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WEKA, aka Weka

[Waikato Environment (for) Knowledge Analysis]

History

WEKA began taking shape in 1992. During that time, ML algorithms:

* were implemented in several languages

* ran on multiple platforms

* had to be run with custom data formats

* were in essence, not inter-operable! Was not possible to test and compare learning algorithms, by having them operate on the same data on the same machine

Weka was conceived both as a toolbox of algorithms, and also as a workbench for implementing new ones.

Today, Weka is at (stable) version 3.8. Weka is open source, is written in Java (keeps everything portable, cross-platform).

Workbench

Collection of ML algorithms, visualization and data pre-processing tools, all accessible via GUI.

Makes it easy to compare algorithms.

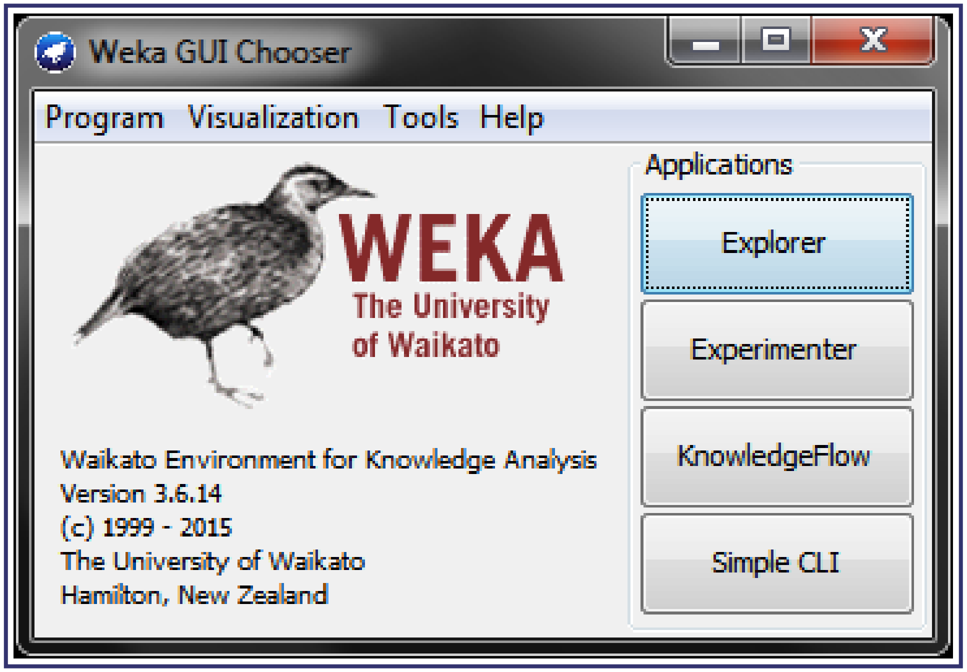
Modular and EXTENSIBLE, via a Java API plugin scheme.

Includes algorithms in all the main categories - classification, clustering, rule learning, regression.

Can be used standalone, or as a library (in library mode, Weka functions can be invoked from your own Java client code).

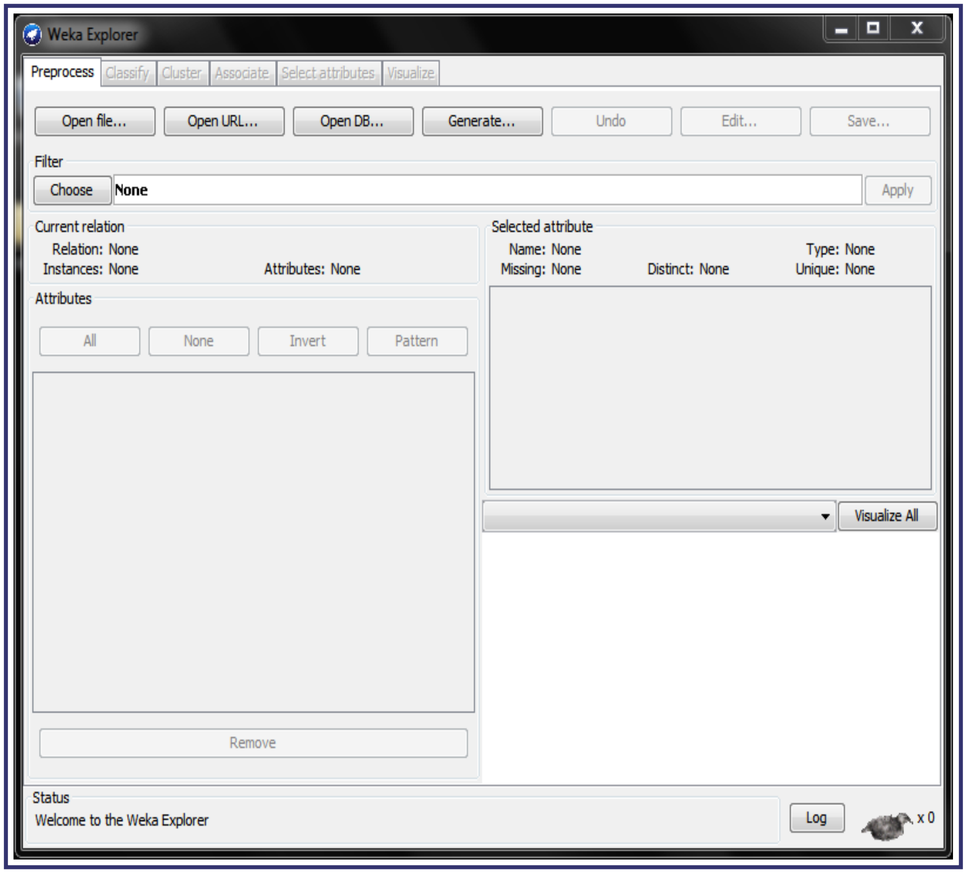
UIs

WEKA's GUI chooser is what comes up first:



Waikato Environment for Knowledge Analysis
Version 3.6.14
(c) 1999 - 2015
The University of Waikato
Hamilton, New Zealand

The Explorer panel provides the bulk of the functionality: data-preprocessing, ML algorithms, visualization.



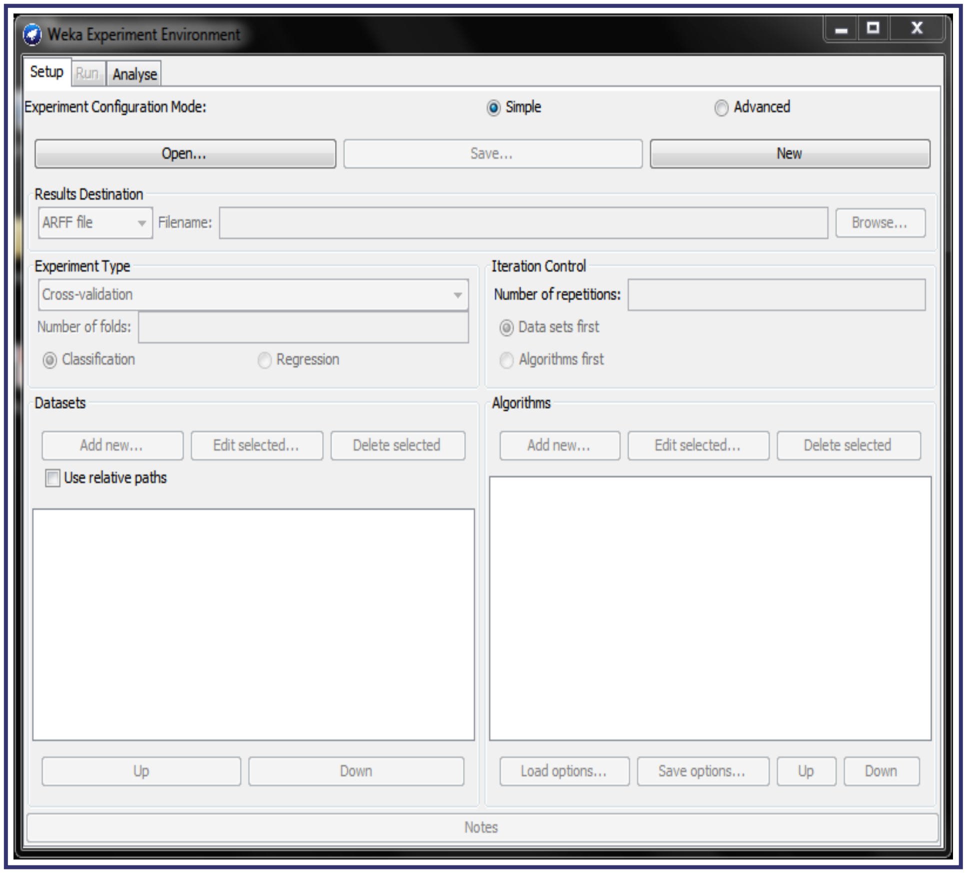
None

Relation: None
Instances: None
Attributes: None

Name: None
Type: None
Missing: None
Distinct: None
Unique: None

Welcome to the Weka Explorer

The Experimenter panel provides way to compare predictions of algorithms, based on a variety of criteria.



Experiment Configuration Mode: ● Simple ○ Advanced

Results Destination: ARFF file Filename:

Experiment Type: Cross-validation

Number of folds:

● Classification ○ Regression

Iteration Control

Number of repetitions:

● Data sets first

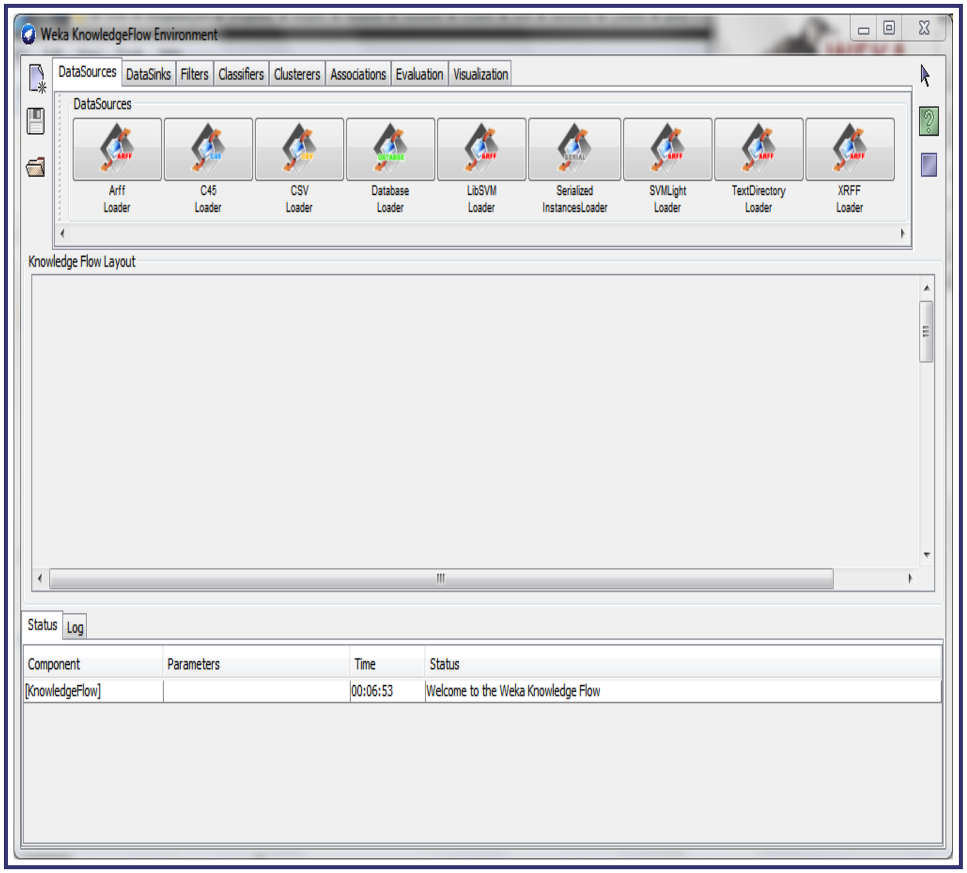
○ Algorithms first

Datasets

□ Use relative paths

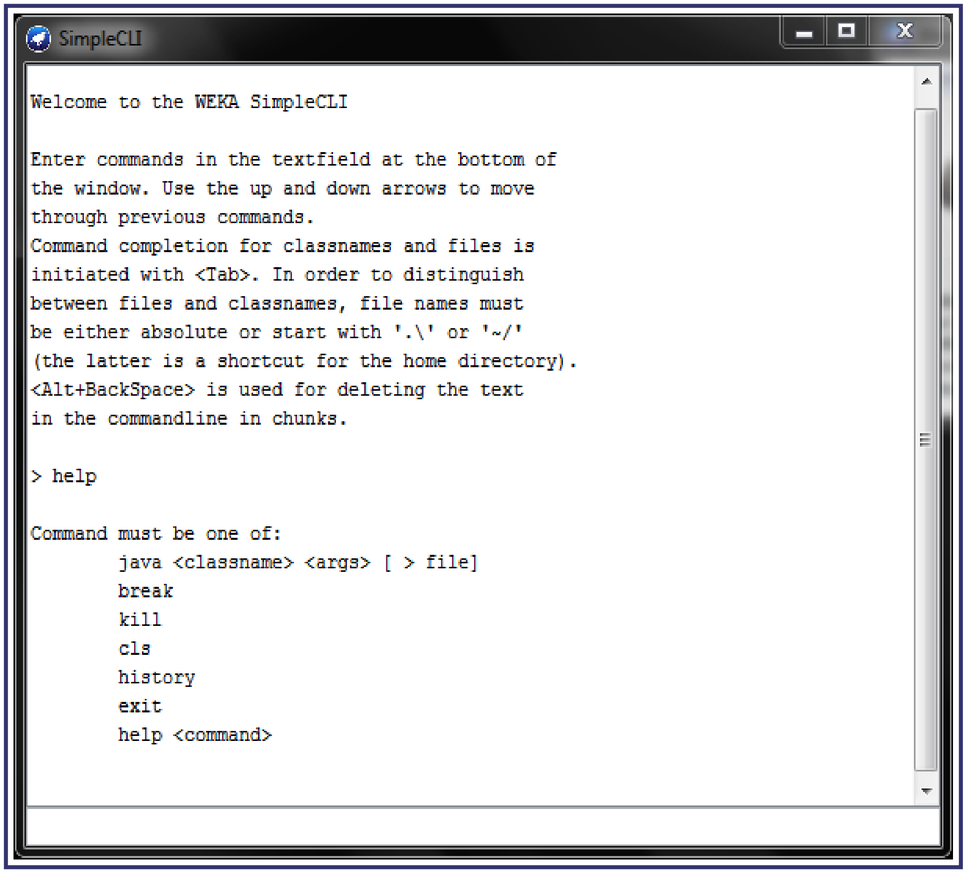
Algorithms

The Knowledge Flow panel permits incremental updates of ML algorithms (compared to Explorer, which is for btach processing).



Component	Parameters	Time	Status
[KnowledgeFlow]		00:06:53	Welcome to the Weka Knowledge Flow

And finally, it's possible to use Weka in command line mode too:

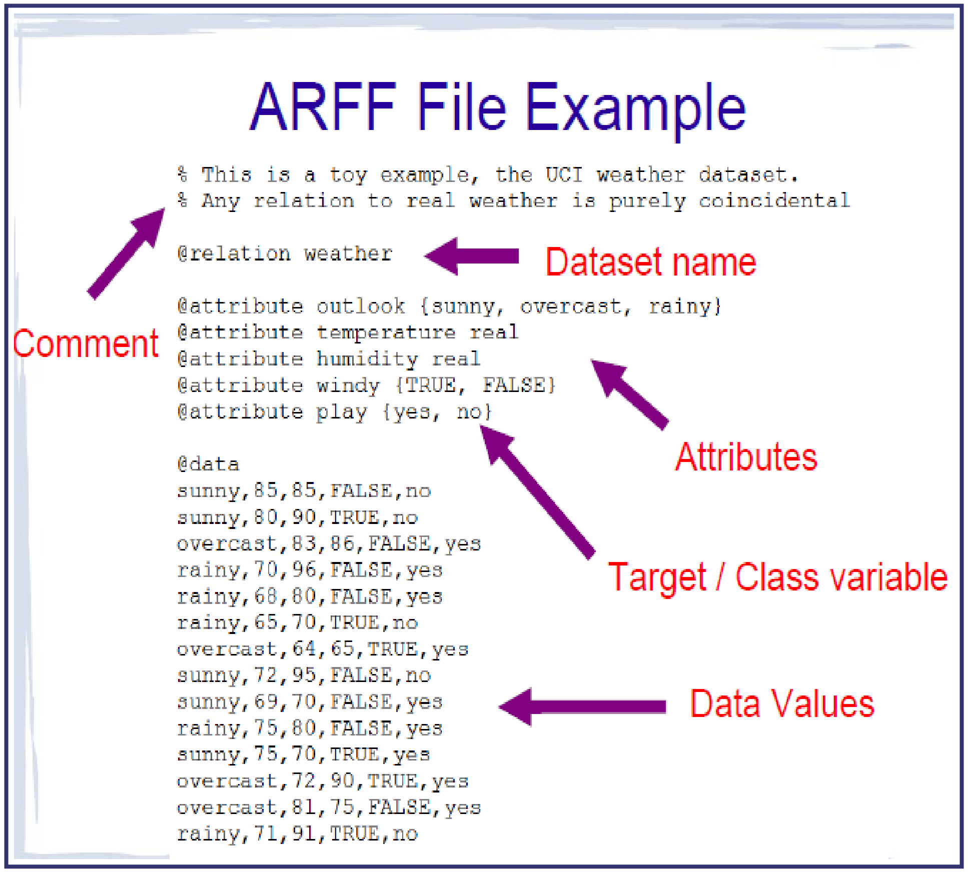


```
Welcome to the WEKA SimpleCLI

Enter commands in the textfield at the bottom of
the window. Use the up and down arrows to move
through previous commands.
Command completion for classnames and files is
initiated with <Tab>. In order to distinguish
between files and classnames, file names must
be either absolute or start with '.\' or '~/'
(the latter is a shortcut for the home directory).
<Alt+BackSpace> is used for deleting the text
in the commandline in chunks.

> help

Command must be one of:
        java <classname> <args> [ > file]
        break
        kill
        cls
        history
        exit
        help <command>
```

The CLI offers deeper functionality than the GUIs.

ARFF (Attribute Relation File Format) - Weka's native dataset format

Weka data can be expressed in a .arff file which has a simple data layout:
[from 'IntroductionToWeka.pdf']



ARFF File Example

```
% This is a toy example, the UCI weather dataset.
% Any relation to real weather is purely coincidental

@relation weather

@attribute outlook {sunny, overcast, rainy}
@attribute temperature real
@attribute humidity real
@attribute windy {TRUE, FALSE}
@attribute play {yes, no}

@data
sunny,85,85,FALSE,no
sunny,80,90,TRUE,no
overcast,83,86,FALSE,yes
rainy,70,96,FALSE,yes
rainy,68,80,FALSE,yes
rainy,65,70,TRUE,no
overcast,64,65,TRUE,yes
sunny,72,95,FALSE,no
sunny,69,70,FALSE,yes
rainy,75,80,FALSE,yes
sunny,75,70,TRUE,yes
overcast,72,90,TRUE,yes
overcast,81,75,FALSE,yes
rainy,71,91,TRUE,no
```

Weka-based projects

Weka has been a stable, mature platform for so long that it has been used to base, or work in conjunction with, a variety of data-related projects (40+!):

* Linguistics: GATE, Bali, Senseval-2, Kea..

* Biology: BioWEKA, Epitopes Toolkit (EpiT)..

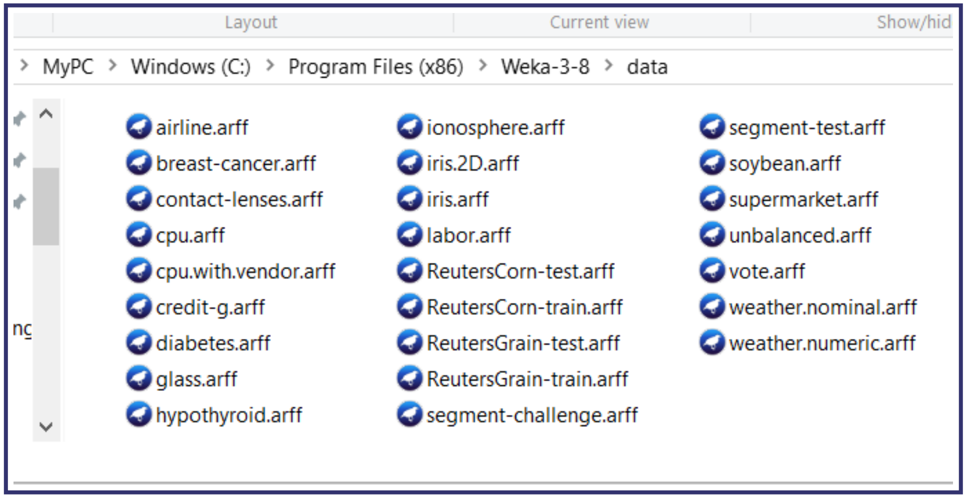
* Distributed, parallel systems: Weka-Parallel, GridWeka..

* Other data mining tools (these provide a 'bridge' to Weka, by supporting Weka's plugin format): Konstanz Information Miner (KNIME), RapidMiner, RWeka

* Scientific workflows: Kepler

Analysis: classification

Let's classify irises, using data in the iris.arff dataset - Weka ships with many sample datasets, this is one of them - look for them all, in the data/ directory off your Weka installation:

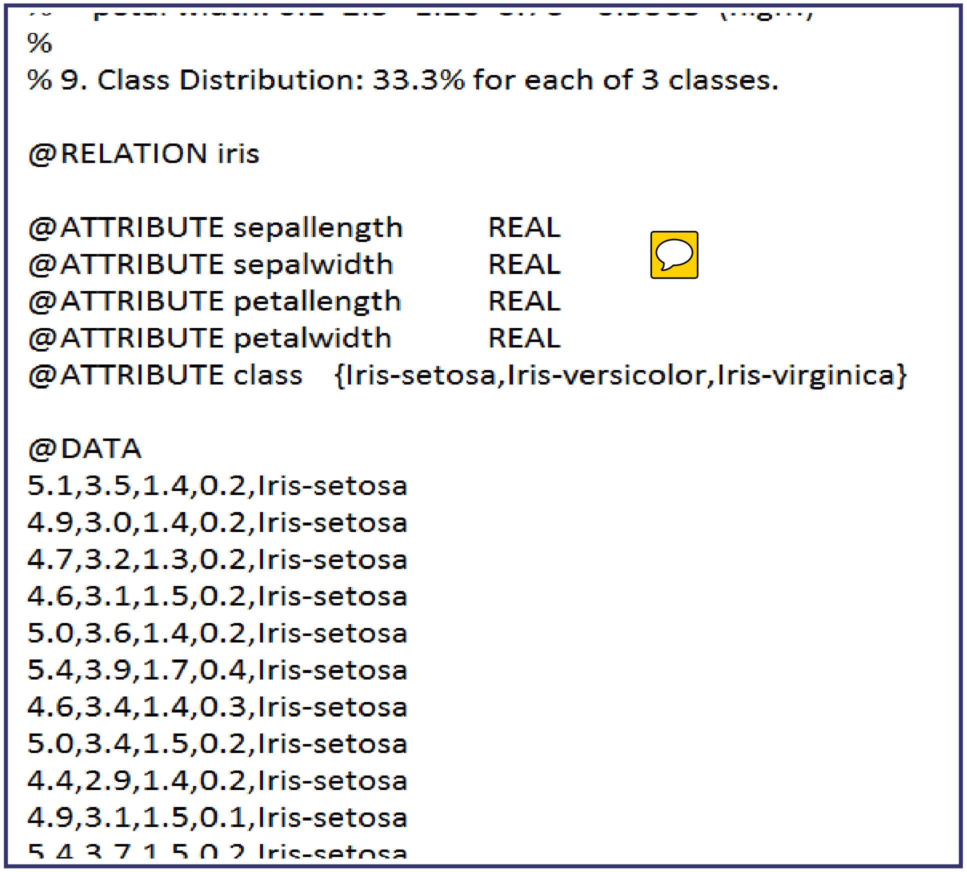


MyPC > Windows (C:) > Program Files (x86) > Weka-3-8 > data

- airline.arff
- breast-cancer.arff
- contact-lenses.arff
- cpu.arff
- cpu.with.vendor.arff
- credit-g.arff
- diabetes.arff
- glass.arff
- hypothyroid.arff
- ionosphere.arff
- iris.2D.arff
- iris.arff
- labor.arff
- ReutersCorn-test.arff
- ReutersCorn-train.arff
- ReutersGrain-test.arff
- ReutersGrain-train.arff
- segment-challenge.arff
- segment-test.arff
- soybean.arff
- supermarket.arff
- unbalanced.arff
- vote.arff
- weather.nominal.arff
- weather.numeric.arff

The Irises dataset ('iris.arff') contains 150 samples (rows of data), each with 4 attrs (columns); each sample has a known

classification, into one of 3 types of irises:



```
%    petal width: 0.1  2.5   1.20  0.76    0.9565  (high!)
%
% 9. Class Distribution: 33.3% for each of 3 classes.

@RELATION iris

@ATTRIBUTE sepallength        REAL
@ATTRIBUTE sepalwidth         REAL
@ATTRIBUTE petallength        REAL
@ATTRIBUTE petalwidth         REAL
@ATTRIBUTE class    {Iris-setosa,Iris-versicolor,Iris-virginica}

@DATA
5.1,3.5,1.4,0.2,Iris-setosa
4.9,3.0,1.4,0.2,Iris-setosa
4.7,3.2,1.3,0.2,Iris-setosa
4.6,3.1,1.5,0.2,Iris-setosa
5.0,3.6,1.4,0.2,Iris-setosa
5.4,3.9,1.7,0.4,Iris-setosa
4.6,3.4,1.4,0.3,Iris-setosa
5.0,3.4,1.5,0.2,Iris-setosa
4.4,2.9,1.4,0.2,Iris-setosa
4.9,3.1,1.5,0.1,Iris-setosa
5.4,3.7,1.5,0.2,Iris-setosa
```

Our goal is to run the data through a classifier - we will use a part of the data as 'training' data and the rest, as 'new' data, and see how much accuracy we get from the classifying algorithm - in other words, given rows of 'new' data (which is actually data for which we *do* know the iris type - shhh!),

what % of rows will the algorithm classify correctly? Close to 100% accurate classification would be our desired goal.

Analysis: classification [cont'd]

We'll first classify the iris data using the 'no op' ZeroR classifier (which misclassifies a LOT of data because it "cheats" and "lies", which in turn is because it does not consider any actual sample feature data at all!) as a baseline metric, then switch to using J48 (which is the Java version of C4.8, which is itself an extension of the famous C4.5 algorithm) for the classification task.

Here is a clip that shows the analysis and the result. As you could see, J48 classifies the ('outcome unknown') data with 94% accuracy - good!

The analysis takes mere seconds to do - all GUI-driven, no coding, config files to set up, etc.. :)

Analysis: regression

Let us build a multi-linear regression out of this housing dataset - we have 6 variables (houseSize etc), 7 data points, and (known) house prices:

```
@RELATION house

@ATTRIBUTE houseSize NUMERIC
@ATTRIBUTE lotSize NUMERIC
@ATTRIBUTE bedrooms NUMERIC
@ATTRIBUTE granite NUMERIC
@ATTRIBUTE bathroom NUMERIC
@ATTRIBUTE sellingPrice NUMERIC

@DATA
3529,9191,6,0,0,205000
3247,10061,5,1,1,224900
4032,10150,5,0,1,197900
```

```
2397,14156,4,1,0,189900
2200,9600,4,0,1,195000
3536,19994,6,1,1,325000
2983,9365,5,0,1,230000
```

After reading in the file, we pick LinearRegression under Classify->Functions, make sure sellingPrice is set to be the dependent variable (by default, Weka will pick the right-most attr, so we should structure our data that way), then press Start.

Very quickly, Weka calculates regression coeffs for the best line through the data:

```
sellingPrice = (-26.6882   * houseSize) +
                           (7.0551     * lotSize) +
                      (43166.0767 * bedrooms) +
                      (42292.0901 * bathroom)
                      - 21661.1208
```

So from here on, given attrs for a house to be sold, we can come up with a good suggested price for it.

-26.6882*houseSize is odd! houseSize is not an indep variable, we need to remove it (in Preprocessing), re-run the model to get a better equation.

This clip shows the above steps..

Analysis: clustering

Let us analyze customers' 'browsing' data at a BMW car dealership..

We use SimpleKMeans (under Cluster) as the algorithm.

Looking at the cluster data, we can observe interesting behaviors, all the way from 0% buying to 100% buying (after having looked at BMWs).

This clip shows the clustering being carried out.

Learning more

If you want to get deep into Weka, here are key resources:

- THE Weka book is now in its third edition - it offers a THOROUGH treatment of all the algorithms found in Weka's menus [just take a look at the table of contents posted in the linked page!]
- Data Mining with Weka: an online course offered by Weka's creators
- More Data Mining with Weka: a followup course