attribute “Class”. We now click on start to generate the J48-classifier.



The following cross-validation summary is printed out.

```
=== Stratified cross-validation ===

Correctly Classified Instances         216               75.5245 %
Incorrectly Classified Instances        70               24.4755 %
Kappa statistic                          0.2826
Mean absolute error                      0.3676
Root mean squared error                  0.4324
Relative absolute error                 87.8635 %
Root relative squared error             94.6093 %
Total Number of Instances              286
```

As is seen above the decision tree has an accuracy of 75%.

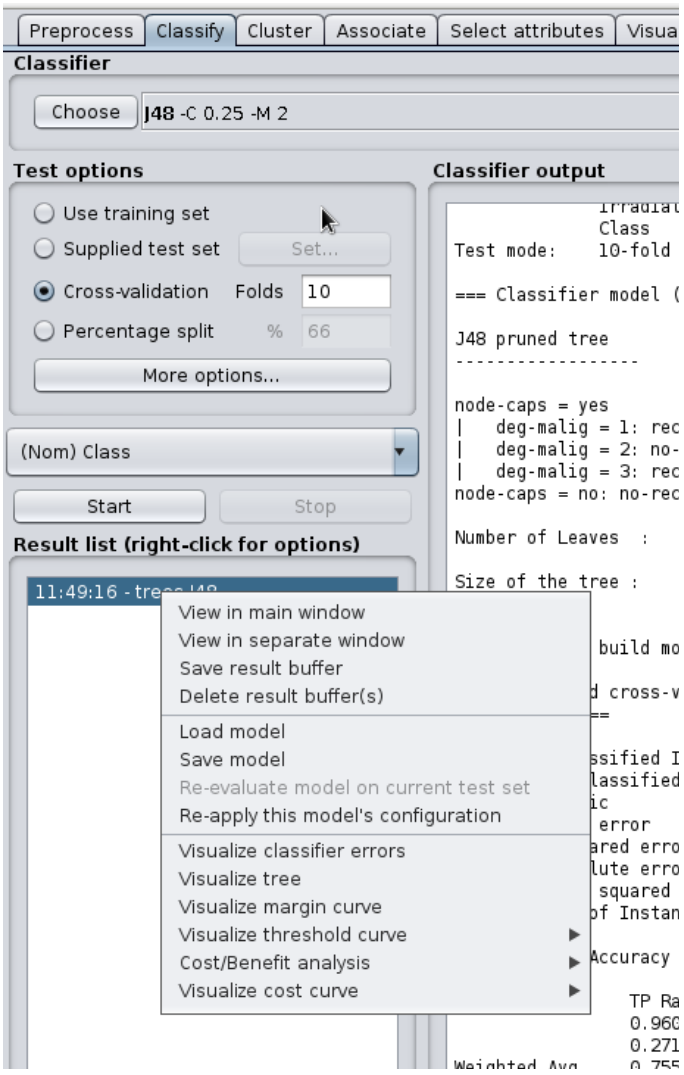
The classifier leads to the following confusion matrix.

```
=== Confusion Matrix ===
   a   b   <-- classified as
 193   8 |   a = no-recurrence-events
  62  23 |   b = recurrence-events
```

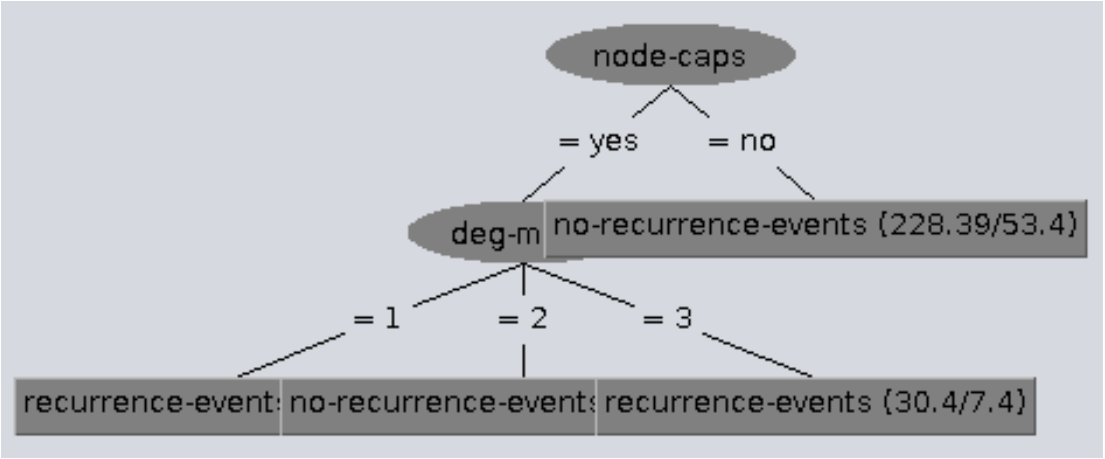
It can be seen that the majority of the “recurrence-events” class were falsely classified as class a (no-recurrence-events). In Total 70 instances were classified as the wrong class.

[2] https://en.wikipedia.org/wiki/Cross-validation_(statistics)#k-fold_cross-validation

The decision tree can now be visualized by right-clicking the classifier and selecting “Visualize tree”.



The following decision tree is now shown.



As is seen in the decision tree above, a lot attributes are purged out of the j48-tree. The final classifier is only based on the attributes “node-caps” and “deg-malig”.

Naive Bayes - Weka Java API

The purpose of this part is to test the Naive Bayes classifier using the Java API, so we have written the following commented code

```
import weka.classifiers.Evaluation;
import weka.classifiers.bayes.NaiveBayes;
import weka.core.Instances;
import java.io.BufferedReader;
import java.io.FileReader;
import java.util.Random;

public class Lab2 {
	public static void main(String[] args)
	{
		BufferedReader reader;
		Instances data = null;
		try {
			//Reading dataset
			reader = new BufferedReader(new
FileReader("dataset/breast-cancer.arff"));
			//Create seeded number generator
			Random rand = new Random(System.currentTimeMillis());
			//Create Instances from read data: Instances is a
class for handling an ordered set of weighted instances.
			data = new Instances(reader);
			//Randomize the position of instances.
			data.randomize(rand);
			reader.close();
		} catch (Exception e) {
			e.printStackTrace();
		}
		System.out.println(data);
		//Setting the last attribute as class attribute
		data.setClassIndex(data.numAttributes() - 1);
		//Creating instances for train taking the half first part
	Instances train = data.trainCV(2, 0);
	//Creating instances for test taking the half last part
	Instances test = data.testCV(2, 1);
	try {
			//Creating Naive Bayes model
```

```
                NaiveBayes model=new NaiveBayes();
                //Building the classifier using the training Instances
                model.buildClassifier(train);
                //Creating the evaluation with test instances
                Evaluation eval = new Evaluation(test);
                //Doing the evaluation specifying which model and test
instances use
              eval.evaluateModel(model,test);
              //Printing the confusion matrix
              System.out.println(eval.toMatrixString());
              //Printing the percentage of model
              System.out.println(eval.toSummaryString());
           } catch (Exception e) {
                e.printStackTrace();
           }
      }
}
```

[3] [4]

The result of the Naive Bayes classifier are the confusion matrix and the accuracy percentage, as we can see the accuracy level is almost the same as the J48 classifier. And as for the previous classifier the majority of b class is misclassified in a class.

```
=== Confusion Matrix ===

  a  b   <-- classified as
 85 12 |  a = no-recurrence-events
 23 23 |  b = recurrence-events


Correctly Classified Instances         108               75.5245 %
Incorrectly Classified Instances        35               24.4755 %
Kappa statistic                          0.4015
Mean absolute error                      0.2951
Root mean squared error                  0.4183
Relative absolute error                 67.4922 %
Root relative squared error             89.5506 %
Total Number of Instances              143
```

[3] http://weka.sourceforge.net/doc.stable/weka/classifiers/Evaluation.html
[4] http://weka.sourceforge.net/doc.dev/weka/classifiers/bayes/NaiveBayes.html

Conclusion

The Weka GUI allows for a very fast and seamless process in exploring the data and applying various filters. A classifier can then easily be created, saved and modified. All this is possible without having to write code which makes it easier, especially for beginners, to do various data mining tasks. The Weka Java API can be use to obtain more complex analysis and results. As we have seen in this dataset apply a J48 tree classifier or a Naive Bayes classifier give us almost the same result.