UNIVERSIDAD DE CÓRDOBA

TRABAJO FIN DE GRADO

GRADO EN INGENIERÍA INFORMÁTICA

Implementación de una interfaz para el algoritmo NSLVOrd en la biblioteca ORCA

Manual de Código

Autor

Federico García-Arévalo Calles

Directores

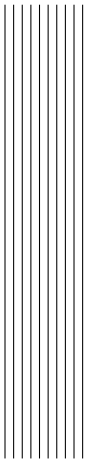
Pedro Antonio Gutiérrez Peña

Juan Carlos Gámez Granados

Escuela Politécnica Superior

—

Córdoba, mes de 2020



Índice General

Índice de Código

1 Introducción

Este documento corresponde al manual de usuario del Trabajo Fin de Grado "*Implementación de una interfaz para el algoritmo NSLVOrd en la biblioteca ORCA*", en el que se muestran los códigos que se han creado y modificado para este trabajo. Los ficheros se agruparán según al módulo que pertenecen:

- **ORCA:** este es el módulo principal del sistema que se encarga configurar el experimento, calcular las métricas de los resultados y exportar toda la información. Está codificado en lenguaje Matlab.
- **Read File:** este módulo se encarga de leer los ficheros de entrenamiento y test; devolviendo los datos separando las entradas y salidas. Está codificado en lenguaje Matlab.
- **Algorithms:** este módulo se encarga de contener diferentes algoritmos y de la ejecución de estos. Está codificado en lenguaje Matlab.
- **NSLVOrd:** este módulo es el que se encarga de ejecutar el algoritmo NSLVOrd. Está codificado en Java.
- **Rule View:** este módulo es el que se encarga de mostrar las reglas generadas por el algoritmo en una ventana de tal forma que cualquier tipo de usuario pueda entenderlas. Está codificado en Java.

- **JFML:** este módulo es el encargado de exportar las reglas generadas por el algoritmo a ficheros XML en formato JFML y PMML en un directorio especificado por el usuario. Está codificado en Java.

2 Módulo ORCA

2.1. Clase Utilities

```
1 classdef Utilities < handle
2     %UTILITIES Static class that contains several methods for
          configurating
3     %   and running the experiments. It allows experiments CPU
          parallelization.
4     %   Examples of integration with HTCondor are provided src/condor
          folder.
5     %
6     %   UTILITIES methods:
7     %       runExperiments              - setting and running experiments
8     %       runExperimentFold           - Launchs a single experiment fold
9     %       configureExperiment         - sets configuration of the several
          experiments
10    %       results                     - creates experiments reports
11    %
12    %   This file is part of ORCA: https://github.com/ayrna/orca
13    %   Original authors: Pedro Antonio GutiÃ©rrez, MarÃa PÃ©rez Ortiz,
          Javier SÃ¡nchez Monedero
14    %   Citation: If you use this code, please cite the associated paper
          http://www.uco.es/grupos/ayrna/orreview
15    %   Copyright:
16    %       This software is released under the The GNU General Public
          License v3.0 licence
17    %       available at http://www.gnu.org/licenses/gpl-3.0.html
18
19    properties
20
21    end
22
23
```

```
24      methods (Static = true)
25          function [logsDir] = runExperiments(expFile, varargin)
26              %RUNEXPERIMENTS Function for setting and running the
                    experiments
27              %   [LOGSDIR] = RUNEXPERIMENTS(EXPFILE) runs
28              %   experiments described in EXPFILE and returns the folder
29              %   name LOGSDIR that stores all the results. LOGSDIR is
30              %   generated based on the date and time of the system.
31              %
32              %   [LOGSDIR] = RUNEXPERIMENTS(EXPFILE, options) runs
33              %   experiments described in EXPFILE and returns the folder
34              %   name LOGSDIR that stores all the results. Options are:
35              %       - 'parallel': 'false' or 'true' to activate CPU
                        parallel
36              %         processing of databases's folds. Default is 'false'
37              %       - 'numcores': default maximum number of cores or
                        desired
38              %         number. If parallel = 1 and numcores <2 it sets the
                        number
39              %         to maximum number of cores.
40              %       - 'closepool': whether to close or not the pool after
41              %         experiments. Default 'true'. Disabling it can speed
42              %         up consecutive calls to runExperiments.
43              %
44              % Examples:
45              %
46              % Runs parallel folds with 3 workers:
47              %   Utilities.runExperiments('tests/cvtests-30-holdout/kdlor.
                        ini', 'parallel', 1, 'numcores', 3)
48              % Runs parallel folds with max workers:
49              %   Utilities.runExperiments('tests/cvtests-30-holdout/kdlor.
                        ini', 'parallel', 1)
50              % Runs parallel folds with max workers and do not close the
51              % pool:
52              %   Utilities.runExperiments('tests/cvtests-30-holdout/kdlor.
                        ini', 'parallel', 1, 'closepool', false)
53              %   Utilities.runExperiments('tests/cvtests-30-holdout/svorim.
                        ini', 'parallel', 1, 'closepool', false)
54              %
55              addpath(fullfile(fileparts(which('Utilities.m')),'Measures'));
56              addpath(fullfile(fileparts(which('Utilities.m')),'Algorithms'))
                    ;
57
58              disp('Setting up experiments...');
59
60              %TODO: move ID generation to configureExperiment?
61              c = clock;
62              dirSuffix = [num2str(c(1)) '-' num2str(c(2)) '-' num2str(c(3))
                     '-' num2str(c(4)) '-' num2str(c(5)) '-' num2str(uint8(c(6)
                    ))];
63              logsDir = Utilities.configureExperiment(expFile,dirSuffix);
64              expFiles = dir([logsDir '/' 'exp-*']);
65
```

```
66              % Parse options.
67              op = Utilities.parseParArgs(varargin);
68              myExperiment = Experiment;
69
70              if op.parallel
71                  Utilities.preparePool(op.numcores)
72                  if (exist ('OCTAVE_VERSION', 'builtin') > 0)
73                      logsCell = cell(numel(expFiles),1);
74                      logsCell(:) = logsDir;
75                      parcellfun(op.numcores,@(varargin) Utilities.
                            octaveParallelAuxFunction(varargin{:}),num2cell(
                            expFiles),logsCell);
76                  else
77                      parfor i=1:numel(expFiles)
78                          if ~strcmp(expFiles(i).name(end), '~')
79                              disp(['Running experiment ', expFiles(i).name])
                                    ;
80                              myExperiment.launch([logsDir '/' expFiles(i).
                                    name]);
81                          end
82                      end
83                  end
84
85                  Utilities.closePool()
86              else
87                  for i=1:numel(expFiles)
88                      if ~strcmp(expFiles(i).name(end), '~')
89                          disp(['Running experiment ', expFiles(i).name]);
90                          myExperiment.launch([logsDir '/' expFiles(i).name])
                                ;
91                      end
92                  end
93              end
94
95              disp('Calculating results...');
96              % Train results (note last argument)
97
98              Utilities.results([logsDir '/' 'Results'],'report_sum',
                    myExperiment.report_sum, 'train', true);
99              % Test results
100             Utilities.results([logsDir '/' 'Results'], 'report_sum',
                    myExperiment.report_sum);
101             %rmpath('Measures');
102             %rmpath('Algorithms');
103
104         end
105
106         function octaveParallelAuxFunction(experimentToRun,logsDir)
107             %OCTAVEPARALLELAUXFUNCTION Function for running one experiment
                     file
108             %   It is used in Octave because it Octave does not have parfor
109             %   OCTAVEPARALLELAUXFUNCTION(EXPERIMENT,LOGSDIR) run the
                    experiment
```

```
110             %   named EXPERIMENT and contained in the folder LOGSDIR
111             if ~strcmp(experimentToRun.name(end), '~')
112                 myExperiment = Experiment;
113                 disp(['Running experiment ', experimentToRun.name]);
114                 myExperiment.launch([logsDir '/' experimentToRun.name]);
115             end
116         end
117
118         function results(experiment_folder,varargin)
119             %RESULTS Function for computing the results
120             %   RESULTS(EXPERIMENT_FOLDER) computes results of predictions
121             %   stored in EXPERIMENT_FOLDER. It generates CSV files with
122             %   several performance metrics of the testing (generalization)
123             %   predictions.
124             %       * |mean-results_test.csv|: CSV file with datasets in
                    files
125             %       and performance metrics in columns. For each metric two
                     columns
126             %       are created (mean and standard deviation considering
                    the _k_ folds
127             %       of the experiment).
128             %       * |mean-results_matrices_sum_test.csv|: CSV file with
129             %       performance metrics calculated using the sum of all the
130             %       confussion matrices of the _k_ experiments (as Weka
                    does). Each column
131             %       presents the performance of this single matrix.
132             %
133             %   RESULTS(EXPERIMENT_FOLDER,'TRAIN', true) same as
134             %   RESULTS(EXPERIMENT_FOLDER) but calculates performance in
                    train
135             %   data. It can be usefull to evaluate overfitting.
136             %
137             %   See also MEASURES/MZE, MEASURES/MAE, MEASURES/AMAE,
                    MEASURES/CCR,
138             %   MEASURES/MMAE, MEASURES/GM, MEASURES/MS, MEASURES/Spearman,
139             %   MEASURES/Tkendall, MEASURES/Wkappa
140
141             addpath(fullfile(fileparts(which('Utilities.m')),'Measures'));
142             addpath(fullfile(fileparts(which('Utilities.m')),'Algorithms'))
                    ;
143
144             opt.train = false;
145             opt.report_sum = false;
146
147             opt = parsevarargs(opt, varargin);
148
149             experiments = dir(experiment_folder);
150
151             for i=1:numel(experiments)
152                 if ~(any(strcmp(experiments(i).name, {'.', '..'}))) &&
                        experiments(i).isdir
153                     disp([experiment_folder '/' experiments(i).name '/' '
                            dataset'])
```

```
154                     fid = fopen([experiment_folder '/' experiments(i).name
                            '/' 'dataset'],'r');
155                     datasetPath = fgetl(fid);
156                     fclose(fid);
157
158                     if opt.train
159                         predicted_files = dir([experiment_folder '/'
                                experiments(i).name '/' 'Predictions' '/' '
                                train_*']);
160                     else
161                         predicted_files = dir([experiment_folder '/'
                                experiments(i).name '/' 'Predictions' '/' '
                                test_*']);
162                     end
163                     % Check if we have a missing fold experiment.
164                     %-2 is to compensate . and ..
165                     predicted_files_train = dir([experiment_folder '/'
                            experiments(i).name '/' 'Predictions' '/' 'train_*'
                            ]);
166                     predicted_files_test = dir([experiment_folder '/'
                            experiments(i).name '/' 'Predictions' '/' 'test_*'
                            ]);
167
168                     if (numel(predicted_files_train)+numel(
                            predicted_files_test)) ~= numel(dir(datasetPath))
                            -2
169                         warning(sprintf('\n ********** \n The execution of
                                 some folds failed. Number of experiments
                                differs from number of train-test files. \n
                                ********** \n'))
170                     end
171                     time_files = dir([experiment_folder '/' experiments(i).
                            name '/' 'Times' '/' '*.*']);
172                     hyp_files = dir([experiment_folder '/' experiments(i).
                            name '/' 'OptHyperparams' '/' '*.*']);
173
174                     if opt.train
175                         guess_files = dir([experiment_folder '/'
                                experiments(i).name '/' 'Guess' '/' 'train_*'])
                                ;
176                     else
177                         guess_files = dir([experiment_folder '/'
                                experiments(i).name '/' 'Guess' '/' 'test_*']);
178                     end
179
180                     % Discard "." and ".."
181                     if ~(exist ('OCTAVE_VERSION', 'builtin') > 0)
182                         time_files = time_files(3:numel(time_files));
183                         hyp_files = hyp_files(3:numel(hyp_files));
184                     end
185
186                     if opt.train
187                         real_files = dir([datasetPath '/' 'train_*']);
```

```
188                     else
189                         real_files = dir([datasetPath '/' 'test_*']);
190                     end
191
192                     act = cell(1, numel(predicted_files));
193                     pred = cell(1, numel(predicted_files));
194                     proj = cell(1, numel(guess_files));
195
196                     times = zeros(3,numel(predicted_files));
197                     param = [];
198
199                     for j=1:numel(predicted_files)
200                         pred{j} = importdata([experiment_folder '/'
                                experiments(i).name '/' 'Predictions' '/'
                                predicted_files(j).name]);
201                         times(:,j) = importdata([experiment_folder '/'
                                experiments(i).name '/' 'Times' '/' time_files(
                                j).name]);
202                         proj{j} = importdata([experiment_folder '/'
                                experiments(i).name '/' 'Guess' '/' guess_files
                                (j).name]);
203
204                         if ~isempty(hyp_files)
205                             struct_hyperparams(j) = importdata([
                                    experiment_folder '/' experiments(i).name '
                                    /' 'OptHyperparams' '/' hyp_files(j).name],
                                    ',');
206                             for z = 1:numel(struct_hyperparams(j).data)
207                                 param(z,j) = struct_hyperparams(j).data(z);
208                             end
209                         end
210
211
212                         actual = TFGFileReadClass().ReadFile(datasetPath,
                                real_files(j).name,0);
213                         act{j} = actual.targets;
214                     end
215
216                     names = {'Dataset', 'Acc', 'GM', 'MS', 'MAE', 'AMAE', '
                        MMAE','RSpearman', 'Tkendall', 'Wkappa', 'TrainTime
                        ', 'TestTime', 'CrossvalTime'};
217
218                     if ~isempty(hyp_files)
219                         for j=1:numel(struct_hyperparams(1).textdata)
220                             names{numel(names)+1} = struct_hyperparams(1).
                                    textdata{j};
221                         end
222                     end
223
224                     if exist ('OCTAVE_VERSION', 'builtin') > 0
225                         accs = cell2mat(cellfun(@(varargin) CCR.
                                calculateMetric(varargin{:}), act, pred, '
                                UniformOutput', false)) * 100;
```

```
226                     gms = cell2mat(cellfun(@(varargin) GM.
                            calculateMetric(varargin{:}), act, pred, '
                            UniformOutput', false)) * 100;
227                     mss = cell2mat(cellfun(@(varargin) MS.
                            calculateMetric(varargin{:}), act, pred, '
                            UniformOutput', false)) * 100;
228                     maes = cell2mat(cellfun(@(varargin) MAE.
                            calculateMetric(varargin{:}), act, pred, '
                            UniformOutput', false));
229                     amaes = cell2mat(cellfun(@(varargin) AMAE.
                            calculateMetric(varargin{:}), act, pred, '
                            UniformOutput', false));
230                     maxmaes = cell2mat(cellfun(@(varargin) MMAE.
                            calculateMetric(varargin{:}), act, pred, '
                            UniformOutput', false));
231                     spearmans = cell2mat(cellfun(@(varargin) Spearman.
                            calculateMetric(varargin{:}), act, pred, '
                            UniformOutput', false));
232                     kendalls = cell2mat(cellfun(@(varargin) Tkendall.
                            calculateMetric(varargin{:}), act, pred, '
                            UniformOutput', false));
233                     wkappas = cell2mat(cellfun(@(varargin) Wkappa.
                            calculateMetric(varargin{:}), act, pred, '
                            UniformOutput', false));
234                 else
235                     accs = cell2mat(cellfun(@CCR.calculateMetric, act,
                            pred, 'UniformOutput', false)) * 100;
236                     gms = cell2mat(cellfun(@GM.calculateMetric, act,
                            pred, 'UniformOutput', false)) * 100;
237                     mss = cell2mat(cellfun(@MS.calculateMetric, act,
                            pred, 'UniformOutput', false)) * 100;
238                     maes = cell2mat(cellfun(@MAE.calculateMetric, act,
                            pred, 'UniformOutput', false));
239                     amaes = cell2mat(cellfun(@AMAE.calculateMetric, act
                            , pred, 'UniformOutput', false));
240                     maxmaes = cell2mat(cellfun(@MMAE.calculateMetric,
                            act, pred, 'UniformOutput', false));
241                     spearmans = cell2mat(cellfun(@Spearman.
                            calculateMetric, act, pred, 'UniformOutput',
                            false));
242                     kendalls = cell2mat(cellfun(@Tkendall.
                            calculateMetric, act, pred, 'UniformOutput',
                            false));
243                     wkappas = cell2mat(cellfun(@Wkappa.calculateMetric,
                             act, pred, 'UniformOutput', false));
244                 end
245
246                 results_matrix = [accs; gms; mss; maes; amaes; maxmaes;
                        spearmans; kendalls; wkappas; times(1,:); times
                    (2,:); times(3,:)];
247                 if ~isempty(hyp_files)
248                     for j=1:numel(struct_hyperparams(1).textdata)
```

```
249                         results_matrix = [results_matrix ; param(j,:)
                                ];
250                     end
251                 end
252
253                 results_matrix = results_matrix';
254
255                 % Results for the independent dataset
256                 if opt.train
257                     fid = fopen([experiment_folder '/' experiments(i).
                            name '/' 'results_train.csv'],'w');
258                 else
259                     fid = fopen([experiment_folder '/' experiments(i).
                            name '/' 'results_test.csv'],'w');
260                 end
261
262                 for h = 1:numel(names)
263                     fprintf(fid, '%s,', names{h});
264                 end
265                 fprintf(fid,'\n');
266
267                 for h = 1:size(results_matrix,1)
268                     fprintf(fid, '%s,', real_files(h).name);
269                     for z = 1:size(results_matrix,2)
270                         fprintf(fid, '%f,', results_matrix(h,z));
271                     end
272                     fprintf(fid,'\n');
273                 end
274                 fclose(fid);
275
276                 % Confusion matrices and sum of confusion matrices
277                 if opt.report_sum
278                     if opt.train
279                         fid = fopen([experiment_folder '/' experiments(
                                i).name '/' 'matrices_train.txt'],'w');
280                     else
281                         fid = fopen([experiment_folder '/' experiments(
                                i).name '/' 'matrices_test.txt'],'w');
282                     end
283
284                     J = length(unique(act{1}));
285                     cm_sum = zeros(J);
286                     for h = 1:size(results_matrix,1)
287                         fprintf(fid, '%s\n----------\n', real_files(h).
                                name);
288                         cm = confusionmat(act{h},pred{h});
289                         cm_sum = cm_sum + cm;
290                         for ii = 1:size(cm,1)
291                             for jj = 1:size(cm,2)
292                                 fprintf(fid, '%d ', cm(ii,jj));
293                             end
294                             fprintf(fid, '\n');
295                         end
```

```
296                         end
297                         fclose(fid);
298
299                         % Calculate metrics with the sum of confusion
                                matrices
300                         accs_sum = CCR.calculateMetric(cm_sum) * 100;
301                         gms_sum = GM.calculateMetric(cm_sum) * 100;
302                         mss_sum = MS.calculateMetric(cm_sum) * 100;
303                         maes_sum = MAE.calculateMetric(cm_sum);
304                         amaes_sum = AMAE.calculateMetric(cm_sum);
305                         maxmaes_sum = MMAE.calculateMetric(cm_sum);
306                         spearmans_sum = Spearman.calculateMetric(cm_sum);
307                         kendalls_sum = Tkendall.calculateMetric(cm_sum);
308                         wkappas_sum = Wkappa.calculateMetric(cm_sum);
309                         results_matrix_sum = [accs_sum; gms_sum; mss_sum;
                                maes_sum; amaes_sum; maxmaes_sum; spearmans_sum
                                ; kendalls_sum; wkappas_sum; sum(times(1,:));
                                sum(times(2,:)); sum(times(3,:))];
310
311                         results_matrix_sum = results_matrix_sum';
312                     end
313
314
315                     means = mean(results_matrix,1);
316                     stdev = std(results_matrix,0,1);
317
318                     if opt.train
319                         if ~exist([experiment_folder '/' 'mean-
                                results_train.csv'],'file')
320                             add_head = 1;
321                         else
322                             add_head = 0;
323                         end
324                         fid = fopen([experiment_folder '/' 'mean-
                                results_train.csv'],'at');
325                     else
326                         if ~exist([experiment_folder '/' 'mean-results_test
                                .csv'],'file')
327                             add_head = 1;
328                         else
329                             add_head = 0;
330                         end
331                         fid = fopen([experiment_folder '/' 'mean-
                                results_test.csv'],'at');
332                     end
333
334
335                     if add_head
336                         fprintf(fid, 'Dataset-Experiment,');
337
338                         for h = 2:numel(names)
339                             fprintf(fid, 'Mean%s,Std%s,', names{h},names{h
                                    });
```

```
340                         end
341                         fprintf(fid,'\n');
342                     end
343
344
345
346                     fprintf(fid, '%s,', experiments(i).name);
347                     for h = 1:numel(means)
348                         fprintf(fid, '%f,%f,', means(h), stdev(h));
349                     end
350                     fprintf(fid,'\n');
351                     fclose(fid);
352
353
354                     %Confusion matrices and sum of confusion matrices
355                     if opt.report_sum
356                         if opt.train
357                             fid = fopen([experiment_folder '/' 'mean-
                                    results_matrices_sum_train.csv'],'at');
358                         else
359                             fid = fopen([experiment_folder '/' 'mean-
                                    results_matrices_sum_test.csv'],'at');
360                         end
361
362                         if add_head
363                             fprintf(fid, 'Dataset-Experiment,');
364
365                             for h = 2:numel(names)
366                                 fprintf(fid, '%s,', names{h});
367                             end
368                             fprintf(fid,'\n');
369                         end
370
371                         fprintf(fid, '%s,', experiments(i).name);
372                         for h = 1:numel(results_matrix_sum)
373                             fprintf(fid, '%f,', results_matrix_sum(h));
374                         end
375                         fprintf(fid,'\n');
376                         fclose(fid);
377                     end
378
379                 end
380
381             end
382             rmpath(fullfile(fileparts(which('Utilities.m')),'Measures'));
383             rmpath(fullfile(fileparts(which('Utilities.m')),'Algorithms'));
384
385
386         end
387
388         function logsDir = configureExperiment(expFile,dirSuffix)
389             %CONFIGUREEXPERIMENT Function for setting the configuration of
                    the
```

```
390             %   different experiments.
391             %   LOGSDIR = CONFIGUREEXPERIMENT(EXPFILE,DIRSUFFIX) parses
                    EXPFILE and
392             %       generates single experiment files describing individual
                     experiment
393             %       of each fold. It also creates folders to store
                    predictions
394             %       and models for all the partitions. All the resources
                    are
395             %       created int exp-DIRSUFFIX folder.
396             if( ~(exist(expFile,'file')))
397                 error('The file %s does not exist\n',expFile);
398             end
399
400             logsDir = ['Experiments' '/' 'exp-' dirSuffix];
401             resultsDir = [logsDir '/' 'Results'];
402             if ~exist('Experiments','dir')
403                 mkdir('Experiments');
404             end
405             mkdir(logsDir);
406             mkdir(resultsDir);
407
408             %Load and parse conf file
409             cObj = Config(expFile);
410
411             num_experiment = numel(cObj.exps);
412             for e = 1:num_experiment
413                 expObj = cObj.exps{e};
414
415                 id_experiment = expObj.expId;
416                 directory = expObj.general('basedir');
417                 if ~(exist(directory,'dir'))
418                     error('Datasets directory "%s" does not exist',
                            directory)
419                 end
420
421                 archive = 'matlab';
422                 if isKey(expObj.general,'archive')
423                     archive = expObj.general('archive');
424                 end
425
426                 TFGFileReadClass().Valid_archive(archive);
427
428                 datasets = expObj.general('datasets');
429                 conf_file = [logsDir '/' 'exp-' id_experiment];
430                 [matchstart,matchend,tokenindices,matchstring,tokenstring,
                        tokenname,datasetsList] = regexpi(datasets,',');
431                 %Check that all datasets partitions are accesible
432                 %The method checkDatasets calls error
433                 Utilities.checkDatasets(directory, datasets, archive);
434
435                 [train, test] = Utilities.processDirectory(directory,
                        datasetsList,archive);
```

```
436
437                 % Generate one config file and corresponding directories
438                 % for each fold.
439                 for i=1:numel(train)
440                     aux_directory = [resultsDir '/' datasetsList{i} '-'
                            id_experiment];
441                     mkdir(aux_directory);
442
443                     mkdir([aux_directory '/' 'OptHyperparams']);
444                     mkdir([aux_directory '/' 'Times']);
445                     mkdir([aux_directory '/' 'Models']);
446                     mkdir([aux_directory '/' 'Predictions']);
447                     mkdir([aux_directory '/' 'Guess']);
448
449                     file = [resultsDir '/' datasetsList{i} '-'
                            id_experiment '/' 'dataset'];
450                     fich = fopen(file,'w');
451                     fprintf(fich, [directory '/' datasetsList{i} '/'
                            archive]);
452                     fclose(fich);
453
454                     runfolds = numel(train{i});
455                     for j=1:runfolds
456                         iniFile = [conf_file '-' datasetsList{i} '-'
                                num2str(j) '.ini'];
457
458                         expObj.general('directory') = [directory '/'
                                datasetsList{i} '/' archive];
459                         expObj.general('train') = train{i}(j).name;
460                         expObj.general('test') = test{i}(j).name ;
461                         expObj.general('results') = [resultsDir '/'
                                datasetsList{i} '-' id_experiment];
462
463                         expObj.writeIni(iniFile);
464                     end
465                 end
466             end
467         end
468
469         function runExperimentFold(confFile)
470             %RUNEXPERIMENTFOLD(CONFFILE) launch a single experiment
                    described in
471             %   file CONFFILE
472             addpath(fullfile(fileparts(which('Utilities.m')),'Measures'));
473             addpath(fullfile(fileparts(which('Utilities.m')),'Algorithms'))
                    ;
474
475             auxiliar = Experiment;
476             auxiliar.launch(confFile);
477
478             rmpath(fullfile(fileparts(which('Utilities.m')),'Measures'));
479             rmpath(fullfile(fileparts(which('Utilities.m')),'Algorithms'));
480
```

```
481         end
482     end
483
484     methods(Static = true, Access = private)
485
486         function [trainFileNames, testFileNames] = processDirectory(
                directory, dataSetNames, archive)
487             %PROCESSDIRECTORY Function to get all the train and test pair
                    of
488             %   files of dataset's folds
489             %   [TRAINFILENAMES, TESTFILENAMES] = PROCESSDIRECTORY(
                    DIRECTORY, DATASETNAMES)
490             %   process comma separated list of datasets names in
                    DATASETNAMES.
491             %   All the dataset's folders need to be stored in DIRECTORY.
492             %   Returns all the pairs of train-test files in TRAINFILENAMES
                     and
493             %   TESTFILENAMES.
494             %   [TRAINFILENAMES, TESTFILENAMES] = PROCESSDIRECTORY(
                    DIRECTORY,
495             %   'all') process all datasets in DIRECTORY.
496             dbs = dir(directory);
497             dbs(2) = [];
498             dbs(1) = [];
499             validDataSets = 1;
500
501             trainFileNames = cell(numel(dataSetNames),1);
502             testFileNames = cell(numel(dataSetNames),1);
503             for j=1:numel(dataSetNames)
504                 dsdirectory = [directory '/' dataSetNames{j}];
505                 if(isdir(dsdirectory))
506                     [trainFileNames{validDataSets},testFileNames{
                            validDataSets}] = ...
507                         TFGFileReadClass().TFGFileName(dsdirectory, archive
                                , dataSetNames{j});
508
509                     validDataSets = validDataSets + 1;
510                 end
511             end
512         end
513
514         function checkDatasets(basedir, datasets, archive)
515             %CHECKDATASETS Test datasets are accessible and with expected
516             %names. Launch error in case a dataset is not found.
517             %   CHECKDATASETS(BASEDIR, DATASETS) tests all DATASETS (comma
518             %   separated list of datasets) in directory BASEDIR.
519
520             if ~exist(basedir,'dir')
521                 error('Datasets directory "%s" does not exist', basedir)
522             end
523
524             dsdirsCell = regexp(datasets, '((\w|-|_)+(\w*))','tokens');
525             for i=1:length(dsdirsCell) %skip . and ..
```

```
526                 dsName = dsdirsCell{i};
527                 dsName = dsName{:};
528                 if ~exist([basedir '/' dsName],'dir')
529                     error('Dataset directory "%s" does not exist', [basedir
                            '/' dsName])
530                 end
531
532                 datasetPath = [basedir '/' dsName '/' archive];
533                 dsTrainFiles = dir([datasetPath '/train*']);
534
535                 % Test every train file has a test file
536                 for f=1:length(dsTrainFiles)
537
538                     trainName = dsTrainFiles(f).name;
539                     testName = strrep(trainName, 'train', 'test');
540
541                     cellData = TFGFileReadClass().ReadFile(datasetPath,
                            trainName,0);
542                     trainData = [cellData.patterns cellData.targets];
543                     cellData = TFGFileReadClass().ReadFile(datasetPath,
                            testName,0);
544                     testData = [cellData.patterns cellData.targets];
545
546                     if size(trainData,2) ~= size(testData,2)
547                         error('Train and test data dimensions do not agree
                                for dataset "%s"', dsName)
548                     end
549
550                 end
551             end
552
553         end
554
555         function preparePool(numcores)
556             %PREPAREPOOL(NUMCORES) creates a pool of workers. Function to
557             %abstract code from different matlab versions. Adapt the pool
558             %to the desired number of cores. If there is a current pool
                    with
559             %desired number of cores do not open again to save time
560             if (exist ('OCTAVE_VERSION', 'builtin') > 0)
561                 maximum_ncores = nproc;
562             else
563                 maximum_ncores = feature('numCores');
564             end
565
566             % Adjust number of cores
567             if numcores > maximum_ncores
568                 disp(['Number of cores was too high and was set up to the
                        maximum available: ' num2str(feature('numCores')) ])
569                 numcores = maximum_ncores;
570             end
571
572             % Check size of the pool
```

```
573             if (exist ('OCTAVE_VERSION', 'builtin') > 0)
574                 pkg load parallel;
575             else
576                 if verLessThan('matlab', '8.3')
577                     poolsize = matlabpool('size');
578                     if poolsize > 0
579                         if poolsize ~= numcores
580                             matlabpool close;
581                             matlabpool(numcores);
582                         end
583                     else
584                         matlabpool(numcores);
585                     end
586                 else
587                     poolobj = gcp('nocreate'); % If no pool, do not create
                        new one.
588                     if ~isempty(poolobj)
589                         if poolobj.NumWorkers ~= numcores
590                             numcores = poolobj.NumWorkers;
591                             delete(gcp('nocreate'))
592                             parpool(numcores);
593                         end
594                     else
595                         parpool(numcores);
596                     end
597                 end
598             end
599         end
600 
601         function closePool()
602             if (exist ('OCTAVE_VERSION', 'builtin') > 0)
603                 pkg unload parallel;
604             else
605                 if verLessThan('matlab', '8.3')
606                     isOpen = matlabpool('size') > 0;
607                     if isOpen
608                         matlabpool close;
609                     end
610                 else
611                     delete(gcp('nocreate'))
612                 end
613             end
614         end
615 
616         function options = parseParArgs(varargin)
617             %OPTIONS = PARSEPARARGS(VARARGIN) parses parallelization
618             %options with are:
619             %- 'parallel': 'false' or 'true' to activate, default 'false'
620             %- 'numcores': default maximum number of cores or desired
621             %    number. If parallel = 1 and numcores <2 it sets the number
622             %    to maximum number of cores.
623             %- 'closepool': whether to close or not the pool after
624             %    experiments. Default 'true'
```

```
625             % Solution adapted from https://stackoverflow.com/questions
                    /2775263/how-to-deal-with-name-value-pairs-of-function-
                    arguments-in-matlab#2776238
626
627             if (exist ('OCTAVE_VERSION', 'builtin') > 0)
628                 maximum_ncores = nproc;
629             else
630                 maximum_ncores = feature('numCores');
631             end
632
633             options = struct('parallel',false,'numcores',maximum_ncores,'
                    closepool',true);
634
635             varargin = varargin{:};
636             if ~isempty(varargin)
637                 options = parsevarargs(options, varargin);
638                 if options.parallel && options.numcores <2
639                     disp('Number of cores to low, setting to default number
                            of cores')
640                     options.numcores = maximum_ncores;
641                 end
642             end
643         end
644
645     end
646 end
```

Código 2.1: Archivo *Utilities.m* correspondiente al módulo ORCA

2.2. Clase Dataset

```
classdef DataSet < handle
    %DATASET Class to specify the name of the datasets and perform data preprocessing
    %
    %   This file is part of ORCA: https://github.com/ayrna/orca
    %   Original authors: Pedro Antonio GutiÃ©rrez, MarÃa PÃ©rez Ortiz, Javier SÃ¡nchez Monedero
    %   Citation: If you use this code, please cite the associated paper http://www.uco.es/grupos/ayrna/orreview
    %   Copyright:
    %       This software is released under the The GNU General Public License v3.0 licence
    %       available at http://www.gnu.org/licenses/gpl-3.0.html

    properties
        directory = '';
        train = '';
        test = '';
        standarize = true;
        dataname = '';
        nOfFolds = 5;
    end

    methods
        function obj = dataSet(direct)
            if(nargin ~= 0)
                obj.directory = direct;
            end
        end


        function obj = set.directory(obj,direc)
            if isdir(direc)
                obj.directory = direc;
            else
                error('%s --> Not a directory', direc);
            end
        end

        function [trainSet, testSet] = preProcessData(obj,method)
        %PREPROCESSDATA preprocess a data partition, i.e., deletes the constant
        %   and non numerical atributes and standarize the data. Test set
        %   is standardised using train mean and standard error.
        %   [TRAINSET, TESTSET] = PREPROCESSDATA() preprocess dataset and
        %   returns the preprocessed patterns in TRAINSET and TESTSET.

            if(exist([obj.directory '/' obj.train], 'file') && exist([obj.directory '/' obj.test], 'file'))
                obj.dataname = strrep(obj.train, 'train_', '');
```

```
                trainSet = TFGFileReadClass().ReadFile(obj.directory,obj.train,method.categ);
                testSet = TFGFileReadClass().ReadFile(obj.directory,obj.test,method.categ);

                if(obj.standarize)
                    %[trainSet, testSet] = obj.deleteNonNumericValues(trainSet, testSet);
                    [trainSet, testSet] = obj.deleteConstantAtributes(trainSet,testSet);
                    [trainSet, testSet] = obj.standarizeData(trainSet,testSet);
                    %[trainSet, testSet] = obj.scaleData(trainSet,testSet);
                end


                datasetname=[obj.directory '/' obj.train];
                [matchstart,matchend] = regexpi(datasetname,'/');
                trainSet.name = datasetname(matchend(end)+1:end);

                datasetname=[obj.directory '/' obj.test];
                [matchstart,matchend] = regexpi(datasetname,'/');
                testSet.name = datasetname(matchend(end)+1:end);
            else
                error('Can not find the files');
            end
        end


    end
    methods (Static = true)

        %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
        %
        % Function: standarizeData (static)
        % Description:
        % Type: It returns the standarized patterns (train and test)
        % Arguments:
        %           trainSet--> Array of training patterns
        %           testSet--> Array of testing patterns
        %
        %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

        function [trainSet, testSet] = standarizeData(trainSet,testSet)
        %STANDARIZEDATA standarizes a set of training and testing patterns.
        %   [TRAINSET, TESTSET] = STANDARIZEDATA(TRAINSET,TESTSET)
        %   standarizes TRAINSET and TESTSET with TRAINSET mean and std.
            [trainSet.patterns, trainMeans, trainStds] = DataSet.standarizeFunction(trainSet.patterns);
            testSet.patterns = DataSet.standarizeFunction(testSet.patterns,trainMeans,trainStds);
        end
```

```
90
91          function [XN, XMeans, XStds] = standarizeFunction(X,XMeans,XStds)
92          %STANDARIZEFUNCTION standardises data with patterns stored in rows
                .
93          %   [XN, XMeans, XStds] = standarizeFunction(X) standardises X
94          %   using X mean and std. Returns normalised data in XN and
95          %   calculated mean and std in XMEANS and XSTDS respectively
96          %   [XN, XMeans, XStds] = standarizeFunction(X,XMeans,XStds)
                standardises X
97          %   using XMeans as mean and XStds as std.
98
99              if (nargin<3)
100                 XStds = std(X);
101             end
102             if (nargin<2)
103                 XMeans = mean(X);
104             end
105             XN = zeros(size(X));
106             for i=1:size(X,2)
107                 XN(:,i) = (X(:,i) - XMeans(i)) / XStds(i);
108             end
109         end
110
111         function [trainSet, testSet] = scaleData(trainSet,testSet)
112         %SCALEDATA scales a set of training and testing patterns.
113         %   [TRAINSET, TESTSET] = SCALEDATA(TRAINSET,TESTSET)
114         %   scales TRAINSET and TESTSET.
115             for i = 1:size(trainSet.patterns,1)
116                 for j = 1:size(trainSet.patterns,2)
117                     trainSet.patterns(i,j) = 1/(1+exp(-trainSet.patterns(i,
                            j)));
118                 end
119             end
120             for i = 1:size(testSet.patterns,1)
121                 for j = 1:size(testSet.patterns,2)
122                     testSet.patterns(i,j) = 1/(1+exp(-testSet.patterns(i,j)
                            ));
123                 end
124             end
125         end
126
127         function [trainSet, testSet] = deleteNonNumericValues(trainSet,
                testSet)
128         %DELETENONNUMERICVALUES This function deletes non numerical values
129         %   in the data, as NaN or Inf.
130         %   [TRAINSET, TESTSET] = DELETENONNUMERICVALUES(TRAINSET,TESTSET)
131         %   performs data cleaning on arrays of patterns TRAINSET and
                TESTSET. Returns
132         %   processed matrices.
133
134             [fils,cols]=find(isnan(trainSet.patterns) | isinf(trainSet.
                    patterns));
135             cols = unique(cols);
```

```
136             for a = size(cols):-1:1
137                trainSet.patterns(:,cols(a)) = [];
138             end
139
140             [fils,cols]=find(isnan(trainSet.targets) | isinf(trainSet.
                    targets));
141             cols = unique(cols);
142             for a = size(cols):-1:1
143                trainSet.patterns(:,cols(a)) = [];
144             end
145
146             [fils,cols]=find(isnan(testSet.patterns) | isinf(testSet.
                    patterns));
147             cols = unique(cols);
148             for a = size(cols):-1:1
149                testSet.patterns(:,cols(a)) = [];
150             end
151
152             [fils,cols]=find(isnan(testSet.targets) | isinf(testSet.targets
                    ));
153             cols = unique(cols);
154             for a = size(cols):-1:1
155                testSet.patterns(:,cols(a)) = [];
156             end
157
158         end
159
160         function [trainSet,testSet] = deleteConstantAtributes(trainSet,
                testSet)
161         %DELETECONSTANTATRIBUTES This function deletes constant variables
162         %   [TRAINSET, TESTSET] = DELETECONSTANTATRIBUTES(TRAINSET,TESTSET)
163         %   performs data cleaning on arrays of patterns TRAINSET and
                TESTSET. Returns
164         %   processed matrices.
165
166             all = [trainSet.patterns ; testSet.patterns];
167
168             minvals = min(all);
169             maxvals = max(all);
170
171             r = 0;
172             for k=1:size(trainSet.patterns,2)
173                 if minvals(k) == maxvals(k)
174                     r = r + 1;
175                     index(r) = k;
176                 end
177             end
178
179             if r > 0
180                r = 0;
181                for k=1:size(index,2)
182                     trainSet.patterns(:,index(k)-r) = [];
183                     testSet.patterns(:,index(k)-r) = [];
```

```
184                         r = r + 1;
185                     end
186                 end
187             end
188         end
189 end
```

CÓDIGO 2.2: Archivo *Dataset.m* correspondiente al módulo ORCA

3 Módulo Read File

3.1. Clase TFGFileReadClass

```
1 classdef TFGFileReadClass
2     properties (Access = private)
3         path = fullfile(fileparts(which('TFGFileReadClass.m')),'
              TFGReadFiles');
4     end
5
6     methods
7         function Valid_archive(obj,archive)
8             addpath(obj.path);
9
10            if exist(fullfile(obj.path,[lower(strtrim(archive)) '.m']),'
                  file') ~= 2 || strcmpi(archive,'ReadFileCommon')
11                error('"%s" unsupported file type', archive)
12            end
13
14            rmpath(obj.path);
15        end
16
17        function datas = ReadFile(obj,directory,file,cat)
18            addpath(obj.path);
19
20            folders = strsplit(directory,'/');
21            archive = char(folders(end));
22
23            TFGReadFiles = feval(archive);
24            raw = [directory '/' file];
25            datas = TFGReadFiles.ReadFileFunction(raw,cat);
26
27            rmpath(obj.path);
28        end
```

```
29
30          function [trainFileName,testFileName] = TFGFileName(obj,dsdirectory
                ,archive,dataSetName)
31              addpath(obj.path);
32
33              format = feval(archive);
34              [trainFileName,testFileName] = format.FormatFile(dsdirectory,
                    archive,dataSetName);
35
36              rmpath(obj.path);
37          end
38      end
39
40      methods (Static, Access = private)
41          function cols = SearchInvalidValue(datas)
42              [~,cols] = find(isnan(datas) | isinf(datas));
43          end
44      end
45  end
```

Código 3.1: Archivo *TFGFileReadClass.m* correspondiente al módulo Read File

3.2. Clase ReadFileCommon

```
1 classdef ReadFileCommon < handle
2     properties
3         info = [];
4         categ_att = [];
5     end
6
7     properties (Access = protected)
8         categ = 0;
9     end
10
11    methods
12        function [trainFileName,testFileName] = FormatFile(obj,dsdirectory,
              archive,dataSetName)
13            [file_train_expr, file_test_expr] = obj.Format(dataSetName);
14
15            file_expr = [dsdirectory '/' archive '/' file_train_expr];
16            trainFileName = dir(file_expr);
17            file_expr = [dsdirectory '/' archive '/' file_test_expr];
18            testFileName = dir(file_expr);
19        end
20
21        function [file_train_expr, file_test_expr] = Format(obj,dataSetName
              )
22            error('format should be implemented in all subclasses');
23        end
24
25        function datas = ReadFileFunction(obj,file,cat)
26            obj.categ = cat;
27            try
28                datas = obj.ReadFile(file);
29            catch ME
30                error('Cannot read file "%s" \n %s', file, ME.message)
31            end
32            datas = obj.deleteNonNumericValues(datas);
33
34            datas.info.personal = obj.info;
35            datas.info.utilities.type = class(obj);
36            datas.info.utilities.categ_att = obj.categ_att;
37        end
38
39        function datas = ReadFile(obj,file)
40            error('ReadFile method should be implemented in all subclasses'
                  );
41        end
42    end
43
44    methods (Access = private)
45        function datas = deleteNonNumericValues(obj,datas)
46            % Search invalid data on targets
```

```
47              [fils,cols] = find(isnan(datas.targets) | isinf(datas.targets))
                    ;
48              del = fils;
49
50              if obj.categ == 0 || ~iscell(datas.patterns)
51                  %Search invalid data on patterns
52                  [fils,cols] = find(isnan(datas.patterns) | isinf(datas.
                        patterns));
53                  del = unique([del;fils]);
54
55              else
56                  for i = 1:size(datas.patterns,1)
57                      for j = 1:size(datas.patterns,2)
58                          if ~ischar(datas.patterns{i,j}) && isnan(datas.
                                patterns{i,j})
59                              del = [del;i];
60                          end
61                      end
62                  end
63                  del = unique(del);
64              end
65
66              if isempty(del)
67                  return;
68              end
69
70              %Delete lines whit invalid data
71              datas.targets(del,:) = [];
72              datas.patterns(del,:) = [];
73          end
74      end
75  end
```

Código 3.2: Archivo *ReadFileCommon.m* correspondiente al módulo Read File

3.3. Clase matlab

```
1 classdef matlab < ReadFileCommon
2     methods
3         function [file_train_expr, file_test_expr] = Format(obj,dataSetName
              )
4             file_train_expr = ['train_' dataSetName '.*'];
5             file_test_expr = ['test_' dataSetName '.*'];
6         end
7
8         function datas = ReadFile(obj,file)
9             raw = load(file);
10
11            datas.targets = raw(:,end);
12            datas.patterns = raw(:,1:end-1);
13        end
14    end
15 end
```

CÓDIGO 3.3: Archivo *matlab.m* correspondiente al módulo Read File

3.4. Clase weka

```
1 classdef weka < ReadFileCommon
2     properties
3         attrs = [];
4     end
5
6     methods
7         function [file_train_expr, file_test_expr] = Format(obj,dataSetName
              )
8             file_train_expr = ['train_' dataSetName '-*.arff'];
9             file_test_expr = ['test_' dataSetName '-*.arff'];
10        end
11
12        function datas = ReadFile(obj,file)
13            [datas.patterns, datas.targets] = obj.ReadWekaFile(file);
14            obj.info.attrs = obj.attrs;
15        end
16    end
17
18    methods (Access = private)
19        function [patterns,targets] = ReadWekaFile(obj,file_name)
20            file = fopen(file_name, 'rt');
21
22            %Read header
23            obj.ReadHeader(file);
24
25            %Read datas
26            [patterns,targets] = obj.ReadDatas(file);
27
28            fclose(file);
29        end
30
31        function ReadHeader(obj,file)
32            while ~feof(file)
33                line = fgetl(file);
34
35                if ~isempty(line)
36                    vec = strsplit(line,' ');
37                    if strcmpi(vec(1),'@attribute')
38                        %Check if attribute have a name
39                        %and type
40                        if length(vec) < 3
41                            error('Attribute incorrect.');
42                        end
43
44                        %Read name and type
45                        name = vec(2);
46                        aux = strcat(name,{' '});
47                        aux = aux{1};
48                        ini = length(aux) + 12;
49                        type = lower(line(ini:end));
```

```
50
51                      %Add attribute
52                      obj.NewAttribute(name,type);
53                  elseif strcmpi(vec(1),'@data')
54                      if length(obj.attrs) < 2
55                          error('Need more attributes.');
56                      end
57                      return;
58                  end
59              end
60          end
61          error('Unrecognized as WEKA format.')
62      end
63
64      function NewAttribute(obj,name,type)
65          %Comprobar que no exista el nombre en otro atributo
66          if ~isempty(obj.attrs)
67              if ismember(name,[obj.attrs.name])
68                  error('Attributes with same name.');
69              end
70          end
71
72          %Comprobar el tipo de atributo
73          info = [];
74          if ~strcmp(type,'numeric')
75              indexL = strfind(type,'{');
76              indexR = strfind(type,'}');
77              if length(indexL) == 1 && length(indexR) == 1 && indexL ==
                    1 && indexR == length(type)
78                  type = strrep(type(2:length(type)-1),' ','');
79                  [info,num] = strsplit(type,',');
80                  for i = num
81                      if length(i{1}) ~= 1
82                          error('Categoric attribute without type.');
83                      end
84                  end
85                  type = 'categoric';
86              else
87                  error('Attributes should be numeric or categoric.');
88              end
89          end
90
91          %Guardar los datos
92          aux.name = name;
93          aux.type = type;
94          aux.info = info;
95          obj.attrs = [obj.attrs;aux];
96      end
97
98      function [patterns,targets] = ReadDatas(obj,file)
99          %Leer los datos
100         datas = [];
101         while ~feof(file)
```

```
102                 line = fgetl(file);
103                 line = strrep(line,' ','');
104                 if ~isempty(line)
105                     att_datas = strsplit(line,',');
106                     datas = [datas;att_datas];
107                 end
108             end
109             datas = lower(datas);
110 
111             if isempty(datas)
112                 error('No data found.');
113             end
114 
115             %Guardar las entradas
116             patterns_aux = datas(:,1:end-1);
117             patterns = [];
118             att_aux = [];
119             for i = 1:size(patterns_aux,2)
120                 if strcmp(obj.attrs(i).type,'categoric')
121                     if obj.categ == 0
122                         [patt,atti] = obj.ToOneHot(patterns_aux(:,i),obj.
                                attrs(i));
123                         patterns = [patterns patt];
124                         att_aux = [att_aux;atti];
125                     else
126                         aux = patterns_aux(:,i);
127                         elements = obj.attrs(i).info;
128                         [k,~] = obj.Categoric_to_Numeric(aux,elements);
129                         aux(find(isnan(k),1)) = {NaN};
130 
131                         patterns = [patterns aux];
132                         att_aux = [att_aux;obj.attrs(i)];
133                     end
134                 elseif strcmp(obj.attrs(i).type,'numeric')
135                     line_aux = zeros(length(patterns_aux(:,i)),1);
136                     for j = 1:length(line_aux)
137                       line_aux(j) = str2double(patterns_aux(j,i));
138                     end
139                     if obj.categ == 0
140                         patterns = [patterns line_aux];
141                         att_aux = [att_aux;obj.attrs(i)];
142                     else
143                         aux = patterns_aux(:,i);
144                         aux(find(isnan(line_aux),1)) = {NaN};
145                         patterns = [patterns aux];
146                         att_aux = [att_aux;obj.attrs(i)];
147                     end
148                 else
149                     error('Attribute type no valid.');
150                 end
151             end
152             obj.attrs = [att_aux;obj.attrs(end)];
153 
```

```
154             % Gardar las salidas
155             datas = datas(:,end);
156             att = obj.attrs(end);
157             [targets,obj.attrs(end)] = obj.ToNumeric(datas,att);
158         end
159
160         function [datas,attnew] = ToOneHot(obj,patterns,att)
161             % Convert datas
162             datas = zeros(size(patterns,1),size(att.info,2));
163             for i = 1:size(datas,1)
164                 for j = 1:size(datas,2)
165                     datas(i,j) = double(strcmp(patterns{i},att.info{j}));
166                 end
167             end
168
169             % Check all values are valids
170             ind = ~sum(datas,2);
171             datas(ind,:) = NaN;
172
173             % Update attribute
174             attnew = [];
175             for i = 1:size(att.info,2)
176                 att_aux.type = 'categoric';
177                 att_aux.name = strcat(att.name,'_',int2str(i));
178                 att_aux.info = ['0' '1'];
179                 attnew = [attnew;att_aux];
180             end
181         end
182
183         function [datas,att] = ToNumeric(obj,datas,att)
184             if strcmpi(att.type,'numeric')
185                 line_aux = zeros(size(datas));
186                 for j = 1:size(line_aux,1)
187                   line_aux(j) = str2double(datas(j));
188                 end
189                 datas = line_aux;
190             elseif strcmpi(att.type,'categoric')
191                 elements = att.info;
192                 [datas,convert] = obj.Categoric_to_Numeric(datas,elements);
193                 att.info = convert;
194             end
195         end
196
197         function [final_datas,targets_type] = Categoric_to_Numeric(obj,
            datas,elements)
198             % Apuntar la conversion
199             targets_type.cat = elements;
200             targets_type.num = 1:length(elements);
201
202             % Convertir los datos
203             final_datas = zeros(size(datas,1),size(targets_type.cat,2));
204             for i = 1:size(final_datas,1)
205                 for j = 1:size(final_datas,2)
```

```
206                         final_datas(i,j) = double(strcmp(datas{i},targets_type.
                                cat{j}));
207                     end
208                 end
209                 final_datas = final_datas * targets_type.num';
210
211                 % Comprobar que ninguno sea un valor no valido
212                 ind = ~sum(final_datas,2);
213                 final_datas(ind,:) = NaN;
214             end
215         end
216 end
```

Código 3.4: Archivo *weka.m* correspondiente al módulo Read File

4 Módulo Algorithms

4.1. Clase Algorithm

```
1 classdef Algorithm < handle
2     %ALGORITHM abstract interface class. Abstract class which defines the
3     %settings for the algorithms (common methods and variables).
4     %
5     %   This file is part of ORCA: https://github.com/ayrna/orca
6     %   Original authors: Pedro Antonio GutiÃ©rrez, MarÃa PÃ©rez Ortiz,
          Javier SÃ¡nchez Monedero
7     %   Citation: If you use this code, please cite the associated paper
          http://www.uco.es/grupos/ayrna/orreview
8     %   Copyright:
9     %       This software is released under the The GNU General Public
          License v3.0 licence
10    %       available at http://www.gnu.org/licenses/gpl-3.0.html
11
12    properties
13        model = [];
14        categ = false;
15    end
16
17    methods
18        function mInf = runAlgorithm(obj,train, test, param)
19            %RUNALGORITHM runs the corresponding algorithm, fitting the
20            %model and testing it in a dataset.
21            %   mInf = RUNALGORITHM(OBJ, TRAIN, TEST, PARAMETERS) learns a
22            %   model with TRAIN data and PARAMETERS as hyper-parameter
23            %   structure of values for the method. It tests the
24            %   generalization performance with TRAIN and TEST data and
25            %   returns predictions and model in mInf structure.
26            if nargin == 3
27                param = [];
```

```
28              else
29                  %Mix parameters with default
30                  obj.setParam(param)
31              end
32              param = obj.parameters;
33
34              c1 = clock;
35              [mInf.projectedTrain, mInf.predictedTrain] = obj.fit(train,
                    param);
36              %Save the model type
37              obj.model.algorithm = class(obj);
38              c2 = clock;
39              mInf.trainTime = etime(c2,c1);
40
41              c1 = clock;
42              [mInf.projectedTest, mInf.predictedTest] = obj.predict(test.
                    patterns);
43              c2 = clock;
44              mInf.testTime = etime(c2,c1);
45              mInf.model = obj.model;
46          end
47
48          function [projectedTrain, predictedTrain] = fit( obj,train,param)
49          %FIT trains the model for the Algorithm method with TRAIN data and
50          %vector of parameters PARAMETERS. Returns the projection of
51          %patterns (only valid for thresshold models) and the predictel
                labels.
52          %The model can be accessed thourgh getModel() method.
53              if nargin < 3
54                  param = [];
55                  if nargin < 2
56                      error('Please provide training data')
57                  end
58              end
59              if ~all(isfield(train, {'patterns','targets'}))
60                  error('Please provide a structure with train patterns and
                        targets')
61              end
62              %check that dimensions agree
63              if ~size(train.patterns,1) == size(train.targets,1)
64                  error('Number of train patterns and targets must agree')
65              end
66
67              [projectedTrain, predictedTrain] = obj.privfit(train, param);
68          end
69
70          function [projected, predicted]= predict(obj,test)
71          %PREDICT predicts labels of TEST patterns labels using fitted
                MODEL.
72              %Check if there is a model
73              if isempty(obj.model)
74                  error('The object does not have a fitted model')
75              end
```

```
76              %Avoid typicall error of passing a structure instead of
77              %the matrix of independent variables
78              if ~obj.categ && ~isa(test,'double')
79                  error('test parameter has to be a matrix')
80              end
81
82              [projected, predicted]= privpredict(obj,test);
83          end
84
85          %Abstract methods: they have been implemented in this way to
86          %ensure compatibility with Octave. An error is thrown if the
                method
87          %is not implemented in child class.
88
89          function [projectedTrain, predictedTrain] = privfit( obj,train,
                param)
90              %PRIVFIT trains the model for the Algorithm method. It is
                    called by
91              %super-class Algorithms's 'fit' function. This method is
                    public, but
92              %should not be called by the user.
93              error('train method should be implemented in all subclasses');
94          end
95
96          function [projected, predicted]= privpredict(obj,test)
97              %PREDICT predicts labels of TEST patterns labels using fitted
                    MODEL.
98              %It is called by super-class Algorithms's 'predict' function.
99              %This method is public, but should not be called by the user.
100             error('test method should be implemented in all subclasses');
101         end
102
103         function parseArgs(obj,varargin)
104             %PARSEARGS(VARARGIN) parses a pair of keys-values in matlab
105             %style format. It throws different exceptions if the field
                    does
106             %not exits on the class or if the type assignement is not
                    consistent.
107             if ~isempty(varargin) && ~isempty(varargin{1})
108                 while iscell(varargin{1})
109                     varargin = varargin{1};
110                     if isempty(varargin{1})
111                         return
112                     end
113                 end
114
115                 %# read the acceptable names
116                 optionNames = fieldnames(obj);
117
118                 %# count arguments
119                 nArgs = length(varargin);
120                 if mod(nArgs,2)
```

```
121                     error('parseParArgs needs propertyName/propertyValue
                            pairs')
122                 end
123
124                 for pair = reshape(varargin,2,[]) %pair is {propName;
                        propValue}
125                     inpName = pair{1}; %make case insensitive
126
127                     if any(strcmp(inpName,optionNames))
128                         %overwrite properties.
129                         %check type
130                         if strcmp(class(obj.(inpName)), class(pair{2}))
131                             obj.(inpName) = pair{2};
132                         else
133                             %Check boolean
134                             if islogical(obj.(inpName)) && ...
135                                     (strcmp(pair{2},'true') || strcmp(pair
                                            {2},'false'))
136                                 obj.(inpName) = eval(pair{2});
137                             else
138                                 msg = sprintf('Data type of property ''%s''
                                        (%s) not compatible with data type (%s
                                        ) of assigned value in configuration
                                        file', ...
139                                     inpName, class(obj.(inpName)), class(
                                            pair{2}));
140                                 error(msg);
141                             end
142                         end
143                     else
144                         error('Error ''%s'' is not a recognized class
                                property name',inpName)
145                     end
146                 end
147             end
148         end
149
150         function setParam(obj,param)
151             %SETPARAM(PARAM) set parameters contained in param and keep
                    default
152             %values of class parameters field. It throws different
                    exceptions if
153             %the field does not exits on the class or if the type
                    assignement is not consistent.
154             %paramNames = fieldnames(obj.parameters);
155
156             %Ignore empty argument
157             if isempty(param)
158                 return
159             end
160             if ~isstruct(param)
161                 error('parameters variable have to be a structure')
162             end
```

```
163             paramNames = fieldnames(param);
164
165             for i = 1:length(paramNames)
166                 inpName = paramNames{i};
167                 if isfield(obj.parameters,inpName)
168                     %check type
169                     if strcmp(class(obj.parameters.(inpName)), class(param
                            .(inpName)))
170                         obj.parameters.(inpName) = param.(inpName);
171                     else
172                         %Check boolean
173                         if islogical(obj.parameters.(inpName)) && ...
174                                 (strcmp(param.(inpName),'true') || strcmp(
                                        param.(inpName),'false'))
175                             obj.parameters.(inpName) = eval(pair{2});
176                         else
177                             msg = sprintf('Data type of property ''%s'' (%s
                                    ) not compatible with data type (%s) of
                                    assigned value in configuration file', ...
178                                 inpName, class(obj.parameters.(inpName)),
                                        class(param.(inpName)));
179                             error(msg);
180                         end
181                     end
182                 else
183                     error('Error ''%s'' is not a recognized class parameter
                            name',inpName)
184                 end
185             end
186         end
187
188         function m = getModel(obj)
189             m = obj.model;
190         end
191
192         function m = setModel(obj, m)
193             obj.model = m;
194         end
195
196         function name_parameters = getParameterNames(obj)
197             if ~isempty(obj.parameters)
198                 name_parameters = sort(fieldnames(obj.parameters));
199             else
200                 name_parameters = [];
201             end
202         end
203     end
204
205 end
```

Código 4.1: Archivo *Algorithm.m* correspondiente al módulo Algorithms

4.2. Clase NSLVOrd

```
1 classdef NSLVOrd < Algorithm
2     properties
3         description = 'Inclusion del algoritmo NSLVOrd como TFG de Federico
              Garcia-Arevalo Calles';
4         % Parameters to optimize and default value
5         parameters = struct('Seed', 1286082570, 'LabelsInputs', 5, '
              LabelsOutputs', 5,...
6                             'Shift', 35, 'Alpha', 0.5, 'Population', -1, '
                                  MaxIteration', 500,...
7                             'IniProbBin', 0.9, 'CrosProbBin', 0.25, '
                                  MutProbBin', 0.5, 'MutProbEachBin',
                                  0.17,...
8                             'IniProbInt', 0.5, 'CrosProbInt', 0.0, '
                                  MutProbInt', 0.5,'MutProbEachInt', 0.01,...
9                             'IniProbReal', 0.0, 'CrosProbReal', 0.25,'
                                  MutProbReal', 0.5, 'MutProbEachReal',
                                  0.14,...
10                            'SeeRules', 0);
11
12    end
13
14    methods (Access = private, Static)
15        function param_java = initParameters(param)
16            param_java = {...
17                num2str(param.Seed),...
18                num2str(param.LabelsInputs),...
19                num2str(param.LabelsOutputs),...
20                num2str(param.Shift),...
21                num2str(param.Alpha),...
22                num2str(param.Population),...
23                num2str(param.MaxIteration),...
24                num2str(param.IniProbBin),...
25                num2str(param.CrosProbBin),...
26                num2str(param.MutProbBin),...
27                num2str(param.MutProbEachBin),...
28                num2str(param.IniProbInt),...
29                num2str(param.CrosProbInt),...
30                num2str(param.MutProbInt),...
31                num2str(param.MutProbEachInt),...
32                num2str(param.IniProbReal),...
33                num2str(param.CrosProbReal),...
34                num2str(param.MutProbReal),...
35                num2str(param.MutProbEachReal)};
36        end
37
38        function header = getHeader(datas)
39            header = '@relation NSLVOrd';
40            if strcmp(datas.info.utilities.type,'weka')
41                for i = 1:length(datas.info.personal.attrs)-1
```

```
42                  line = strcat('@attribute',{' '},datas.info.personal.
                        attrs(i).name,{' '});
43                  if strcmp(datas.info.personal.attrs(i).type,'numeric')
44                      line = strcat(line,datas.info.personal.attrs(i).
                            type);
45                  elseif strcmp(datas.info.personal.attrs(i).type,'
                        categoric')
46                      line = strcat(line,'{',datas.info.personal.attrs(i)
                            .info(1));
47                      for j = 2:length(datas.info.personal.attrs(i).info)
48                          line = strcat(line,',',datas.info.personal.
                                attrs(i).info(j));
49                      end
50                      line = strcat(line,'}');
51                  else
52                      error('error');
53                  end
54                  header = [header;line];
55              end
56
57              line = strcat('@attribute',{' '},datas.info.personal.attrs(
                    end).name,{' '});
58              if strcmp(datas.info.personal.attrs(end).type,'numeric')
59                  error('In NSLVOrd output should be categoric');
60              elseif strcmp(datas.info.personal.attrs(end).type,'
                    categoric')
61                  line = strcat(line,'{',datas.info.personal.attrs(end).
                        info.cat(1));
62                  for j = 2:length(datas.info.personal.attrs(end).info.
                        cat)
63                      line = strcat(line,',',datas.info.personal.attrs(
                            end).info.cat(j));
64                  end
65                  line = strcat(line,'}');
66              else
67                error('In NSLVOrd output should be categoric');
68              end
69              header = [header;line];
70          else
71              for i = 1:size(datas.patterns,2)
72                  line = strcat('@attribute x',{int2str(i)},' numeric');
73                  header = [header;line];
74              end
75              aux = unique(datas.targets);
76              line = strcat('@attribute y {',num2str(aux(1)),{''});
77              for i = 2:size(aux,1)
78                  line = strcat(line,',',num2str(aux(i)));
79              end
80              line = strcat(line,'}');
81              header = [header;line];
82          end
83          header = [header;'@data'];
84      end
```

```
85
86          function datas_java = getDatas(datas)
87              [a,b] = size(datas);
88              datas_java = [];
89              for i = 1:a
90                  aux = '';
91                  for j = 1:b-1
92                      dat = datas(i,j);
93                      if strcmpi(class(dat),'double')
94                          dat = num2str(dat);
95                      end
96                      aux = strcat(aux,dat,',');
97                  end
98                  aux = strcat(aux,datas(i,b));
99                  datas_java = [datas_java;aux];
100             end
101         end
102
103         function targets = ConvertTargetsToCategoric(train)
104             if strcmp(train.info.utilities.type,'weka')
105                 trans = train.info.personal.attrs(end).info;
106                 targets_m = repmat(train.targets,1,length(trans.num));
107                 num_m = repmat(trans.num,length(train.targets),1);
108                 a = (targets_m == num_m) * [1:length(trans.num)]';
109                 targets = trans.cat(a)';
110             else
111                 if strcmpi(class(train.targets),'double')
112                     targets = cellstr(num2str(train.targets));
113                 else
114                     targets = train.targets;
115                 end
116             end
117         end
118
119         function patterns = ConvertPatternsToChar(patterns)
120             patt_aux = [];
121             for i = 1:size(patterns,2)
122                 aux = patterns(:,i);
123                 if strcmpi(class(aux),'double')
124                     patt_aux = [patt_aux cellstr(num2str(aux))];
125                 else
126                     patt_aux = [patt_aux aux];
127                 end
128             end
129             patterns = patt_aux;
130         end
131
132         function targets = ConvertCategoricToTargets(result,trans)
133             a = zeros(size(result,1),size(trans.cat,2));
134             for i = 1:size(a,1)
135                 for j = 1:size(a,2)
136                     a(i,j) = double(strcmp(result(i),trans.cat{j}));
137                 end
```

```
138             end
139             a = a * [1:length(trans.cat)]';
140             targets = trans.num(a)';
141         end
142
143         function res = toChar(param)
144             res = [];
145             for i = 1:size(param,1)
146                 a1 = param(i);
147                 res1 = [];
148                 for j = 1:size(a1,1)
149                     a2 = a1(j);
150                     res2 = [];
151                     for k = 1:size(a2,1)
152                         a3 = char(a2(k));
153                         res2 = [res2,{a3}];
154                     end
155                     res1 = [res1;{res2}];
156                 end
157                 res = [res;{res1}];
158             end
159         end
160
161         function res = toCell(param)
162             res = [];
163             for i = 1:size(param,1)
164                 res = [res;{char(param(i))}];
165             end
166         end
167
168         function res = toJavaString(param)
169             res = javaArray('java.lang.String[][]',size(param,1));
170             for i = 1:size(param,1)
171                 a1 = param{i};
172                 res1 = [];
173                 for j = 1:size(a1,1)
174                     a2 = a1{j};
175                     res2 = [];
176                     for k = 1:size(a2,2)
177                         a3 = java.lang.String(a2{k});
178                         res2 = [res2,a3];
179                     end
180                     res1 = [res1;res2];
181                 end
182                 res(i) = [res1;[]];
183             end
184         end
185     end
186
187     methods
188         function obj = NSLVOrd(~,varargin)
189             % Process key-values pairs of parameters
190             obj.parseArgs(varargin);
```

```
191
192             obj.categ = true;
193         end
194
195         function [projectedTrain, predictedTrain] = privfit(obj, train,
                param)
196             % fit the model and return prediction of train set. It is
                    called by
197             % super class Algorithm.fit() method.
198
199             % Convertir los datos a objetos Java
200             param_java = obj.initParameters(param);
201
202             header = obj.getHeader(train);
203             targets = obj.ConvertTargetsToCategoric(train);
204             patterns = obj.ConvertPatternsToChar(train.patterns);
205             datas = [patterns targets];
206             datas = obj.getDatas(datas);
207
208             % NSLVOrd Java
209             algorithmPath = fullfile(fileparts(which('Algorithm.m')),'
                    NSLVOrd');
210             jarfolder = fullfile(algorithmPath,'NSLVOrdJava.jar');
211             javaaddpath(jarfolder);
212
213             nslvord = javaObject('NSLVOrdJava.NSLVOrdJava');
214             result = javaMethod('Train', nslvord, header,datas,param_java);
215             knowledgebase = javaMethod('get_knowledge_base', nslvord);
216             rulebase = javaMethod('get_rule_base', nslvord);
217             rules = javaMethod('get_rules', nslvord);
218
219             clear nslvord;
220             javarmpath(jarfolder);
221
222             % Process output
223             if strcmpi(train.info.utilities.type,'weka')
224                 trans = train.info.personal.attrs(end).info;
225                 targets = obj.ConvertCategoricToTargets(result,trans);
226             else
227                 aux = [];
228                 for i = 1:size(result,1)
229                     aux = [aux;str2double(result(i))];
230                 end
231                 targets = aux;
232             end
233             projectedTrain = targets;
234             predictedTrain = targets;
235
236             % Save the model
237             try
238                 model.name = train.name;
239                 SeeRules = param.SeeRules;
240             catch
```

```
241                 SeeRules = 0;
242             end
243             model.knowledgebase =  obj.toCell(knowledgebase);
244             model.rulebase = obj.toCell(rulebase);
245             model.rules = obj.toCell(rules);
246             if strcmpi(train.info.utilities.type,'weka')
247                 model.outPutsClass = train.info.personal.attrs(end).info;
248             else
249                 model.outPutsClass = {num2str(result(1))};
250             end
251             model.type = train.info.utilities.type;
252             model.header = header;
253             model.parameters = param;
254             obj.model = model;
255
256             %See rules
257             if SeeRules
258               obj.visual_rules();
259             end
260         end
261
262         function [projected, predicted] = privpredict(obj, patterns)
263             %predict unseen patterns with 'obj.model' and return
                    prediction and
264             %projection of patterns (for threshold models)
265             %It is called by super class Algorithm.predict() method.
266
267             %Convert inputs to java objects
268             if strcmpi(obj.model.type,'weka')
269               targets = repmat(obj.model.outPutsClass.cat(1),size(patterns
                      ,1),1);
270             else
271                 patterns = obj.ConvertPatternsToChar(patterns);
272                 targets = repmat(obj.model.outPutsClass,size(patterns,1),1)
                      ;
273             end
274
275             datas = [patterns targets];
276             datas = obj.getDatas(datas);
277
278             %NSLVOrd Java
279             algorithmPath = fullfile(fileparts(which('Algorithm.m')),'
                    NSLVOrd');
280             jarfolder = fullfile(algorithmPath,'NSLVOrdJava.jar');
281             javaaddpath(jarfolder);
282
283             nslvord = javaObject('NSLVOrdJava.NSLVOrdJava');
284             javaMethod('LoadModel', nslvord, obj.model.knowledgebase,obj.
                    model.rulebase);
285             result = javaMethod('Test', nslvord, obj.model.header,datas);
286
287             clear nslvord;
288             javarmpath(jarfolder);
```

```
289
290             % Process output
291             if strcmpi(obj.model.type,'weka')
292                 trans = obj.model.outPutsClass;
293                 targets = obj.ConvertCategoricToTargets(result,trans);
294             else
295                 aux = [];
296                 for i = 1:size(result,1)
297                     aux = [aux;str2double(result(i))];
298                 end
299                 targets = aux;
300             end
301             projected = targets;
302             predicted = targets;
303         end
304
305         function visual_rules(obj)
306             visual = RulesVisual;
307
308             % RuleBase
309             rb = obj.model.rules;
310             numr = str2num(rb{1});
311             finr = 1;
312             % Rule
313             for i = 1:numr
314                 inir = finr + 1;
315                 finr = inir + 2 + str2num(rb{inir + 2});
316                 r = rb(inir:finr);
317                 rname = r{1};
318                 rweight = str2double(r{2});
319                 numant = str2num(r{4}) - 1;
320                 con = r(end-1:end);
321                 ant = getant(obj,r(5:end-2),numant);
322                 visual.new_rule(rname,rweight);
323                 for j = 1:size(ant,1)
324                     visual.add_antecedent(ant(j).name,ant(j).values);
325                 end
326                 visual.new_consequent(con{1},con{2});
327             end
328
329             % Visual
330             visual.visual_rules(obj.model.name);
331         end
332
333         function export_rules(obj,dir)
334             export = RulesExport;
335
336             % KnowledgeBase
337             kb = obj.model.knowledgebase;
338             numfv = str2num(kb{5});
339             finfv = 5;
340             % FuzzyVariable
341             for i = 1:numfv
```

```
342                 inifv = finfv + 1;
343                 numft = str2num(kb{inifv + 8});
344                 finfv = inifv + 8 + 7 * numft;
345                 fv = kb(inifv:finfv);
346                 export.new_variable(fv{1},fv{5},fv{6});
347                 finft = 9;
348                 %FuzzyTerm
349                 for j = 1:numft
350                     inift = finft + 1;
351                     finft = inift + 6;
352                     ft = fv(inift:finft);
353                     export.add_terms(ft{1},ft{2},ft{3},ft{4},ft{5});
354                 end
355             end
356
357             %RuleBase
358             rb = obj.model.rules;
359             numr = str2num(rb{1});
360             finr = 1;
361             %Rule
362             for i = 1:numr
363                 inir = finr + 1;
364                 finr = inir + 2 + str2num(rb{inir + 2});
365                 r = rb(inir:finr);
366                 rname = r{1};
367                 rweight = str2double(r{2});
368                 numant = str2num(r{4}) - 1;
369                 con = r(end-1:end);
370                 ant = subrules(obj,r(5:end-2),numant);
371                 for j = 1:size(ant,1)
372                     acname = rname;
373                     if size(ant,1) > 1
374                         acname = [rname '_' num2str(j)];
375                     end
376                     export.new_rule(acname,rweight);
377                     antr = ant{j};
378                     for k = 1:2:size(antr,2)
379                         export.add_antecedent(antr{k},antr{k+1});
380                     end
381                     export.new_consequent(con{1},con{2});
382                 end
383             end
384
385             %Export
386             export.export_rules(dir,obj.model.name);
387         end
388
389         function ant = subrules(obj,r,numant)
390             [ant_aux,comb] = obj.getant(r,numant);
391             ant = [];
392             if ~isempty(ant_aux)
393                 ant = cell(comb,1);
394                 for i = 1:comb
```

```
395                     start = comb;
396                     index = i;
397                     for j = 1:size(ant_aux,1)
398                         aux = ant_aux(j);
399                         name = aux.name;
400                         aux = aux.values;
401                         start = start / size(aux,1);
402                         value = aux{floor((index-1)/start) + 1};
403                         index = index - start * floor((index-1)/start);
404                         ant{i} = [ant{i},{name},{value}];
405                     end
406                 end
407             end
408         end
409
410         function [ant,comb] = getant(obj,r,numant)
411             ant = [];
412             fin = 0;
413             comb = 1;
414             for i = 1:numant
415                 ini = fin + 1;
416                 aux.name = r{ini};
417                 numval = str2num(r{ini+1});
418                 fin = ini + 1 + numval * 7;
419                 vr = r(ini:fin);
420                 values = [];
421                 finv = 2;
422                 comb = comb * numval;
423                 for j = 1:numval
424                     iniv = finv + 1;
425                     finv = iniv + 6;
426                     tr = vr(iniv:finv);
427                     aux2 = {tr{1},str2double(tr{2}),str2double(tr{3}),
                            str2double(tr{4}),str2double(tr{5}),str2num(tr{6}),
                            str2num(tr{7})};
428                     values = [values;aux2];
429                 end
430                 aux.values = values;
431                 ant = [ant;aux];
432             end
433         end
434     end
435 end
```

Código 4.2: Archivo *NSLVOrd.m* correspondiente al módulo Algorithms

5 Módulo NSLVOrd

5.1. Clase NSLVOrdJava

```
1 package NSLVOrdJava;
2
3 // para la integracion en keel
4 import keel.Dataset.*;
5
6 import java.util.*;
7
8 /**
9  * @file NSLVOrd.java
10 * @brief main file of proyect
11 * @author Juan Carlos Gamez (original de Raul Perez)
12 * @version 1
13 * @date diciembre 2015
14 * @note Implement of NSLV algorithm for ordinal classification
15 */
16 public class NSLVOrdJava {
17
18     // habra 3 valores: indice 0->izda, indice 1->centro, indice 2->dcha
19     // static int numDesplazamientos=3;
20     static int numDesplazamientos=1;
21     static double[] time;
22     static int[] iter;
23
24     static FuzzyProblemClass[] fuzzyProblem;
25     static ExampleSetProcess[] E_par, E_par_test;
26     static RuleSetClass[] R;
27
28     static InstanceSet iSet;
29     static InstanceSet tSet;
30
```

```
31      static Random[] randomNum;
32
33      static String fileResultDebug;
34      static double[][] costMatrix;
35      static int seed;
36      static int numLabelsInputs;
37      static int numLabelsOutput;
38      static int shift;
39
40      static int homogeneousLabel=0; // se elimina el parametro de cuda para
            introducir la creacion de etiquetas homogeneas
41      // parametros de ponderacion de la caracteristica ordinal o nominal de
            la funcion fitness
42      // alpha * CCR y (1-alpha) * MAE
43      static double alpha=0.5;
44
45      static String[] poblationParam;
46
47      public static String[] Train(String[] _header,String[] _datas,String[]
            args){
48          Attributes.clearAll();
49          initParameters(args);
50
51          // Aqui se inicializa Random
52          randomNum= new Random[numDesplazamientos];
53          iter= new int[numDesplazamientos];
54          time= new double[numDesplazamientos];
55          for (int i=0; i < numDesplazamientos; i++){
56            randomNum[i]= new Random(seed);
57          }
58
59          // obtener las instancias (ejemplos) de training y test y pasarlas
                a "los objetos de mis clases"
60          if(!ReadSet(_header,_datas, true)) return null;
61
62          if(!executeNSLVOrd(homogeneousLabel)) return null;
63
64          return Targets(E_par,1);
65
66      }
67
68      public static FuzzyProblemClass[] GetFuzzyProblem(){
69          return fuzzyProblem;
70      }
71
72      public static String[] get_knowledge_base(){
73          RuleSystem _exp = new RuleSystem(fuzzyProblem[0], R[0]);
74          String[] kb = _exp.Export_KnowledgeBase();
75          return kb;
76      }
77
78      public static String[] get_rules(){
79          RuleSystem _exp = new RuleSystem(fuzzyProblem[0], R[0]);
```

```
80          String[] rules = _exp.Export_Rules();
81          return rules;
82      }
83
84      public static String[] get_rule_base(){
85          RuleSystem _exp = new RuleSystem(fuzzyProblem[0], R[0]);
86          String[]  rb = _exp.Export_RuleBase();
87          return rb;
88      }
89
90      public static void LoadModel(String[] _fuzzyProblem,String[] _R){
91          fuzzyProblem = new FuzzyProblemClass[numDesplazamientos];
92          R= new RuleSetClass[numDesplazamientos];
93          E_par_test= new ExampleSetProcess[numDesplazamientos];
94
95          Load_KnowledgeBase(_fuzzyProblem);
96          Load_RuleBase(_R);
97      }
98
99      public static void Load_KnowledgeBase(String[] sfp){
100         // FUZZY PROBLEM
101         FuzzyProblemClass fp = new FuzzyProblemClass();
102         fp.setConsequentIndexOriginal(Integer.parseInt(sfp[0]));
103         fp.setShift(Integer.parseInt(sfp[1]));
104         fp.setDirection(Integer.parseInt(sfp[2]));
105         fp.setHomogeneousLabel(Integer.parseInt(sfp[3]));
106         fp.setFuzzyLinguisticVariableNum(Integer.parseInt(sfp[4]));
107
108         // FUZZY VARIABLE
109         FuzzyLinguisticVariableClass[] fv = new
                FuzzyLinguisticVariableClass[fp.getFuzzyLinguisticVariableNum()
                ];
110         int pos = 5;
111         for(int i = 0; i < fp.getFuzzyLinguisticVariableNum(); i++){
112             fv[i] = new FuzzyLinguisticVariableClass();
113             fv[i].setName(sfp[pos]); pos++;
114             fv[i].setUnit(Integer.parseInt(sfp[pos])); pos++;
115             fv[i].setNumTermAutomatic(Double.parseDouble(sfp[pos])); pos++;
116             fv[i].setVariableType(Integer.parseInt(sfp[pos])); pos++;
117             fv[i].setInfRange(Double.parseDouble(sfp[pos])); pos++;
118             fv[i].setSupRange(Double.parseDouble(sfp[pos])); pos++;
119             fv[i].setInfRangeIsInf(Integer.parseInt(sfp[pos])); pos++;
120             fv[i].setSupRangeIsInf(Integer.parseInt(sfp[pos])); pos++;
121             fv[i].setFuzzyLinguisticTermNum(Integer.parseInt(sfp[pos]));
                    pos++;
122
123             // FUZZY TERM
124             FuzzyLinguisticTermClass[] ft = new FuzzyLinguisticTermClass[fv
                    [i].getFuzzyLinguisticTermNum()];
125             for(int j = 0; j < fv[i].getFuzzyLinguisticTermNum(); j++){
126                 ft[j] = new FuzzyLinguisticTermClass();
127                 ft[j].setName(sfp[pos]); pos++;
128                 ft[j].setA(Double.parseDouble(sfp[pos])); pos++;
```

```
129                 ft[j].setB(Double.parseDouble(sfp[pos])); pos++;
130                 ft[j].setC(Double.parseDouble(sfp[pos])); pos++;
131                 ft[j].setD(Double.parseDouble(sfp[pos])); pos++;
132                 ft[j].setAbInf(Integer.parseInt(sfp[pos])); pos++;
133                 ft[j].setCdInf(Integer.parseInt(sfp[pos])); pos++;
134             }
135 
136             fv[i].setFuzzyLinguisticTermList(ft);
137         }
138 
139         fp.setFuzzyLinguisticVariableList(fv);
140 
141         fuzzyProblem[0] = fp;
142     }
143 
144     public static void Load_RuleBase(String[] srs){
145         // RULE SET
146         RuleSetClass rs = new RuleSetClass();
147         rs.setNumRules(Integer.parseInt(srs[0]));
148         rs.CCR = Double.parseDouble(srs[1]);
149         rs.SM = Double.parseDouble(srs[2]);
150         rs.TPR = Double.parseDouble(srs[3]);
151         rs.TNR = Double.parseDouble(srs[4]);
152         rs.FPR = Double.parseDouble(srs[5]);
153         rs.Kappa = Double.parseDouble(srs[6]);
154         rs.AUC = Double.parseDouble(srs[7]);
155         rs.MSE = Double.parseDouble(srs[8]);
156         rs.RMSE = Double.parseDouble(srs[9]);
157         rs.RMAE = Double.parseDouble(srs[10]);
158         rs.OMAE = Double.parseDouble(srs[11]);
159         rs.OMAENormalizado = Double.parseDouble(srs[12]);
160         rs.MMAE = Double.parseDouble(srs[13]);
161         rs.mMAE = Double.parseDouble(srs[14]);
162         rs.AMAE = Double.parseDouble(srs[15]);
163         rs.Spearman = Double.parseDouble(srs[16]);
164         rs.Kendall = Double.parseDouble(srs[17]);
165         rs.OC = Double.parseDouble(srs[18]);
166         rs.beta = Double.parseDouble(srs[19]);
167         rs.metric = Double.parseDouble(srs[20]);
168         rs.metricMedia = Double.parseDouble(srs[21]);
169         rs.Precision = Double.parseDouble(srs[22]);
170         rs.alphaMetric = Double.parseDouble(srs[23]);
171         rs.confusion = new double[Integer.parseInt(srs[24])][];
172         int pos = 25;
173         for(int i = 0; i < rs.confusion.length; i++){
174             rs.confusion[i] = new double[Integer.parseInt(srs[pos])]; pos
                    ++;
175             for(int j = 0; j < rs.confusion[i].length; j++){
176                 rs.confusion[i][j] = Double.parseDouble(srs[pos]); pos++;
177             }
178         }
179 
180         // RULE
```

```
181         GenetCodeClass[] rul = new GenetCodeClass[rs.getNumRules()];
182         for(int i = 0; i < rul.length; i++){
183             // Binary elements
184             int binaryBlocs;
185             int[] sizeBinaryBlocs;
186             int[][] binaryMatrix;
187             binaryBlocs = Integer.parseInt(srs[pos]); pos++;
188             sizeBinaryBlocs = new int[binaryBlocs];
189             binaryMatrix = new int[binaryBlocs][];
190             for(int j = 0; j < binaryBlocs; j++){
191                 sizeBinaryBlocs[j] = Integer.parseInt(srs[pos]); pos++;
192                 binaryMatrix[j] = new int[sizeBinaryBlocs[j]];
193                 for(int k = 0; k < sizeBinaryBlocs[j]; k++){
194                     binaryMatrix[j][k] = Integer.parseInt(srs[pos]); pos++;
195                 }
196             }
197 
198             // Integer elements
199             int integerBlocs;
200             int[] sizeIntegerBlocs;
201             int[][] integerMatrix;
202             int[] integerRange;
203             integerBlocs = Integer.parseInt(srs[pos]); pos++;
204             sizeIntegerBlocs = new int[integerBlocs];
205             integerMatrix = new int[integerBlocs][];
206             for(int j = 0; j < integerBlocs; j++){
207                 sizeIntegerBlocs[j] = Integer.parseInt(srs[pos]); pos++;
208                 integerMatrix[j] = new int[sizeIntegerBlocs[j]];
209                 for(int k = 0; k < sizeIntegerBlocs[j]; k++){
210                     integerMatrix[j][k] = Integer.parseInt(srs[pos]); pos
                        ++;
211                 }
212             }
213             integerRange = new int[Integer.parseInt(srs[pos])]; pos++;
214             for(int j = 0; j < integerRange.length; j++){
215                 integerRange[j] = Integer.parseInt(srs[pos]); pos++;
216             }
217 
218             // Real elements
219             int realBlocs;
220             int[] sizeRealBlocs;
221             double[][] realMatrix;
222             double[] realInfRange;
223             double[] realSupRange;
224             realBlocs = Integer.parseInt(srs[pos]); pos++;
225             sizeRealBlocs = new int[realBlocs];
226             realMatrix = new double[realBlocs][];
227             for(int j = 0; j < realBlocs; j++){
228                 sizeRealBlocs[j] = Integer.parseInt(srs[pos]); pos++;
229                 realMatrix[j] = new double[sizeRealBlocs[j]];
230                 for(int k = 0; k < sizeRealBlocs[j]; k++){
231                     realMatrix[j][k] = Double.parseDouble(srs[pos]); pos++;
232                 }
```

```
233             }
234             realInfRange = new double[Integer.parseInt(srs[pos])]; pos++;
235             for(int j = 0; j < realInfRange.length; j++){
236                realInfRange[j] = Double.parseDouble(srs[pos]); pos++;
237             }
238             realSupRange = new double[Integer.parseInt(srs[pos])]; pos++;
239             for(int j = 0; j < realSupRange.length; j++){
240                 realSupRange[j] = Double.parseDouble(srs[pos]); pos++;
241             }
242
243
244             rul[i] = new GenetCodeClass(binaryBlocs,integerBlocs,realBlocs,
245                         sizeBinaryBlocs,sizeIntegerBlocs,sizeRealBlocs,
246                         integerRange,realInfRange,realSupRange);
247             rul[i].setBinaryMatrix(binaryMatrix);
248             rul[i].setIntegerMatrix(integerMatrix);
249             rul[i].setRealMatrix(realMatrix);
250         }
251         rs.setRules(rul);
252
253         R[0] = rs;
254     }
255
256     public static String[] Test(String[] _header,String[] _datas){
257         Attributes.clearAll();
258         iter= new int[numDesplazamientos];
259         time= new double[numDesplazamientos];
260
261         // obtener las instancias (ejemplos) de training y test y pasarlas
                a "los objetos de mis clases"
262         if(!ReadSet(_header,_datas,false)) return null;
263
264         if(!executeNSLVOrdPredict()) return null;
265
266         return Targets(E_par_test,1);
267     }
268
269     public static void initParameters(String[] param){
270
271         String auxString;
272
273         fuzzyProblem = new FuzzyProblemClass[numDesplazamientos];
274         E_par= new ExampleSetProcess[numDesplazamientos];
275         E_par_test= new ExampleSetProcess[numDesplazamientos];
276         R= new RuleSetClass[numDesplazamientos];
277
278         seed= Integer.parseInt(param[0]);
279         homogeneousLabel = 0;
280         numLabelsInputs= Integer.parseInt(param[1]);
281         numLabelsOutput= Integer.parseInt(param[2]);
282         shift= Integer.parseInt(param[3]);
283         alpha= Double.parseDouble(param[4]); // indica si realiza
                clasificacion(1) o regresion(0)
```

```
284         if ((alpha + (1-alpha)) != 1){
285             alpha= 0.5;
286         }
287 
288         // el resto de parametros que corresponden a las probabilidades de
289         // inicializacion, cruce y mutacion de las subpoblaciones y de cada
290         // elemento de la subpoblacion
291         poblationParam = new String[14];
292         poblationParam[0] = param[5];
293         poblationParam[1] = param[6];
294         poblationParam[2] = param[7];
295         poblationParam[3] = param[8];
296         poblationParam[4] = param[9];
297         poblationParam[5] = param[10];
298         poblationParam[6] = param[11];
299         poblationParam[7] = param[12];
300         poblationParam[8] = param[13];
301         poblationParam[9] = param[14];
302         poblationParam[10] = param[15];
303         poblationParam[11] = param[16];
304         poblationParam[12] = param[17];
305         poblationParam[13] = param[18];
306     }
307 
308     public static boolean ReadSet(String[] _header, String[] _datas,
        boolean _train){
309         // obtener las instancias (ejemplos) de training y test y pasarlas
            a "los objetos de mis clases"
310         InstanceSet _Set= new InstanceSet();
311         _Set.readSetTFG(_header,_datas,true);
312         _Set.setAttributesAsNonStatic();
313 
314         //si no hay ejemplos sale directamente
315         if (_Set.getNumInstances() == 0){
316           return false;
317         }
318 
319         if(_train){
320             iSet = _Set;
321         }else{
322             tSet = _Set;
323         }
324 
325         return true;
326     }
327 
328     public static boolean executeNSLVOrd(int homogeneousLabel){
329         // parte de ejecucion en serie
330         randomNum[0]= new Random(seed);
331         return executeLearning(0, 0, 0, homogeneousLabel); // para probar
            por ahora nada mas que con una ejecucion
332         // FIN - parte de ejecucion en serie
333     }
```

```
334
335     public static boolean executeNSLVOrdPredict() {
336         // parte de ejecucion en serie
337         return executePredict(0, 0, 0); // para probar por ahora nada mas
                que con una ejecucion
338         // FIN - parte de ejecucion en serie
339     }
340
341     public static boolean executeLearning(int shift, int direction, int
            index, int homogeneousLabel){
342           iter[index]=0;
343           if (numLabelsInputs == -1 || numLabelsOutput == -1){
344             // constructor para la creacion de etiquetas no homogeneas (en
                  funcion del numero de individuos por etiqueta)
345             numLabelsInputs = 11;
346             numLabelsOutput = 11;
347             fuzzyProblem[index]= new FuzzyProblemClass(iSet,
                    numLabelsInputs, numLabelsOutput, shift, direction,
                    homogeneousLabel);
348           }
349           else{
350             // constructor original para la creacion de etiquetas
                  homogeneas
351             fuzzyProblem[index]= new FuzzyProblemClass(iSet,
                    numLabelsInputs, numLabelsOutput, shift, direction,
                    homogeneousLabel);
352           }
353           // pasar los ejemplos a "mis objetos"
354           E_par[index]= new ExampleSetProcess(fuzzyProblem[index], iSet);
355           String result= E_par[index].calcAdaptExVarLabTFG();
356           if (result.compareTo("") != 0){
357               return false;
358           }
359
360           // calcular las medidas de informacion para agilizar los calculos
361           E_par[index].calcInformationMeasures();
362
363           // crear el objeto para el algoritmo genetico
364           R[index]= new RuleSetClass(alpha);
365
366           //creacion del objeto genetico e inicializarlo
367           GeneticAlgorithmClass GA= new GeneticAlgorithmClass(
                  poblationParam, E_par[index]);
368           // inicializar la poblacion
369           GA.initPopulation(randomNum[index],E_par[index],costMatrix);
370
371
372           // BEGIN - aqui comenzaria el bloque de ejecuciones del algoritmo
                  genetico
373           Util.initStatisticalData(GA.getP(), fuzzyProblem[index]);
374
375           // calcular la nueva regla
376           int ejemplosCubiertos=0, eliminadoReglas=0, newRule=1;
```

```
377             Util.numIterGenetic++;
378
379             //// AQUI PARA ANNADIR O NO LA REGLA POR DEFECTO AL COMIENZO ...
380             int addDefaultRule=0;
381             Util.classDefaultRule= GA.setDefaultRule(addDefaultRule,E_par[
                    index],R[index]);
382             if (addDefaultRule == 1){ // Si se ha includo la regla por
                    defecto al principio.
383               ejemplosCubiertos= E_par[index].calcCoveredTFG(R[index],GA.getP
                      (), fuzzyProblem[index]);
384             }
385
386             eliminadoReglas= 1;
387             while (eliminadoReglas == 1){
388               while (newRule == 1 && ejemplosCubiertos < E_par[index].
                      numExamples){
389                 iter[index]++;
390                 newRule= GA.findNewRuleTFG(randomNum[index],0,E_par[index],R[
                        index]); // en la version de homogeneousLabel se ha
                        eliminado la opcion de cuda
391                 Util.numIterGenetic++;
392
393                 ejemplosCubiertos= E_par[index].calcCoveredTFG(R[index],GA.
                        getP(),fuzzyProblem[index]);
394
395
396               }//while (newRule == 1){
397                 eliminadoReglas= R[index].removeRulesForImproveMetricTFG(
                        E_par[index],GA, fuzzyProblem[index]); // probar a quitar
                         reglas y ver si mejora la precision
398                 if (eliminadoReglas == 1){
399                   newRule=1;
400                   ejemplosCubiertos= E_par[index].calcCoveredTFG(R[index], GA
                          .getP(), fuzzyProblem[index]);
401                 }
402             }// while (eliminadoReglas != 1){
403
404
405             if (addDefaultRule == 0){ // No se ha includo la regla por
                    defecto al principio. Se debe incluir al final
406                 R[index].addRule(Util.DefaultRule, Util.DefaultRule.
                        getRealMatrix(Util.classDefaultRule, 4), E_par[index]);
407             }
408
409             return true;
410         }
411
412         public static boolean executePredict(int shift, int direction, int
                index){
413
414             String auxString="";
415             int numRules;        // numero de reglas de la particion
416             double varXRule;     // media de numero de variables por regla
```

```
417
418             iter[index]=0;
419
420             // pasar los ejemplos a "mis objetos"
421             E_par_test[index]= new ExampleSetProcess(fuzzyProblem[index],
                    tSet);
422             String result= E_par_test[index].calcAdaptExVarLabTFG();
423             if (result.compareTo("") != 0){
424                 return false;
425             }
426
427             return true;
428         }
429
430         public static String[] Targets(ExampleSetProcess[] _par,int numShifts){
431             int indexRule=0;
432             int claseInference;
433             int varCons= _par[0].getProblemDefinition().consequentIndex();
434             double valueReglaCombinado;
435             int[] indRegla;
436             String[] _Resultado;
437
438             indRegla= new int[numShifts];
439             _Resultado = new String[_par[0].getNumExamples()];
440
441             for (int i=0; i < _par[0].getNumExamples(); i++){
442                 for (int d=0; d < numShifts; d++){
443                     indexRule= R[d].inference(_par[d],i);
444                     indRegla[d]= indexRule;
445                 }
446                 claseInference= R[0].getRules(indexRule).getIntegerMatrix(0,0);
447                 valueReglaCombinado= Util.getCentralValue(claseInference,
                        varCons, _par[0]);
448
449                 _Resultado[i] = _par[0].getProblemDefinition().
                        getFuzzyLinguisticVariableList(varCons).
                        getFuzzyLinguisticTermList((int)valueReglaCombinado).
                        getName();
450             }
451
452             return _Resultado;
453         }
454 }
```

Código 5.1: Archivo *NSLVOrdJava.java* correspondiente al módulo NSLVOrd

5.2. Clase RuleSystem

```
1 package NSLVOrdJava;
2
3 import java.util.ArrayList;
4 import jfml.FuzzyInferenceSystem;
5
6 public class RuleSystem {
7     static private FuzzyInferenceSystem _f;
8     static private FuzzyProblemClass _fuzzyProblem;
9     static private RuleSetClass _R;
10
11    public RuleSystem(FuzzyProblemClass fuzzyProblem, RuleSetClass R){
12        _f = new FuzzyInferenceSystem();
13        _fuzzyProblem = fuzzyProblem;
14        _R = R;
15    }
16
17    public String[] Export_KnowledgeBase(){
18        ArrayList export_aux = new ArrayList();
19
20        // FUZZY PROBLEM
21        export_aux.add(String.valueOf(_fuzzyProblem.
              getConsequentIndexOriginal()));
22        export_aux.add(String.valueOf(_fuzzyProblem.getShift()));
23        export_aux.add(String.valueOf(_fuzzyProblem.getDirection()));
24        export_aux.add(String.valueOf(_fuzzyProblem.getHomogeneousLabel())
              ;
25        export_aux.add(String.valueOf(_fuzzyProblem.
              getFuzzyLinguisticVariableNum()));
26
27        // FUZZY VARIABLE
28        for (FuzzyLinguisticVariableClass auxLinguisticVar : _fuzzyProblem.
              getFuzzyLinguisticVariableList()){
29            export_aux.add(auxLinguisticVar.getName());
30            export_aux.add(String.valueOf(auxLinguisticVar.getUnit()));
31            export_aux.add(String.valueOf(auxLinguisticVar.
                  getNumTermAutomatic()));
32            export_aux.add(String.valueOf(auxLinguisticVar.getVariableType
                  ()));
33            export_aux.add(String.valueOf(auxLinguisticVar.getInfRange()));
34            export_aux.add(String.valueOf(auxLinguisticVar.getSupRange()));
35            export_aux.add(String.valueOf(auxLinguisticVar.getInfRangeIsInf
                  ()));
36            export_aux.add(String.valueOf(auxLinguisticVar.getSupRangeIsInf
                  ()));
37            export_aux.add(String.valueOf(auxLinguisticVar.
                  getFuzzyLinguisticTermNum()));
38
39            // FUZZY TERM
40            for (FuzzyLinguisticTermClass auxLinguisticTerm :
                  auxLinguisticVar.getFuzzyLinguisticTermList()){
```

```
41                  export_aux.add(auxLinguisticTerm.getName());
42                  export_aux.add(String.valueOf(auxLinguisticTerm.getA()));
43                  export_aux.add(String.valueOf(auxLinguisticTerm.getB()));
44                  export_aux.add(String.valueOf(auxLinguisticTerm.getC()));
45                  export_aux.add(String.valueOf(auxLinguisticTerm.getD()));
46                  export_aux.add(String.valueOf(auxLinguisticTerm.getAbInf())
                        );
47                  export_aux.add(String.valueOf(auxLinguisticTerm.getCdInf())
                        );
48              }
49          }
50
51          // To String vector
52          String[] export = new String[export_aux.size()];
53          for(int i = 0; i < export_aux.size(); i++){
54              export[i] = (String) export_aux.get(i);
55          }
56
57          return export;
58      }
59
60      public String[] Export_RuleBase(){
61          ArrayList export_aux = new ArrayList();
62
63          // RULE SET
64          export_aux.add(String.valueOf(_R.getNumRules()));
65          export_aux.add(String.valueOf(_R.CCR));
66          export_aux.add(String.valueOf(_R.SM));
67          export_aux.add(String.valueOf(_R.TPR));
68          export_aux.add(String.valueOf(_R.TNR));
69          export_aux.add(String.valueOf(_R.FPR));
70          export_aux.add(String.valueOf(_R.Kappa));
71          export_aux.add(String.valueOf(_R.AUC));
72          export_aux.add(String.valueOf(_R.MSE));
73          export_aux.add(String.valueOf(_R.RMSE));
74          export_aux.add(String.valueOf(_R.RMAE));
75          export_aux.add(String.valueOf(_R.OMAE));
76          export_aux.add(String.valueOf(_R.OMAENormalizado));
77          export_aux.add(String.valueOf(_R.MMAE));
78          export_aux.add(String.valueOf(_R.mMAE));
79          export_aux.add(String.valueOf(_R.AMAE));
80          export_aux.add(String.valueOf(_R.Spearman));
81          export_aux.add(String.valueOf(_R.Kendall));
82          export_aux.add(String.valueOf(_R.OC));
83          export_aux.add(String.valueOf(_R.beta));
84          export_aux.add(String.valueOf(_R.metric));
85          export_aux.add(String.valueOf(_R.metricMedia));
86          export_aux.add(String.valueOf(_R.Precision));
87          export_aux.add(String.valueOf(_R.alphaMetric));
88          export_aux.add(String.valueOf(_R.confusion.length));
89          for (double[] confusion : _R.confusion) {
90              export_aux.add(String.valueOf(confusion.length));
91              for (double val : confusion) {
```

```
92                  export_aux.add(String.valueOf(val));
93              }
94          }
95
96          // RULE
97          for(GenetCodeClass auxGenetCode : _R.getRules()){
98              // Binary elements
99              export_aux.add(String.valueOf(auxGenetCode.getBinaryBlocs()));
100             for(int i = 0; i < auxGenetCode.getBinaryBlocs(); i++){
101                 export_aux.add(String.valueOf(auxGenetCode.
                        getSizeBinaryBlocs(i)));
102                 for(int j = 0; j < auxGenetCode.getSizeBinaryBlocs(i); j++)
                        {
103                     export_aux.add(String.valueOf(auxGenetCode.
                            getBinaryMatrix(i,j)));
104                 }
105             }
106
107             // Integer elements
108             export_aux.add(String.valueOf(auxGenetCode.getIntegerBlocs()));
109             for(int i = 0; i < auxGenetCode.getIntegerBlocs(); i++){
110                 export_aux.add(String.valueOf(auxGenetCode.
                        getSizeIntegerBlocs(i)));
111                 for(int j = 0; j < auxGenetCode.getSizeIntegerBlocs(i); j
                        ++){
112                     export_aux.add(String.valueOf(auxGenetCode.
                            getIntegerMatrix(i,j)));
113                 }
114             }
115             export_aux.add(String.valueOf(auxGenetCode.getIntegerRange().
                    length));
116             for(int i : auxGenetCode.getIntegerRange()){
117                 export_aux.add(String.valueOf(i));
118             }
119
120             // Real elements
121             export_aux.add(String.valueOf(auxGenetCode.getRealBlocs()));
122             for(int i = 0; i < auxGenetCode.getRealBlocs(); i++){
123                 export_aux.add(String.valueOf(auxGenetCode.getSizeRealBlocs
                        (i)));
124                 for(int j = 0; j < auxGenetCode.getSizeRealBlocs(i); j++){
125                     export_aux.add(String.valueOf(auxGenetCode.
                            getRealMatrix(i,j)));
126                 }
127             }
128             export_aux.add(String.valueOf(auxGenetCode.getRealInfRange().
                    length));
129             for(double i : auxGenetCode.getRealInfRange()){
130                 export_aux.add(String.valueOf(i));
131             }
132             export_aux.add(String.valueOf(auxGenetCode.getRealSupRange().
                    length));
133             for(double i : auxGenetCode.getRealSupRange()){
```

```
134                 export_aux.add(String.valueOf(i));
135             }
136         }
137 
138         // To String vector
139         String[] export = new String[export_aux.size()];
140         for(int i = 0; i < export_aux.size(); i++){
141             export[i] = (String) export_aux.get(i);
142         }
143 
144         return export;
145     }
146 
147     public String[] Export_Rules(){
148         ArrayList export_aux = new ArrayList();
149 
150         // RULES
151         int numRules= _R.getNumRules();
152         export_aux.add(String.valueOf(numRules));
153         for (int i = 0; i < numRules; i++){
154             int classR= _R.getRules(i).getIntegerMatrix(0,0);
155 
156             // DATA RULE
157             export_aux.add("R" + i);
158             export_aux.add(String.valueOf(_R.getRules(i).getRealMatrix(2+
                    classR,4)));
159 
160             // ANTECEDENT
161             ArrayList ant = Export_Antecedents(i);
162             export_aux.add(String.valueOf(ant.size() + 2));
163             for (Object ant1 : ant) {
164                 export_aux.add((String) ant1);
165             }
166 
167             // CONSEQUENT
168             int conseqIndex = _fuzzyProblem.consequentIndex();
169             export_aux.add(_fuzzyProblem.getFuzzyLinguisticVariableList(
                    conseqIndex).getName());
170             export_aux.add(_fuzzyProblem.getFuzzyLinguisticVariableList(
                    conseqIndex).getFuzzyLinguisticTermList(_R.getRules(i).
                    getIntegerMatrix(0,0)).getName());
171         }
172 
173         // To String vector
174         String[] export = new String[export_aux.size()];
175         for(int i = 0; i < export_aux.size(); i++){
176             export[i] = (String) export_aux.get(i);
177         }
178 
179         return export;
180     }
181 
182     public ArrayList Export_Antecedents(int rule){
```

```
183         // Get antecedents
184         ArrayList validTerm = new ArrayList();
185         int numVariables = _fuzzyProblem.getFuzzyLinguisticVariableNum();
186         int start = 0;
187         int tamBloc = _R.getRules(rule).getSizeRealBlocs(0);
188         int conseqIndex = _fuzzyProblem.consequentIndex();
189         int numT = 0;
190         double infMeasureClass = _R.getRules(rule).getRealMatrix(0, tamBloc
                -1);
191         for (int j=0; j < numVariables-1; j++){
192             ArrayList aux = new ArrayList();
193             int numLabels = _fuzzyProblem.getFuzzyLinguisticVariableList(j)
                    .getFuzzyLinguisticTermNum();
194             double actInfMeasure = _R.getRules(rule).getRealMatrix(0, j);
195             if ((_R.getRules(rule).binaryMatrix0AllToOne(start,numLabels)
                    != 1) &&
196                (j != conseqIndex && actInfMeasure >= infMeasureClass)){
197                 for (int k=0; k < numLabels; k++){
198                     int valueLabel = _R.getRules(rule).getBinaryMatrix(0,
                            start+k);
199                     if (valueLabel == 1){
200                         aux.add(_fuzzyProblem.
                                getFuzzyLinguisticVariableList(j).
                                getFuzzyLinguisticTermList(k).getName());
201                         aux.add(String.valueOf(_fuzzyProblem.
                                getFuzzyLinguisticVariableList(j).
                                getFuzzyLinguisticTermList(k).getA()));
202                         aux.add(String.valueOf(_fuzzyProblem.
                                getFuzzyLinguisticVariableList(j).
                                getFuzzyLinguisticTermList(k).getB()));
203                         aux.add(String.valueOf(_fuzzyProblem.
                                getFuzzyLinguisticVariableList(j).
                                getFuzzyLinguisticTermList(k).getC()));
204                         aux.add(String.valueOf(_fuzzyProblem.
                                getFuzzyLinguisticVariableList(j).
                                getFuzzyLinguisticTermList(k).getD()));
205                         aux.add(String.valueOf(_fuzzyProblem.
                                getFuzzyLinguisticVariableList(j).
                                getFuzzyLinguisticTermList(k).getAbInf()));
206                         aux.add(String.valueOf(_fuzzyProblem.
                                getFuzzyLinguisticVariableList(j).
                                getFuzzyLinguisticTermList(k).getCdInf()));
207                     }
208                 }
209                 if(!aux.isEmpty()){
210                     aux.add(_fuzzyProblem.getFuzzyLinguisticVariableList(j)
                            .getName());
211                     validTerm.add(aux);
212                     numT++;
213                 }
214             }
215             start= start+numLabels;
216         }
```

```
217
218         // Save antecedents
219         ArrayList ant = new ArrayList();
220         ant.add(String.valueOf(numT+1));
221         for (Object next : validTerm) {
222             ArrayList aux = (ArrayList) next;
223             ant.add((String) aux.get(aux.size()-1));
224             int numTerm = (aux.size() - 1) / 7;
225             ant.add(String.valueOf(numTerm));
226             for(int i = 0; i < numTerm; i++){
227                 int num = i * 7;
228                 ant.add((String) aux.get(num));
229                 ant.add((String) aux.get(num + 1));
230                 ant.add((String) aux.get(num + 2));
231                 ant.add((String) aux.get(num + 3));
232                 ant.add((String) aux.get(num + 4));
233                 ant.add((String) aux.get(num + 5));
234                 ant.add((String) aux.get(num + 6));
235             }
236         }
237
238         return ant;
239     }
240 }
```

Código 5.2: Archivo *RuleSystem.java* correspondiente al módulo NSLVOrd

6 Módulo Rule View

6.1. Clase RulesVisual

```
1 classdef RulesVisual < handle
2     properties
3         rules = [];
4     end
5
6     methods
7         function visual_rules(obj,name)
8             if isempty(obj.rules)
9                 error('Rules System is empty');
10            end
11
12            addpath(fullfile(fileparts(which('RulesVisual.m')),'VisualRules
                  '));
13
14            Visual(name,obj.rules);
15
16            rmpath(fullfile(fileparts(which('RulesVisual.m')),'VisualRules'
                  ));
17        end
18
19        function num = detect_number(~,num)
20            if iscell(num)
21                if ~isempty(find(size(num) ~= 1,1))
22                    num = NaN;
23                else
24                    num = num{1};
25                end
26            end
27
28            switch class(num)
```

```
29                  case 'double'
30                      if ~isempty(find(size(num) ~= 1,1))
31                          num = NaN;
32                      end
33                  case 'char'
34                      num = str2double(num);
35                  otherwise
36                      num = NaN;
37              end
38          end
39
40          function new_rule(obj,name,weight)
41              obj.rules = [obj.rules,struct('Name',name,'Weight',num2str(
                    weight),'Antecedent',[],'Consequent',[])];
42          end
43
44          function add_antecedent(obj,variable,term)
45              if isempty(obj.rules)
46                  error('Rules System is empty');
47              end
48
49              term_aux = [];
50              if ~iscell(term)
51                  term = {term};
52              end
53              for i = 1:size(term,1)
54                  try
55                      for j = 1:7
56                          term_aux = [term_aux;{num2str(term{i,j})}];
57                      end
58                  catch
59                      error('Terms no valids');
60                  end
61              end
62              term = term_aux;
63
64              obj.rules(length(obj.rules)).Antecedent = [obj.rules(length(obj
                    .rules)).Antecedent;{variable term}];
65          end
66
67          function new_consequent(obj,variable,term)
68              if isempty(obj.rules)
69                  error('Rules System is empty');
70              end
71
72              obj.rules(length(obj.rules)).Consequent = {variable term};
73          end
74      end
75  end
```

Código 6.1: Archivo *RulesVisual.m* correspondiente al módulo Rule View

6.2. Función Visual

```
function Visual(name,rules)
    %Load VisualRules.jar
    algorithmPath = fileparts(which('Visual.m'));
    jarfolder = fullfile(algorithmPath,'VisualRules.jar');
    javaaddpath(jarfolder);

    %Initialize VisualRules
    try
        visual = javaObject('visualrules.VisualRules');
    catch
        disp('**************************');
        disp('See rules is not possible.');
        disp('**************************');

        %Clear Java
        clear visual;
        javarmpath(jarfolder);

        return;
    end

    %Add rules
    for i = 1:size(rules,2)
        namer = rules(i).Name;
        weight = rules(i).Weight;
        ant = rules(i).Antecedent;
        con = rules(i).Consequent;

        %Rule
        javaMethod('new_rule',visual,namer,weight);

        %Antecedent
        for j = 1:size(ant,1)
            namea = ant(j,1);
            values = ant(j,2);
            javaMethod('new_antecedent',visual,namea{1},values{1});
        end

        %Consequent
        javaMethod('new_consequent',visual,con{1},con{2});
    end

    %Activate panel
    javaMethod('SeeRules',visual,name);

    %Clear Java
    clear visual;
    javarmpath(jarfolder);
end
```

Código 6.2: Archivo *Visual.java* correspondiente al módulo Rule View

6.3. Clase VisualRules

```
1 /*
2  * To change this license header, choose License Headers in Project
       Properties.
3  * To change this template file, choose Tools | Templates
4  * and open the template in the editor.
5  */
6 package visualrules;
7
8 import com.sun.glass.events.KeyEvent;
9 import java.awt.Component;
10 import java.util.ArrayList;
11 import java.util.Arrays;
12
13 /**
14  *
15  * @author Federico Garcia-Arevalo Calles
16  */
17 public class VisualRules extends javax.swing.JFrame {
18     /**
19      * Creates new form VisualRules
20      */
21     private final ArrayList rules;
22
23     public VisualRules() {
24         rules = new ArrayList();
25         initComponents();
26     }
27
28     public void new_rule(String name, String weight){
29         ArrayList aux = new ArrayList();
30         aux.add(name);
31         aux.add(weight);
32         this.rules.add(aux);
33     }
34
35     public void new_antecedent(String name, String[] values){
36         ((ArrayList) this.rules.get(this.rules.size()-1)).add(name);
37         ((ArrayList) this.rules.get(this.rules.size()-1)).add(String.
               valueOf(values.length/7));
38         ((ArrayList) this.rules.get(this.rules.size()-1)).addAll(Arrays.
               asList(values));
39     }
40
41     public void new_consequent(String name, String value){
42         ((ArrayList) this.rules.get(this.rules.size()-1)).add(name);
43         ((ArrayList) this.rules.get(this.rules.size()-1)).add(value);
44     }
45
46     /**
```

```
47      * This method is called from within the constructor to initialize the
            form.
48      * WARNING: Do NOT modify this code. The content of this method is
            always
49      * regenerated by the Form Editor.
50      */
51     @SuppressWarnings("unchecked")
52     // <editor-fold defaultstate="collapsed" desc="Generated Code">
53     private void initComponents() {
54
55         jPanel1 = new javax.swing.JPanel();
56         jLabel1 = new javax.swing.JLabel();
57         _actual_num_row = new javax.swing.JTextField();
58         _OK = new javax.swing.JButton();
59         _info = new javax.swing.JTextPane();
60         _cont = new javax.swing.JScrollPane();
61         _lista = new javax.swing.JPanel();
62
63         setDefaultCloseOperation(javax.swing.WindowConstants.
               DISPOSE_ON_CLOSE);
64         setMinimumSize(new java.awt.Dimension(860, 642));
65
66         jLabel1.setText("Num of variable per row:");
67
68         _actual_num_row.setHorizontalAlignment(javax.swing.JTextField.
               CENTER);
69         _actual_num_row.setMaximumSize(new java.awt.Dimension(45, 23));
70         _actual_num_row.setMinimumSize(new java.awt.Dimension(45, 23));
71         _actual_num_row.setPreferredSize(new java.awt.Dimension(45, 23));
72         _actual_num_row.addKeyListener(new java.awt.event.KeyAdapter() {
73             public void keyTyped(java.awt.event.KeyEvent evt) {
74                 _actual_num_rowKeyTyped(evt);
75             }
76         });
77
78         _OK.setText("OK");
79         _OK.setFocusPainted(false);
80         _OK.setMaximumSize(new java.awt.Dimension(45, 23));
81         _OK.setMinimumSize(new java.awt.Dimension(45, 23));
82         _OK.setPreferredSize(new java.awt.Dimension(45, 23));
83         _OK.addActionListener(new java.awt.event.ActionListener() {
84             public void actionPerformed(java.awt.event.ActionEvent evt) {
85                 _OKActionPerformed(evt);
86             }
87         });
88
89         _info.setText("Zoom an area of graph: click left and mark the area
               to right.\n" +
90             "See all graph: click left and move to left.");
91         _info.setDisabledTextColor(new java.awt.Color(0, 0, 0));
92         _info.setEnabled(false);
93         _info.setOpaque(false);
94
```

```
95          javax.swing.GroupLayout jPanel1Layout = new javax.swing.GroupLayout
                (jPanel1);
96          jPanel1.setLayout(jPanel1Layout);
97          jPanel1Layout.setHorizontalGroup(
98              jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
99              .addGroup(jPanel1Layout.createSequentialGroup()
100                 .addContainerGap()
101                 .addComponent(jLabel1, javax.swing.GroupLayout.
                        PREFERRED_SIZE, 139, javax.swing.GroupLayout.
                        PREFERRED_SIZE)
102                 .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                        .UNRELATED)
103                 .addComponent(_actual_num_row, javax.swing.GroupLayout.
                        PREFERRED_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE,
                        javax.swing.GroupLayout.PREFERRED_SIZE)
104                 .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                        .RELATED)
105                 .addComponent(_OK, javax.swing.GroupLayout.PREFERRED_SIZE,
                        53, javax.swing.GroupLayout.PREFERRED_SIZE)
106                 .addGap(18, 18, 18)
107                 .addComponent(_info))
108         );
109         jPanel1Layout.setVerticalGroup(
110             jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
111             .addGroup(jPanel1Layout.createSequentialGroup()
112                 .addContainerGap()
113                 .addGroup(jPanel1Layout.createParallelGroup(javax.swing.
                        GroupLayout.Alignment.BASELINE)
114                     .addComponent(jLabel1, javax.swing.GroupLayout.
                            DEFAULT_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE,
                            Short.MAX_VALUE)
115                     .addComponent(_actual_num_row, javax.swing.GroupLayout.
                            DEFAULT_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE,
                            Short.MAX_VALUE)
116                     .addComponent(_OK, javax.swing.GroupLayout.DEFAULT_SIZE
                            , javax.swing.GroupLayout.DEFAULT_SIZE, Short.
                            MAX_VALUE))
117                 .addContainerGap())
118             .addGroup(jPanel1Layout.createSequentialGroup()
119                 .addComponent(_info, javax.swing.GroupLayout.PREFERRED_SIZE
                        , 43, javax.swing.GroupLayout.PREFERRED_SIZE)
120                 .addGap(0, 0, Short.MAX_VALUE))
121         );
122
123         javax.swing.GroupLayout _listaLayout = new javax.swing.GroupLayout(
                _lista);
124         _lista.setLayout(_listaLayout);
125         _listaLayout.setHorizontalGroup(
126             _listaLayout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
127             .addGap(0, 858, Short.MAX_VALUE)
```

```
128         );
129         _listaLayout.setVerticalGroup(
130             _listaLayout.createParallelGroup(javax.swing.GroupLayout.
                Alignment.LEADING)
131             .addGap(0, 568, Short.MAX_VALUE)
132         );
133 
134         _cont.setViewportView(_lista);
135 
136         javax.swing.GroupLayout layout = new javax.swing.GroupLayout(
                getContentPane());
137         getContentPane().setLayout(layout);
138         layout.setHorizontalGroup(
139             layout.createParallelGroup(javax.swing.GroupLayout.Alignment.
                LEADING)
140             .addComponent(_cont)
141             .addComponent(jPanel1, javax.swing.GroupLayout.DEFAULT_SIZE,
                javax.swing.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE)
142         );
143         layout.setVerticalGroup(
144             layout.createParallelGroup(javax.swing.GroupLayout.Alignment.
                LEADING)
145             .addGroup(javax.swing.GroupLayout.Alignment.TRAILING, layout.
                createSequentialGroup()
146                 .addComponent(jPanel1, javax.swing.GroupLayout.
                    PREFERRED_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE,
                    javax.swing.GroupLayout.PREFERRED_SIZE)
147                 .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                    .RELATED)
148                 .addComponent(_cont))
149         );
150 
151         pack();
152     }// </editor-fold>
153 
154     private void _actual_num_rowKeyTyped(java.awt.event.KeyEvent evt) {
155         // TODO add your handling code here:
156         char text = evt.getKeyChar();
157         if(!Character.isDigit(text) ||
158            text == KeyEvent.VK_BACKSPACE ||
159            text == KeyEvent.VK_DELETE)
160                 evt.consume();
161     }
162 
163     private void _OKActionPerformed(java.awt.event.ActionEvent evt) {
164         // TODO add your handling code here:
165         String text = _actual_num_row.getText();
166         if(text.length() < 1 || text.length() > 2) return;
167 
168         int num = Integer.parseInt(text);
169         if(num < 1 || num > 99) return;
170 
171         change_num_rules_in_row(num);
```

```
172     }
173
174     public void SeeRules(String name){
175         this.setTitle(name);
176         CreateRules();
177         this.setVisible(true);
178     }
179
180     private void CreateRules(){
181         int numRules= this.rules.size();
182         int h = 6,w = _lista.getWidth();
183
184         // RULES
185         for(int i = 0; i < numRules; i++) {
186             ArrayList aux = (ArrayList) this.rules.get(i);
187
188             // ANTECEDENT
189             Rule rule = getAntecedent(aux);
190
191             // CONSEQUENT
192             String consequent_variable = (String) aux.get(aux.size() - 2);
193             String consequent_term = (String) aux.get(aux.size() - 1);
194             rule.consequent(consequent_variable,consequent_term);
195
196             // ADD RULE
197             rule.weight(Float.parseFloat((String) aux.get(1)));
198             rule.number((String) aux.get(0));
199             rule.setLocation(6,h);
200             rule.setSize(rule.getPreferredSize());
201             //rule.setBackground(Color.red);
202             h += rule.getHeight() + 6;
203             if(w < rule.getWidth() + 6) w = rule.getWidth() + 6;
204             _lista.add(rule);
205         }
206
207         _lista.setPreferredSize(new java.awt.Dimension(w,h));
208
209         int num = 5;
210         change_num_rules_in_row(num);
211         _actual_num_row.setText("" + num);
212     }
213
214     private void change_num_rules_in_row(int num){
215         int h = 6;
216         for(Component comp : _lista.getComponents()){
217             Rule rule = (Rule) comp;
218             rule.regroup_components(num);
219             rule.setSize(rule.getPreferredSize());
220             rule.setLocation(6,h);
221             h += rule.getHeight() + 6;
222         }
223
```

```
224         _lista.setPreferredSize(new java.awt.Dimension(_lista.
                getPreferredSize().width,h));
225     }
226 
227     private static Rule getAntecedent(ArrayList aux) {
228         Rule rule = new Rule();
229 
230         // Obtener las variables y terminos que van en la regla
231         int act = 2;
232         while(act  < aux.size()-2){
233             String name = (String) aux.get(act); act++;
234             int numLabels = Integer.parseInt((String) aux.get(act)); act++;
235             int type_variable = 0;
236             ArrayList aux_2 = new ArrayList();
237             for(int k = 0; k < numLabels; k++){
238                 String[] data = new String[7];
239                 data[0] = (String) aux.get(act); act++;
240                 data[1] = (String) aux.get(act); act++;
241                 data[2] = (String) aux.get(act); act++;
242                 data[3] = (String) aux.get(act); act++;
243                 data[4] = (String) aux.get(act); act++;
244                 data[5] = (String) aux.get(act); act++;
245                 data[6] = (String) aux.get(act); act++;
246                 if(data[1].equals(data[2]) && data[1].equals(data[3]) &&
                        data[1].equals(data[4]) && type_variable != 2){
247                     type_variable = 1;
248                 }else{
249                     type_variable = 2;
250                 }
251                 aux_2.add(data);
252             }
253             if(type_variable == 1){
254                 String[] terms = new String[aux_2.size()];
255                 for(int i = 0; i < terms.length; i++){
256                     String[] data = (String[]) aux_2.get(i);
257                     terms[i] = data[0];
258                 }
259                 rule.add_categoric_antecedent(name,terms);
260             }else if(type_variable == 2){
261                 double[][][] series = new double[aux_2.size()][4][2];
262                 for(int i = 0; i < series.length; i++){
263                     String[] data = (String[]) aux_2.get(i);
264                     series[i][0][0] = Double.parseDouble(data[1]);
265                     series[i][0][1] = Double.parseDouble(data[5]);
266                     series[i][1][0] = Double.parseDouble(data[2]);
267                     series[i][1][1] = 1;
268                     series[i][2][0] = Double.parseDouble(data[3]);
269                     series[i][2][1] = 1;
270                     series[i][3][0] = Double.parseDouble(data[4]);
271                     series[i][3][1] = Double.parseDouble(data[6]);
272                 }
273                 rule.add_fuzzy_antecedent(name,series);
274             }
```

```
275         }
276         return rule;
277     }
278 
279     // Variables declaration - do not modify
280     private javax.swing.JButton _OK;
281     private javax.swing.JTextField _actual_num_row;
282     private javax.swing.JScrollPane _cont;
283     private javax.swing.JTextPane _info;
284     private javax.swing.JPanel _lista;
285     private javax.swing.JLabel jLabel1;
286     private javax.swing.JPanel jPanel1;
287     // End of variables declaration
288 }
```

Código 6.3: Archivo *VisualRules.java* correspondiente al módulo Rule View

6.4. Clase Rule

```
1 /*
2  * To change this license header, choose License Headers in Project
       Properties.
3  * To change this template file, choose Tools | Templates
4  * and open the template in the editor.
5  */
6 package visualrules;
7
8 import java.awt.Component;
9
10 /**
11  *
12  * @author Federico Garcia-Arevalo Calles
13  */
14 public class Rule extends javax.swing.JPanel {
15
16     /**
17      * Creates new form Rules
18      */
19     public Rule() {
20         initComponents();
21         _num_rules = 0;
22         _IF.setSize(_IF.getPreferredSize());
23         _num_row = -1;
24         _weight = 0;
25         _consequent = new ConditionCategoric();
26         _consequent.setLocation(46,0);
27         _thenpanel.add(_consequent);
28     }
29
30     public void weight(float weight) {
31         if(weight < 0) weight = 0;
32         _weight = weight;
33     }
34
35     public void number(String name) {
36         _num.setText(name + ": (WEIGHT = " + _weight + ")");
37     }
38
39     public void regroup_components(int num) {
40         if(_num_rules <= 1 || num == _num_row) return;
41         _num_row = num;
42         if(num < 1) num = 1;
43         Component a = _ifpanel.getComponent(1);
44         int h,w,line;
45         w = a.getX() + a.getWidth() + 6;
46         java.awt.Dimension tam = new java.awt.Dimension(w,a.getHeight());
47         h = 0;
48         for(int i = 2; i < _num_rules*2; i = i + 2){
49             // Cambio de linea
```

```
50              if ((i/2) %num == 0){
51                  w = 30;
52                  h = tam.height + 6;
53              }
54
55              // Recolocacion AND
56              a = _ifpanel.getComponent(i);
57              a.setLocation(w,h + 11);
58              w += a.getWidth() + 6;
59
60              // Recolocacion antecedente
61              a = _ifpanel.getComponent(i+1);
62              a.setLocation(w,h);
63              w += a.getWidth() + 6;
64
65              // Cambiar tamanyo
66              if(tam.height < a.getHeight() + h) tam.height = a.getHeight() +
                    h;
67              if(tam.width < w) tam.width = w;
68          }
69
70          // Aplicar cambios en los paneles
71          update_panel(tam);
72      }
73
74      private void update_panel(java.awt.Dimension tam){
75          // Actualizar el panel con las reglas
76          _ifpanel.setPreferredSize(tam);
77          _ifpanel.setSize(tam);
78
79          this.updateUI();
80      }
81
82      private void add_antecedent(Component antecedent) {
83          Component ult = _ifpanel.getComponent(_ifpanel.getComponents().
                length - 1);
84          int w = ult.getX() + ult.getWidth() + 6; // 6: el espacio entre
                componentes
85          int h = 0;
86          int lon = _ifpanel.getHeight();
87          int aux_lon;
88
89          // Anyadir un JLabel con el texto AND entre reglas
90          if(_num_rules != 0){
91              javax.swing.JLabel andText = new javax.swing.JLabel();
92              andText.setText("AND");
93              andText.setSize(andText.getPreferredSize());
94              //if((float) (_num_rules + 1) %(_num_row + 1) == 0){ // Cambio
                    de linea
95              //    w = 30;
96              //    h = lon + 6;
97              //}
98              andText.setLocation(w,h+11);
```

```
99              w += andText.getWidth() + 6; // 16: la altura del componente
                    JLabel
100                                          // 6: el espacio entre componentes
101             _ifpanel.add(andText);
102         }
103
104         // Anyadir el antecedente
105         antecedent.setSize(antecedent.getPreferredSize());
106         antecedent.setLocation(w,h);
107         w += antecedent.getWidth() + 6;
108         _ifpanel.add(antecedent);
109
110         // Aplicar cambios en los paneles
111         aux_lon = antecedent.getHeight() + antecedent.getY();
112         if(aux_lon > lon) lon = aux_lon;
113         if(_ifpanel.getWidth() > w) w = _ifpanel.getWidth();
114         update_panel(new java.awt.Dimension(w,lon));
115
116         _num_rules++;
117     }
118
119     public void add_categoric_antecedent(String variable, String[] terms) {
120         ConditionCategoric antecedent = new ConditionCategoric();
121
122         antecedent.setVariable(variable);
123
124         for(String term : terms) {
125             antecedent.addLabel(term);
126         }
127
128         add_antecedent(antecedent);
129     }
130
131     public void add_fuzzy_antecedent(String variable, double[][][] series)
            {
132         ConditionFuzzyLogic antecedent = new ConditionFuzzyLogic();
133
134         antecedent.setVariable(variable);
135
136         for(double[][] serie : series) {
137             antecedent.new_serie();
138             for(double[] point : serie) {
139                 antecedent.add(point[0],point[1]);
140             }
141         }
142
143         antecedent.createGraph();
144
145         add_antecedent(antecedent);
146     }
147
148     public void consequent(String variable, String term) {
149         _consequent.setVariable(variable);
```

```
150         _consequent.addLabel(term);
151         _consequent.setSize(_consequent.getPreferredSize());
152         java.awt.Dimension tam = new java.awt.Dimension(46 + _consequent.
                getWidth(),_consequent.getHeight());
153         _thenpanel.setPreferredSize(tam);
154         _thenpanel.setSize(tam);
155     }
156 
157     /**
158      * This method is called from within the constructor to initialize the
             form.
159      * WARNING: Do NOT modify this code. The content of this method is
             always
160      * regenerated by the Form Editor.
161      */
162     @SuppressWarnings("unchecked")
163     // <editor-fold defaultstate="collapsed" desc="Generated Code">//GEN-
            BEGIN:initComponents
164     private void initComponents() {
165 
166         _num = new javax.swing.JLabel();
167         _ifpanel = new javax.swing.JPanel();
168         _IF = new javax.swing.JLabel();
169         _thenpanel = new javax.swing.JPanel();
170         _THEN = new javax.swing.JLabel();
171 
172         _num.setText("RULE X: (WEIGHT = Y)");
173 
174         _IF.setText("IF");
175 
176         javax.swing.GroupLayout _ifpanelLayout = new javax.swing.
                GroupLayout(_ifpanel);
177         _ifpanel.setLayout(_ifpanelLayout);
178         _ifpanelLayout.setHorizontalGroup(
179             _ifpanelLayout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
180             .addGroup(_ifpanelLayout.createSequentialGroup()
181                 .addContainerGap()
182                 .addComponent(_IF)
183                 .addContainerGap(197, Short.MAX_VALUE))
184         );
185         _ifpanelLayout.setVerticalGroup(
186             _ifpanelLayout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
187             .addGroup(_ifpanelLayout.createSequentialGroup()
188                 .addContainerGap()
189                 .addComponent(_IF)
190                 .addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE,
                        Short.MAX_VALUE))
191         );
192 
193         _THEN.setText("THEN");
194 
```

```
195         javax.swing.GroupLayout _thenpanelLayout = new javax.swing.
                GroupLayout(_thenpanel);
196         _thenpanel.setLayout(_thenpanelLayout);
197         _thenpanelLayout.setHorizontalGroup(
198             _thenpanelLayout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
199             .addGroup(_thenpanelLayout.createSequentialGroup()
200                 .addContainerGap()
201                 .addComponent(_THEN)
202                 .addContainerGap(181, Short.MAX_VALUE))
203         );
204         _thenpanelLayout.setVerticalGroup(
205             _thenpanelLayout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
206             .addGroup(_thenpanelLayout.createSequentialGroup()
207                 .addContainerGap()
208                 .addComponent(_THEN)
209                 .addGap(11, 11, 11))
210         );
211
212         javax.swing.GroupLayout layout = new javax.swing.GroupLayout(this);
213         this.setLayout(layout);
214         layout.setHorizontalGroup(
215             layout.createParallelGroup(javax.swing.GroupLayout.Alignment.
                    LEADING)
216             .addGroup(layout.createSequentialGroup()
217                 .addContainerGap()
218                 .addGroup(layout.createParallelGroup(javax.swing.
                        GroupLayout.Alignment.LEADING)
219                     .addComponent(_num)
220                     .addGroup(layout.createSequentialGroup()
221                         .addGap(10, 10, 10)
222                         .addGroup(layout.createParallelGroup(javax.swing.
                                GroupLayout.Alignment.LEADING)
223                             .addComponent(_ifpanel, javax.swing.GroupLayout
                                    .PREFERRED_SIZE, javax.swing.GroupLayout.
                                    DEFAULT_SIZE, javax.swing.GroupLayout.
                                    PREFERRED_SIZE)
224                             .addComponent(_thenpanel, javax.swing.
                                    GroupLayout.PREFERRED_SIZE, javax.swing.
                                    GroupLayout.DEFAULT_SIZE, javax.swing.
                                    GroupLayout.PREFERRED_SIZE))))
225                 .addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE,
                        Short.MAX_VALUE))
226         );
227         layout.setVerticalGroup(
228             layout.createParallelGroup(javax.swing.GroupLayout.Alignment.
                    LEADING)
229             .addGroup(javax.swing.GroupLayout.Alignment.TRAILING, layout.
                    createSequentialGroup()
230                 .addContainerGap()
231                 .addComponent(_num)
```

```
232                     .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                            .RELATED)
233                     .addComponent(_ifpanel, javax.swing.GroupLayout.
                            PREFERRED_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE,
                            javax.swing.GroupLayout.PREFERRED_SIZE)
234                     .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                            .RELATED)
235                     .addComponent(_thenpanel, javax.swing.GroupLayout.
                            PREFERRED_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE,
                            javax.swing.GroupLayout.PREFERRED_SIZE)
236                     .addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE,
                            Short.MAX_VALUE))
237         );
238     }// </editor-fold>//GEN-END:initComponents
239
240     private int _num_row;
241     private int _num_rules;
242     private float _weight;
243     private ConditionCategoric _consequent;
244
245     // Variables declaration - do not modify//GEN-BEGIN:variables
246     private javax.swing.JLabel _IF;
247     private javax.swing.JLabel _THEN;
248     private javax.swing.JPanel _ifpanel;
249     private javax.swing.JLabel _num;
250     private javax.swing.JPanel _thenpanel;
251     // End of variables declaration//GEN-END:variables
252 }
```

Código 6.4: Archivo *Rule.java* correspondiente al módulo Rule View

6.5. Clase ConditionCategoric

```
1 /*
2  * To change this license header, choose License Headers in Project
       Properties.
3  * To change this template file, choose Tools | Templates
4  * and open the template in the editor.
5  */
6 package visualrules;
7
8 import java.awt.Color;
9
10 /**
11  *
12  * @author Federico Garcia-Arevalo Calles
13  */
14 public class ConditionCategoric extends javax.swing.JPanel {
15
16     /**
17      * Creates new form ConditionCategoric
18      */
19     public ConditionCategoric() {
20         initComponents();
21         _num_labels = 0;
22     }
23
24     /**
25      * This method is called from within the constructor to initialize the
           form.
26      * WARNING: Do NOT modify this code. The content of this method is
           always
27      * regenerated by the Form Editor.
28      */
29     @SuppressWarnings("unchecked")
30     // <editor-fold defaultstate="collapsed" desc="Generated Code">//GEN-
           BEGIN:initComponents
31     private void initComponents() {
32
33         _variable = new javax.swing.JLabel();
34         _is = new javax.swing.JLabel();
35         _label = new javax.swing.JPanel();
36         _parenthesis = new javax.swing.JLabel();
37
38         _variable.setForeground(new java.awt.Color(0, 0, 204));
39         _variable.setText("NameVariable");
40
41         _is.setText("IS");
42
43         _label.setLayout(new java.awt.FlowLayout(java.awt.FlowLayout.CENTER
               , 0, 0));
44
45         _parenthesis.setText("(");
```

```
46          _parenthesis.setVisible(false);
47          _label.add(_parenthesis);
48
49          javax.swing.GroupLayout layout = new javax.swing.GroupLayout(this);
50          this.setLayout(layout);
51          layout.setHorizontalGroup(
52              layout.createParallelGroup(javax.swing.GroupLayout.Alignment.
                    LEADING)
53              .addGroup(layout.createSequentialGroup()
54                  .addContainerGap()
55                  .addComponent(_variable)
56                  .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                        .UNRELATED)
57                  .addComponent(_is)
58                  .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                        .RELATED)
59                  .addComponent(_label, javax.swing.GroupLayout.
                        PREFERRED_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE,
                        javax.swing.GroupLayout.PREFERRED_SIZE)
60                  .addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE,
                        Short.MAX_VALUE))
61          );
62          layout.setVerticalGroup(
63              layout.createParallelGroup(javax.swing.GroupLayout.Alignment.
                    LEADING)
64              .addGroup(layout.createSequentialGroup()
65                  .addContainerGap()
66                  .addGroup(layout.createParallelGroup(javax.swing.
                        GroupLayout.Alignment.LEADING)
67                      .addGroup(layout.createParallelGroup(javax.swing.
                            GroupLayout.Alignment.BASELINE)
68                          .addComponent(_variable)
69                          .addComponent(_is))
70                      .addComponent(_label, javax.swing.GroupLayout.
                            PREFERRED_SIZE, javax.swing.GroupLayout.
                            DEFAULT_SIZE, javax.swing.GroupLayout.
                            PREFERRED_SIZE))
71                  .addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE,
                        Short.MAX_VALUE))
72          );
73      }// </editor-fold>//GEN-END:initComponents
74
75      public void setVariable(String variable) {
76          _variable.setText(variable);
77      }
78
79      public void addLabel(String label) {
80          javax.swing.JLabel new_label = new javax.swing.JLabel(label);
81          if(_num_labels > 1) {
82              _label.remove(_label.getComponentCount() - 1);
83          }
84          if(_num_labels > 0) {
85              _label.add(new javax.swing.JLabel("  OR  "));
```

```
86              _parenthesis.setVisible(true);
87          }
88          new_label.setForeground(Color.BLUE);
89          _label.add(new_label);
90          if(_num_labels > 0) {
91              _label.add(new javax.swing.JLabel(")"));
92          }
93          _num_labels++;
94      }
95
96      int _num_labels;
97
98      // Variables declaration - do not modify//GEN-BEGIN:variables
99      private javax.swing.JLabel _is;
100     private javax.swing.JPanel _label;
101     private javax.swing.JLabel _parenthesis;
102     private javax.swing.JLabel _variable;
103     // End of variables declaration//GEN-END:variables
104 }
```

Código 6.5: Archivo *ConditionCategoric.java* correspondiente al módulo Rule View

6.6. Clase ConditionFuzzyLogic

```
1 /*
2  * To change this license header, choose License Headers in Project
       Properties.
3  * To change this template file, choose Tools | Templates
4  * and open the template in the editor.
5  */
6 package visualrules;
7
8 import java.util.ArrayList;
9 import org.jfree.chart.ChartFactory;
10 import org.jfree.chart.ChartFrame;
11 import org.jfree.chart.ChartPanel;
12 import org.jfree.chart.JFreeChart;
13 import org.jfree.chart.plot.PlotOrientation;
14 import org.jfree.data.xy.XYSeries;
15 import org.jfree.data.xy.XYSeriesCollection;
16
17 /**
18  *
19  * @author Federico Garcia-Arevalo Calles
20  */
21 public class ConditionFuzzyLogic extends javax.swing.JPanel {
22
23     private static ArrayList _series;
24     private static int _num_series;
25
26     /**
27      * Creates new form ConditionFuzzyLogic
28      */
29     public ConditionFuzzyLogic() {
30         initComponents();
31         _series = new ArrayList();
32         _num_series = 0;
33     }
34
35     /**
36      * This method is called from within the constructor to initialize the
           form.
37      * WARNING: Do NOT modify this code. The content of this method is
           always
38      * regenerated by the Form Editor.
39      */
40     @SuppressWarnings("unchecked")
41     // <editor-fold defaultstate="collapsed" desc="Generated Code">//GEN-
           BEGIN:initComponents
42     private void initComponents() {
43
44         _variable = new javax.swing.JLabel();
45         _is = new javax.swing.JLabel();
46         _label = new javax.swing.JPanel();
```

```
47
48          _variable.setForeground(new java.awt.Color(0, 0, 204));
49          _variable.setText("NameVariable");
50
51          _is.setText("IS");
52
53          javax.swing.GroupLayout _labelLayout = new javax.swing.GroupLayout(
                _label);
54          _label.setLayout(_labelLayout);
55          _labelLayout.setHorizontalGroup(
56              _labelLayout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
57              .addGap(0, 393, Short.MAX_VALUE)
58          );
59          _labelLayout.setVerticalGroup(
60              _labelLayout.createParallelGroup(javax.swing.GroupLayout.
                    Alignment.LEADING)
61              .addGap(0, 263, Short.MAX_VALUE)
62          );
63
64          javax.swing.GroupLayout layout = new javax.swing.GroupLayout(this);
65          this.setLayout(layout);
66          layout.setHorizontalGroup(
67              layout.createParallelGroup(javax.swing.GroupLayout.Alignment.
                    LEADING)
68              .addGroup(layout.createSequentialGroup()
69                  .addContainerGap()
70                  .addComponent(_variable)
71                  .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                        .UNRELATED)
72                  .addComponent(_is)
73                  .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement
                        .UNRELATED)
74                  .addComponent(_label, javax.swing.GroupLayout.
                        PREFERRED_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE,
                        javax.swing.GroupLayout.PREFERRED_SIZE)
75                  .addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE,
                        Short.MAX_VALUE))
76          );
77          layout.setVerticalGroup(
78              layout.createParallelGroup(javax.swing.GroupLayout.Alignment.
                    LEADING)
79              .addGroup(layout.createSequentialGroup()
80                  .addContainerGap()
81                  .addGroup(layout.createParallelGroup(javax.swing.
                        GroupLayout.Alignment.LEADING)
82                      .addGroup(layout.createParallelGroup(javax.swing.
                            GroupLayout.Alignment.BASELINE)
83                          .addComponent(_variable)
84                          .addComponent(_is))
85                      .addComponent(_label, javax.swing.GroupLayout.
                            PREFERRED_SIZE, javax.swing.GroupLayout.
                            DEFAULT_SIZE, javax.swing.GroupLayout.
```

```
                                PREFERRED_SIZE))
86                      .addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE,
                            Short.MAX_VALUE))
87          );
88      }// </editor-fold>//GEN-END:initComponents
89
90      public void new_serie() {
91          _series.add(new XYSeries("" + _num_series));
92          _num_series++;
93      }
94
95      public void add(Number X, Number Y) {
96          ((XYSeries) _series.get(_num_series - 1)).add(X,Y);
97      }
98
99      public void setVariable(String variable) {
100         _variable.setText(variable);
101     }
102
103     public void createGraph() {
104         _label.setSize(_label.getPreferredSize());
105
106         XYSeriesCollection dataset = new XYSeriesCollection();
107         for(Object serie : _series){
108             dataset.addSeries((XYSeries) serie);
109         }
110
111         JFreeChart chart = ChartFactory.createXYAreaChart("","","",dataset,
112                                 PlotOrientation.VERTICAL,false,false,false)
                                    ;
113
114         ChartFrame frame = new ChartFrame("",chart);
115         frame.pack();
116         frame.setSize(_label.getSize());
117         frame.setResizable(false);
118
119         ChartPanel panel = frame.getChartPanel();
120         panel.setPopupMenu(null);
121         //panel.setDomainZoomable(false);
122         //panel.setRangeZoomable(false);
123
124         _label.add(panel);
125     }
126
127     // Variables declaration - do not modify//GEN-BEGIN:variables
128     private javax.swing.JLabel _is;
129     private javax.swing.JPanel _label;
130     private javax.swing.JLabel _variable;
131     // End of variables declaration//GEN-END:variables
132 }
```

CÓDIGO 6.6: Archivo *ConditionFuzzyLogic.java* correspondiente al módulo Rule View

7 Módulo JFML

7.1. Clase RulesExport

```
classdef RulesExport < handle
    properties
        rules = [];
        knowledge_base = [];
    end

    methods
        function export_rules(obj,dir,name)
            if isempty(obj.rules) || isempty(obj.knowledge_base)
                error('Rules or Knowledge base is empty')
            end

            addpath(fullfile(fileparts(which('RulesExport.m')),'JFML'));

            JFML(dir,name,obj.knowledge_base,obj.rules);

            rmpath(fullfile(fileparts(which('RulesExport.m')),'JFML'));
        end

        function new_variable(obj,name,domain_left,domain_right)
            domain_left = obj.detect_number(domain_left);
            if isnan(domain_left)
                error('Domain left is not detected like a number.')
            end

            domain_right = obj.detect_number(domain_right);
            if isnan(domain_right)
                error('Domain right is not detected like a number.')
            end

```

```
31              obj.knowledge_base = [obj.knowledge_base,struct('Name',name,'
                    DomainLeft',domain_left,'DomainRight',domain_right,'Terms'
                    ,[])];
32          end
33
34          function add_terms(obj,name,p1,p2,p3,p4)
35              if isempty(obj.knowledge_base)
36                  error('Knowledge base is empty');
37              end
38
39              p1 = obj.detect_number(p1);
40              p2 = obj.detect_number(p2);
41              p3 = obj.detect_number(p3);
42              p4 = obj.detect_number(p4);
43              if isnan(p1) || isnan(p2) || isnan(p3) || isnan(p4)
44                  error('A value is not detected like a number.')
45              end
46
47              obj.knowledge_base(length(obj.knowledge_base)).Terms = [obj.
                    knowledge_base(length(obj.knowledge_base)).Terms;{name p1
                    p2 p3 p4}];
48          end
49
50          function new_rule(obj,name,weight)
51              weight = obj.detect_number(weight);
52              if isnan(weight)
53                  error('Weight is not detected like a number.')
54              end
55
56              obj.rules = [obj.rules,struct('Name',name,'Weight',weight,'
                    Antecedent',[],'Consequent',[])];
57          end
58
59          function add_antecedent(obj,variable,term)
60              if isempty(obj.rules)
61                  error('Rules base is empty');
62              end
63
64              obj.rules(length(obj.rules)).Antecedent = [obj.rules(length(obj
                    .rules)).Antecedent;{variable term}];
65          end
66
67          function new_consequent(obj,variable,term)
68              if isempty(obj.rules)
69                  error('Rules base is empty');
70              end
71
72              obj.rules(length(obj.rules)).Consequent = {variable term};
73          end
74      end
75
76      methods(Access = private,Static)
77          function num = detect_number(num)
```

```
78              if iscell(num)
79                  if ~isempty(find(size(num) ~= 1,1))
80                      num = NaN;
81                  else
82                      num = num{1};
83                  end
84              end
85
86              switch class(num)
87                  case 'double'
88                      if ~isempty(find(size(num) ~= 1,1))
89                          num = NaN;
90                      end
91                  case 'char'
92                      num = str2double(num);
93                  otherwise
94                      num = NaN;
95              end
96          end
97      end
98  end
```

Código 7.1: Archivo *RulesExport.m* correspondiente al módulo JFML

7.2. Función JFML

```
function JFML(dir,name,knowledge_base,rules)
    %Load JFML.jar
    algorithmPath = fileparts(which('JFML.m'));
    jarfolder = fullfile(algorithmPath,'JFML.jar');
    javaaddpath(jarfolder);

    %Initialize FuzzyInferenceSystem
    f = javaObject('jfml.FuzzyInferenceSystem');

    %KNOWLEDGE BASE
    KnowledgeBase(f,knowledge_base);

    %RULE BASE
    RuleBase(f,rules);

    %WRITTING INTO AN XML FILE
    WriteFile(f,dir,name);

    %Clear java
    clear f;
    javarmpath(jarfolder);
end

function KnowledgeBase(f,knowledge_base)
    %Initialize KnowledgeBaseType
    kb = javaObject('jfml.knowledgebase.KnowledgeBaseType');
    javaMethod('setKnowledgeBase',f,kb);

    %FUZZY VARIABLE
    for i = 1:length(knowledge_base)-1
        s = javaObject('jfml.knowledgebase.variable.FuzzyVariableType',
            knowledge_base(i).Name,knowledge_base(i).DomainLeft,
            knowledge_base(i).DomainRight);

        %FUZZY TERM
        for j = 1:size(knowledge_base(i).Terms,1)
            term = knowledge_base(i).Terms(j,:);
            st = javaObject('jfml.term.FuzzyTermType',term{1},7,[term{2},
                term{3},term{4},term{5}]);

            javaMethod('addFuzzyTerm',s,st);
        end

        javaMethod('addVariable',kb,s);
    end

    %OUTPUT CLASS
    s = javaObject('jfml.knowledgebase.variable.FuzzyVariableType',
        knowledge_base(length(knowledge_base)).Name,knowledge_base(length(
        knowledge_base)).DomainLeft,knowledge_base(length(knowledge_base)).
```

```
        DomainRight);
46      javaMethod('setType',s,'output');
47
48      %FUZZY TERM OUTPUT CLASS
49      for j = 1:size(knowledge_base(length(knowledge_base)).Terms,1)
50          term = knowledge_base(length(knowledge_base)).Terms(j,:);
51
52          st = javaObject('jfml.term.FuzzyTermType',term{1},7,[term{2},term
                {3},term{4},term{5}]);
53
54          javaMethod('addFuzzyTerm',s,st);
55      end
56
57      javaMethod('addVariable',kb,s);
58  end
59
60  function RuleBase(f,rules)
61      % Initialize MamdaniRuleBaseType
62      rb = javaObject('jfml.rulebase.MamdaniRuleBaseType','');
63      kb = javaMethod('getKnowledgeBase',f);
64
65      %RULES
66      for i = 1:length(rules)
67          %ANTECEDENT
68          ant = javaObject('jfml.rule.AntecedentType');
69          for j = 1:size(rules(i).Antecedent,1)
70              ant_aux = rules(i).Antecedent(j,:);
71              a = javaMethod('getVariable',kb,ant_aux{1});
72              b = javaMethod('getTerm',a,ant_aux{2});
73              javaMethod('addClause',ant,javaObject('jfml.rule.ClauseType',a,
                    b));
74          end
75
76          %CONSEQUENT
77          con = javaObject('jfml.rule.ConsequentType');
78          a = javaMethod('getVariable',kb,rules(i).Consequent{1});
79          b = javaMethod('getTerm',a,rules(i).Consequent{2});
80          javaMethod('addThenClause',con,a,b);
81
82          %ADD RULE
83          r = javaObject('jfml.rule.FuzzyRuleType',rules(i).Name,'and','MIN',
                javaObject('java.lang.Float',rules(i).Weight));
84          javaMethod('setAntecedent',r,ant);
85          javaMethod('setConsequent',r,con);
86
87          javaMethod('addRule',rb,r);
88      end
89
90      javaMethod('addRuleBase',f,rb);
91  end
92
93  function WriteFile(f,dir,name)
94      % Configure directory
```

```
95      if ~exist(dir,'dir')
96          mkdir(dir);
97      end
98
99      % Export JFML
100     disp('Export JFML...');
101     a = javaObject('jfml.JFML');
102     file = javaObject('java.io.File',[dir '/' name '_JFML.xml']);
103     javaMethod('writeFSTtoXML',a,f,file);
104
105     % Export PMML
106     disp('Export PMML...');
107     b = javaObject('jfml.compatibility.ExportPMML');
108     file = [dir '/' name '_PMML.xml'];
109     javaMethod('exportFuzzySystem',b,f,file);
110 end
```

Código 7.2: Archivo *JFML.m* correspondiente al módulo JFML