MPCOTool

2.4.0

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Chapter 1

MPCOTool

The Multi-Purposes Calibration and Optimization Tool. A software to perform calibrations or optimizations of empirical parameters.

VERSIONS

- 2.4.0: Stable and recommended version.
- 3.1.0: Developing version to do new features.

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TOOLS AND LIBRARIES REQUIRED TO BUILD THE EXECUTABLE

- `gcc` or `clang` (to compile the source code)
- `make` (to build the executable file)
- `autoconf` (to generate the Makefile in different operative systems)
- `automake` (to check the operative system)
- `pkg-config` (to find the libraries to compile)
- `gsl` (to generate random numbers)
- `libxml` (to deal with XML files)
- `glib` (extended utilities of C to work with data, lists, mapped files, regular expressions, using multicores in shared memory machines, ...)
- `json-glib` (to deal with JSON files)
- `genetic` (genetic algorithm)

OPTIONAL TOOLS AND LIBRARIES

- gettext (to work with different locales)
- gtk+ (to create the interactive GUI tool)
- openmpi or mpich (to run in parallelized tasks on multiple computers)
- doxygen (standard comments format to generate documentation)
- latex (to build the PDF manuals)

FILES

The source code has to have the following files:

- 2.4.0/configure.ac: configure generator.
- 2.4.0/Makefile.in: Makefile generator.
- 2.4.0/config.h.in: config header generator.
- 2.4.0/mpcotool.c: main source code.
- 2.4.0/mpcotool.h: main header code.
- 2.4.0/interface.h: interface header code.
- 2.4.0/build: script to build all.
- 2.4.0/logo.png: logo figure.
- 2.4.0/Doxyfile: configuration file to generate doxygen documentation.
- TODO: tasks to do.
- README.md: this file.
- license.md: license file.
- tests/testX/∗: several tests to check the program working.
- locales/∗/LC_MESSAGES/mpcotool.po: translation files.
- manuals/∗.eps: manual figures in EPS format.
- manuals/∗.png: manual figures in PNG format.
- manuals/∗.tex: documentation source files.
- applications/∗/∗: several practical application cases.
- check_errors/∗.xml: several mistaken files to check error handling.

BUILDING INSTRUCTIONS

This software has been built and tested in the following operative systems. Probably, it can be built in other systems, distributions, or versions but it has not been tested.

Debian 8 (Linux, kFreeBSD or Hurd)

DragonFly BSD 4.2

Dyson Illumos

Linux Mint DE 2

NetBSD 7.0

OpenSUSE Linux 13

Ubuntu Linux 12, 14, and 15

1. Download the latest `genetic` doing on a terminal:

   $ git clone `https://github.com/jburguete/genetic.git`
2. Download this repository:

   $ git clone `https://github.com/jburguete/mpcotool.git`
3. Link the latest genetic version to genetic:

   $ cd mpcotool/2.4.0
   $ ln -s ../../genetic/2.0.1 genetic
4. Build doing on a terminal:

   $ ./build

OpenBSD 5.8

1. Select adequate versions:

   $ export AUTOCONF_VERSION=2.69 AUTOMAKE_VERSION=1.15
2. Then, in a terminal, follow steps 1 to 4 of the previous Debian 8 section.

Microsoft Windows 7 (with MSYS2)

Microsoft Windows 8.1 (with MSYS2)

1. Install `MSYS2` and the required libraries and utilities. You can follow detailed instructions in `install-unix`
2. Then, in a MSYS2 terminal, follow steps 1 to 4 of the previous Debian 8 section.
3. Optional Windows binary package can be built doing in the terminal:

   $ make windist

Fedora Linux 23

1. In order to use OpenMPI compilation do in a terminal (in 64 bits version):

   $ export PATH=$PATH:/usr/lib64/openmpi/bin
2. Then, follow steps 1 to 4 of the previous Debian 8 section.

FreeBSD 10.2

1. In order to build in FreeBSD, due to a wrong error in default gcc version, do in a terminal:

   $ export CC=gcc5 (or CC=clang)
2. Then, follow steps 1 to 4 of the previous Debian 8 section.

MAKING MANUALS INSTRUCTIONS

On UNIX type systems you need `texlive` installed. On Windows systems you need `MiKTeX`. In order to compile the manuals you can type on a terminal:

```
$ make manuals
```

MAKING TESTS INSTRUCTIONS

In order to build the tests follow the next instructions:

1. Link some tests that needs genetic library doing in a terminal (assuming that you are in the directory mpcotool/2.4.0):

   ```
   $ cd ../tests/test2
   $ ln -s ../../../genetic/2.0.1 genetic
   $ cd ../test3
   $ ln -s ../../../genetic/2.0.1 genetic
   $ cd ../test4
   $ ln -s ../../../genetic/2.0.1 genetic
   ```

2. Build all tests doing in the same terminal:

   ```
   $ cd ../../2.4.0
   $ make tests
   ```

USER INSTRUCTIONS

Optional arguments are typed in square brackets.

- Command line in sequential mode (where X is the number of threads to execute and S is a seed for the pseudo-random numbers generator):

  ```
  $ ./mpcotoolbin [-nthreads X] [-seed S] input_file.xml [result_file] [variables_file]
  ```

- Command line in parallelized mode (where X is the number of threads to open for every node and S is a seed for the pseudo-random numbers generator):

  ```
  $ mpirun [MPI options] ./mpcotoolbin [-nthreads X] [-seed S] input_file.xml [result_file] [variables↩
  _file]
  ```

- The syntax of the simulator has to be:

  ```
  $ ./simulator_name input_file_1 [input_file_2] [input_file_3] [input_file_4] output_file
  ```

- The syntax of the program to evaluate the objetive function has to be (where the first data in the results file has to be the objective function value):

  ```
  $ ./evaluator_name simulated_file data_file results_file
  ```

- On UNIX type systems the GUI application can be open doing on a terminal:

  ```
  $ ./mpcotool
  ```

INPUT FILE FORMAT

The format of the main input file is as:

```xml
<?xml version="1.0"?>
<optimize simulator="simulator_name" evaluator="evaluator_name" algorithm="algorithm_type" nsimulations="simulations_number" niterations="iterations_number" tolerance="tolerance_value" nbest="best_number" npopulation="population_number" ngenerations="generations_number" mutation="mutation_ratio" reproduction="reproduction_ratio" adaptation="adaptation_ratio" direction="direction_search_type" nsteps="steps_number" relaxation="relaxation_parameter" nestimates="estimates_number" threshold="threshold_parameter" norm="norm_type" p="p_parameter" seed="random_seed" result_file="result_file" variables_file="variables_file">
    <experiment name="data_file_1" template1="template_1_1" template2="template_1_2" ... weight="weight_1"/>
    ...
    <experiment name="data_file_N" template1="template_N_1" template2="template_N_2" ... weight="weight_N"/>
    <variable name="variable_1" minimum="min_value" maximum="max_value" precision="precision_digits" sweeps="sweeps_number" nbits="bits_number" step="step_size"/>
    ...
    <variable name="variable_M" minimum="min_value" maximum="max_value" precision="precision_digits" sweeps="sweeps_number" nbits="bits_number" step="step_size"/>
</optimize>
```

with:

- **simulator**: simulator executable file name.
- **evaluator**: optional. When needed is the evaluator executable file name.
- **seed**: optional. Seed of the pseudo-random numbers generator (default value is 7007).
- **result_file**: optional. It is the name of the optime result file (default name is "result").
- **variables_file**: optional. It is the name of all simulated variables file (default name is "variables").
- **precision**: optional, defined for each variable. Number of precision digits to evaluate the variable. 0 apply for integer numbers (default value is 14).
- **weight**: optional, defined for each experiment. Multiplies the objective value obtained for each experiment in the final objective function value (default value is 1).
- **threshold**: optional, to stop the simulations if objective function value less than the threshold is obtained (default value is 0).
- **algorithm**: optimization algorithm type.
- **norm**: error norm type.

Implemented algorithms are:

- **sweep**: Sweep brute force algorithm. It requires for each variable:
  - *sweeps*: number of sweeps to generate for each variable in every experiment.
    The total number of simulations to run is:
    > (number of experiments) x (variable 1 number of sweeps) x ... x (variable n number of sweeps) x (number of iterations)
- **Monte-Carlo**: Monte-Carlo brute force algorithm. It requires on calibrate:
  - *nsimulations*: number of simulations to run in every experiment.
    The total number of simulations to run is:
    > (number of experiments) x (number of simulations) x (number of iterations)
- Both brute force algorithms can be iterated to improve convergence by using the following parameters:

  - *nbest*: number of best simulations to calculate convergence interval on next iteration (default 1).
  - *tolerance*: tolerance parameter to increase convergence interval (default 0).
  - *niterations*: number of iterations (default 1).
    It multiplies the total number of simulations:

    x (number of iterations)

- Moreover, both brute force algorithms can be coupled with a direction search method by using:
  - *direction*: method to estimate the optimal direction. Two options are currently available:
    * coordinates: coordinates descent method.
      It increases the total number of simulations by:

      (number of experiments) x (number of iterations) x (number of steps) x 2 x (number of variables)
    * random: random method. It requires:
    * nestimates: number of random checks to estimate the optimal direction.
      It increases the total number of simulations by:

      (number of experiments) x (number of iterations) x (number of steps) x (number of estimates)

  Both methods require also:
  - nsteps: number of steps to perform the direction search method,
  - relaxation: relaxation parameter,

  and for each variable:
  - step: initial step size for the direction search method.
- **genetic**: Genetic algorithm. It requires the following parameters:
  - *npopulation*: number of population.
  - *ngenerations*: number of generations.
  - *mutation*: mutation ratio.
  - *reproduction*: reproduction ratio.
  - *adaptation*: adaptation ratio.

  and for each variable:
  - *nbits*: number of bits to encode each variable.

  The total number of simulations to run is:

  (number of experiments) x (npopulation) x [1 + (ngenerations - 1) x (mutation + reproduction + adaptation)]

Implemented error noms are:

- **euclidian**: Euclidian norm.
- **maximum**: maximum norm.
- **p**: p-norm. It requires the parameter:
  - *p*: p exponent.
- **taxicab**: Taxicab norm.

Alternatively, the input file can be also written in JSON format as:

```
{
    "simulator": "simulator_name",
    "evaluator": "evaluator_name",
    "algorithm": "algorithm_type",
    "nsimulations": "simulations_number",
    "niterations": "iterations_number",
    "tolerance": "tolerance_value",
    "nbest": "best_number",
    "npopulation": "population_number",
    "ngenerations": "generations_number",
    "mutation": "mutation_ratio",
    "reproduction": "reproduction_ratio",
    "adaptation": "adaptation_ratio",
    "direction": "direction_search_type",
    "nsteps": "steps_number",
    "relaxation": "relaxation_parameter",
    "nestimates": "estimates_number",
    "threshold": "threshold_parameter",
    "norm": "norm_type",
    "p": "p_parameter",
    "seed": "random_seed",
    "result_file": "result_file",
    "variables_file": "variables_file",
    "experiments":
    [
        {
            "name": "data_file_1",
            "template1": "template_1_1",
            "template2": "template_1_2",
            ...
            "weight": "weight_1",
        },
        ...
        {
            "name": "data_file_N",
            "template1": "template_N_1",
            "template2": "template_N_2",
            ...
            "weight": "weight_N",
        }
    ],
    "variables":
    [
        {

            "name": "variable_1",
            "minimum": "min_value",
            "maximum": "max_value",
            "precision": "precision_digits",
            "sweeps": "sweeps_number",
            "nbits": "bits_number",
            "step": "step_size",
        },
        ...
        {
            "name": "variable_M",
            "minimum": "min_value",
            "maximum": "max_value",
            "precision": "precision_digits",
            "sweeps": "sweeps_number",
            "nbits": "bits_number",
            "step": "step_size",
        }
    ]
}
```

SOME EXAMPLES OF INPUT FILES

Example 1

- The simulator program name is: *pivot*
- The syntax is:

  $ ./pivot input_file output_file

- The program to evaluate the objective function is: *compare*
- The syntax is:

$ ./compare simulated_file data_file result_file

- The calibration is performed with a *sweep brute force algorithm*.
- The experimental data files are:

  27-48.txt
  42.txt
  52.txt
  100.txt

- Templates to get input files to simulator for each experiment are:

  template1.js
  template2.js
  template3.js
  template4.js

- The variables to calibrate, ranges, precision and sweeps number to perform are:

  alpha1, [179.70, 180.20], 2, 5
  alpha2, [179.30, 179.60], 2, 5
  random, [0.00, 0.20], 2, 5
  boot-time, [0.0, 3.0], 1, 5

- Then, the number of simulations to run is: 4x5x5x5x5=2500.
- The input file is:

```
<?xml version="1.0"?>
<optimize simulator="pivot" evaluator="compare" algorithm="sweep">
    <experiment name="27-48.txt" template1="template1.js"/>
    <experiment name="42.txt" template1="template2.js"/>
    <experiment name="52.txt" template1="template3.js"/>
    <experiment name="100.txt" template1="template4.js"/>
    <variable name="alpha1" minimum="179.70" maximum="180.20" precision="2" nsweeps="5"/>
    <variable name="alpha2" minimum="179.30" maximum="179.60" precision="2" nsweeps="5"/>
    <variable name="random" minimum="0.00" maximum="0.20" precision="2" nsweeps="5"/>
    <variable name="boot-time" minimum="0.0" maximum="3.0" precision="1" nsweeps="5"/>
</optimize>
```

- A template file as *template1.js*:

```
{
  "towers" :
  [
    {
      "length"      : 50.11,
      "velocity"    : 0.02738,
      "@variable1@" : @value1@,
      "@variable2@" : @value2@,
      "@variable3@" : @value3@,
      "@variable4@" : @value4@
    },
    {
      "length"    : 50.11,
      "velocity"  : 0.02824,
      "@variable1@" : @value1@,
      "@variable2@" : @value2@,
      "@variable3@" : @value3@,
      "@variable4@" : @value4@
    },
    {
      "length"    : 50.11,
      "velocity"  : 0.03008,
      "@variable1@" : @value1@,
      "@variable2@" : @value2@,
      "@variable3@" : @value3@,
      "@variable4@" : @value4@
    },
    {
      "length"    : 50.11,
      "velocity"  : 0.03753,
      "@variable1@" : @value1@,
      "@variable2@" : @value2@,
      "@variable3@" : @value3@,
      "@variable4@" : @value4@
    }
  ],
  "cycle-time"     : 71.0,
  "plot-time"     : 1.0,
  "comp-time-step": 0.1,
  "active-percent" : 27.48
}
```

- produces simulator input files to reproduce the experimental data file *27-48.txt* as:

```
{
  "towers" :
  [
    {
      "length"      : 50.11,
      "velocity"    : 0.02738,
      "alpha1" : 179.95,
      "alpha2" : 179.45,
      "random" : 0.10,
      "boot-time" : 1.5
    },
    {
      "length"    : 50.11,
      "velocity"  : 0.02824,
      "alpha1" : 179.95,
      "alpha2" : 179.45,
      "random" : 0.10,
      "boot-time" : 1.5
    },
    {
      "length"    : 50.11,
      "velocity"  : 0.03008,
      "alpha1" : 179.95,
      "alpha2" : 179.45,
      "random" : 0.10,
      "boot-time" : 1.5
    },
    {
      "length"    : 50.11,
      "velocity"  : 0.03753,
      "alpha1" : 179.95,
      "alpha2" : 179.45,
      "random" : 0.10,
      "boot-time" : 1.5
    }
  ],
  "cycle-time"     : 71.0,
  "plot-time"     : 1.0,
  "comp-time-step": 0.1,
  "active-percent" : 27.48
}
```

Chapter 2

Data Structure Index

2.1 Data Structures

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Chapter 4

Data Structure Documentation

4.1 Experiment Struct Reference

Struct to define the experiment data.

```
#include <experiment.h>
```

Data Fields

- char ∗ name

  File name.
- char ∗ template [MAX_NINPUTS]

  Array of template names of input files.
- double weight

  Objective function weight.
- unsigned int ninputs

  Number of input files to the simulator.

4.1.1 Detailed Description

Struct to define the experiment data.

Definition at line 45 of file experiment.h.

The documentation for this struct was generated from the following file:

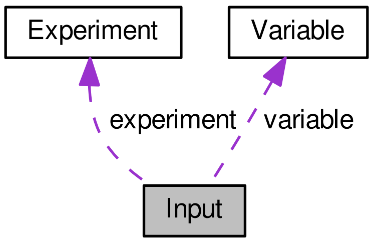
- experiment.h

4.2 Input Struct Reference

Struct to define the optimization input file.

```
#include <input.h>
```

Collaboration diagram for Input:



Data Fields

- Experiment ∗ experiment

    Array or experiments.
- Variable ∗ variable

    Array of variables.
- char ∗ result

    Name of the result file.
- char ∗ variables

    Name of the variables file.
- char ∗ simulator

    Name of the simulator program.
- char ∗ evaluator

    Name of the program to evaluate the objective function.
- char ∗ directory

    Working directory.
- char ∗ name

    Input data file name.
- double tolerance

    Algorithm tolerance.
- double mutation_ratio

    Mutation probability.
- double reproduction_ratio

    Reproduction probability.
- double adaptation_ratio

    Adaptation probability.
- double relaxation

    Relaxation parameter.

- double p

  Exponent of the P error norm.
- double threshold

  Threshold to finish the optimization.
- unsigned long int seed

  Seed of the pseudo-random numbers generator.
- unsigned int nvariables

  Variables number.
- unsigned int nexperiments

  Experiments number.
- unsigned int nsimulations

  Simulations number per experiment.
- unsigned int algorithm

  Algorithm type.
- unsigned int nsteps

  Number of steps to do the direction search method.
- unsigned int direction

  Method to estimate the direction search.
- unsigned int nestimates

  Number of simulations to estimate the direction search.
- unsigned int niterations

  Number of algorithm iterations.
- unsigned int nbest

  Number of best simulations.
- unsigned int norm

  Error norm type.

4.2.1 Detailed Description

Struct to define the optimization input file.

Definition at line 71 of file input.h.

The documentation for this struct was generated from the following file:

- input.h

4.3 Optimize Struct Reference

Struct to define the optimization ation data.

```
#include <optimize.h>
```

Data Fields

- GMappedFile ∗∗ file [MAX_NINPUTS]

    Matrix of input template files.
- char ∗∗ experiment

    Array of experimental data file names.
- char ∗∗ label

    Array of variable names.
- gsl_rng ∗ rng

    GSL random number generator.
- GeneticVariable ∗ genetic_variable

    Array of variables for the genetic algorithm.
- FILE ∗ file_result

    Result file.
- FILE ∗ file_variables

    Variables file.
- char ∗ result

    Name of the result file.
- char ∗ variables

    Name of the variables file.
- char ∗ simulator

    Name of the simulator program.
- char ∗ evaluator

    Name of the program to evaluate the objective function.
- double ∗ value

    Array of variable values.
- double ∗ rangemin

    Array of minimum variable values.
- double ∗ rangemax

    Array of maximum variable values.
- double ∗ rangeminabs

    Array of absolute minimum variable values.
- double ∗ rangemaxabs

    Array of absolute maximum variable values.
- double ∗ error_best

    Array of the best minimum errors.
- double ∗ weight

    Array of the experiment weights.
- double ∗ step

    Array of direction search method step sizes.
- double ∗ direction

    Vector of direction search estimation.
- double ∗ value_old

    Array of the best variable values on the previous step.
- double ∗ error_old

    Array of the best minimum errors on the previous step.
- unsigned int ∗ precision

    Array of variable precisions.
- unsigned int ∗ nsweeps

    Array of sweeps of the sweep algorithm.
- unsigned int ∗ nbits

Array of bits number of the genetic algorithm.
- unsigned int $*$ thread

  Array of simulation numbers to calculate on the thread.
- unsigned int $*$ thread_direction
- unsigned int $*$ simulation_best

  Array of best simulation numbers.
- double tolerance

  Algorithm tolerance.
- double mutation_ratio

  Mutation probability.
- double reproduction_ratio

  Reproduction probability.
- double adaptation_ratio

  Adaptation probability.
- double relaxation

  Relaxation parameter.
- double calculation_time

  Calculation time.
- double p

  Exponent of the P error norm.
- double threshold

  Threshold to finish the optimization.
- unsigned long int seed

  Seed of the pseudo-random numbers generator.
- unsigned int nvariables

  Variables number.
- unsigned int nexperiments

  Experiments number.
- unsigned int ninputs

  Number of input files to the simulator.
- unsigned int nsimulations

  Simulations number per experiment.
- unsigned int nsteps

  Number of steps for the direction search method.
- unsigned int nestimates

  Number of simulations to estimate the direction.
- unsigned int algorithm

  Algorithm type.
- unsigned int nstart

  Beginning simulation number of the task.
- unsigned int nend

  Ending simulation number of the task.
- unsigned int nstart_direction

  Beginning simulation number of the task for the direction search method.
- unsigned int nend_direction

  Ending simulation number of the task for the direction search method.
- unsigned int niterations

  Number of algorithm iterations.
- unsigned int nbest

  Number of best simulations.
- unsigned int nsaveds

Number of saved simulations.
- unsigned int stop

  To stop the simulations.
- int mpi_rank

  Number of MPI task.

4.3.1 Detailed Description

Struct to define the optimization ation data.

Definition at line 45 of file optimize.h.

4.3.2 Field Documentation

4.3.2.1 unsigned int∗ Optimize::thread_direction

Array of simulation numbers to calculate on the thread for the direction search method.

Definition at line 80 of file optimize.h.

The documentation for this struct was generated from the following file:

- optimize.h

4.4 Options Struct Reference

Struct to define the options dialog.

```
#include <interface.h>
```

Data Fields

- GtkDialog ∗ dialog

  Main GtkDialog.
- GtkGrid ∗ grid

  Main GtkGrid.
- GtkLabel ∗ label_seed

  Pseudo-random numbers generator seed GtkLabel.
- GtkSpinButton ∗ spin_seed

  Pseudo-random numbers generator seed GtkSpinButton.
- GtkLabel ∗ label_threads

  Threads number GtkLabel.
- GtkSpinButton ∗ spin_threads

  Threads number GtkSpinButton.
- GtkLabel ∗ label_direction

  Direction threads number GtkLabel.
- GtkSpinButton ∗ spin_direction

  Direction threads number GtkSpinButton.

4.4.1 Detailed Description

Struct to define the options dialog.

Definition at line 48 of file interface.h.

The documentation for this struct was generated from the following file:

- interface.h

4.5 ParallelData Struct Reference

Struct to pass to the GThreads parallelized function.

```
#include <optimize.h>
```

Data Fields

- unsigned int thread
  Thread number.

4.5.1 Detailed Description

Struct to pass to the GThreads parallelized function.

Definition at line 122 of file optimize.h.

The documentation for this struct was generated from the following file:

- optimize.h

4.6 Running Struct Reference

Struct to define the running dialog.

```
#include <interface.h>
```

Data Fields

- GtkDialog ∗ dialog
  Main GtkDialog.
- GtkLabel ∗ label
  Label GtkLabel.
- GtkSpinner ∗ spinner
  Animation GtkSpinner.
- GtkGrid ∗ grid
  Grid GtkGrid.

4.6.1 Detailed Description

Struct to define the running dialog.

Definition at line 67 of file interface.h.

The documentation for this struct was generated from the following file:

- interface.h

4.7 Variable Struct Reference

Struct to define the variable data.

```
#include <variable.h>
```

Data Fields

- char ∗ name

  Variable name.
- double rangemin

  Minimum variable value.
- double rangemax

  Maximum variable value.
- double rangeminabs

  Absolute minimum variable value.
- double rangemaxabs

  Absolute maximum variable value.
- double step

  Direction search method step size.
- unsigned int precision

  Variable precision.
- unsigned int nsweeps

  Sweeps of the sweep algorithm.
- unsigned int nbits

  Bits number of the genetic algorithm.

4.7.1 Detailed Description

Struct to define the variable data.

Definition at line 56 of file variable.h.

The documentation for this struct was generated from the following file:

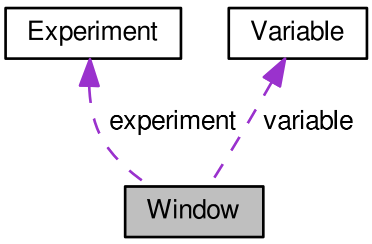
- variable.h

4.8 Window Struct Reference

Struct to define the main window.

```
#include <interface.h>
```

Collaboration diagram for Window:



Data Fields

- GtkWindow ∗ window

  Main GtkWindow.
- GtkGrid ∗ grid

  Main GtkGrid.
- GtkToolbar ∗ bar_buttons

  GtkToolbar to store the main buttons.
- GtkToolButton ∗ button_open

  Open GtkToolButton.
- GtkToolButton ∗ button_save

  Save GtkToolButton.
- GtkToolButton ∗ button_run

  Run GtkToolButton.
- GtkToolButton ∗ button_options

  Options GtkToolButton.
- GtkToolButton ∗ button_help

  Help GtkToolButton.
- GtkToolButton ∗ button_about

  Help GtkToolButton.
- GtkToolButton ∗ button_exit

  Exit GtkToolButton.
- GtkGrid ∗ grid_files

  Files GtkGrid.
- GtkLabel ∗ label_simulator

  Simulator program GtkLabel.
- GtkFileChooserButton ∗ button_simulator

  Simulator program GtkFileChooserButton.

- GtkCheckButton ∗ check_evaluator

    Evaluator program GtkCheckButton.
- GtkFileChooserButton ∗ button_evaluator

    Evaluator program GtkFileChooserButton.
- GtkLabel ∗ label_result

    Result file GtkLabel.
- GtkEntry ∗ entry_result

    Result file GtkEntry.
- GtkLabel ∗ label_variables

    Variables file GtkLabel.
- GtkEntry ∗ entry_variables

    Variables file GtkEntry.
- GtkFrame ∗ frame_norm

    GtkFrame to set the error norm.
- GtkGrid ∗ grid_norm

    GtkGrid to set the error norm.
- GtkRadioButton ∗ button_norm [NNORMS]

    Array of GtkButtons to set the error norm.
- GtkLabel ∗ label_p

    GtkLabel to set the p parameter.
- GtkSpinButton ∗ spin_p

    GtkSpinButton to set the p parameter.
- GtkScrolledWindow ∗ scrolled_p

    GtkScrolledWindow to set the p parameter.
- GtkFrame ∗ frame_algorithm

    GtkFrame to set the algorithm.
- GtkGrid ∗ grid_algorithm

    GtkGrid to set the algorithm.
- GtkRadioButton ∗ button_algorithm [NALGORITHMS]

    Array of GtkButtons to set the algorithm.
- GtkLabel ∗ label_simulations

    GtkLabel to set the simulations number.
- GtkSpinButton ∗ spin_simulations

    GtkSpinButton to set the simulations number.
- GtkLabel ∗ label_iterations

    GtkLabel to set the iterations number.
- GtkSpinButton ∗ spin_iterations

    GtkSpinButton to set the iterations number.
- GtkLabel ∗ label_tolerance

    GtkLabel to set the tolerance.
- GtkSpinButton ∗ spin_tolerance

    GtkSpinButton to set the tolerance.
- GtkLabel ∗ label_bests

    GtkLabel to set the best number.
- GtkSpinButton ∗ spin_bests

    GtkSpinButton to set the best number.
- GtkLabel ∗ label_population

    GtkLabel to set the population number.
- GtkSpinButton ∗ spin_population

    GtkSpinButton to set the population number.
- GtkLabel ∗ label_generations

GtkLabel to set the generations number.

- GtkSpinButton ∗ spin_generations

  GtkSpinButton to set the generations number.
- GtkLabel ∗ label_mutation

  GtkLabel to set the mutation ratio.
- GtkSpinButton ∗ spin_mutation

  GtkSpinButton to set the mutation ratio.
- GtkLabel ∗ label_reproduction

  GtkLabel to set the reproduction ratio.
- GtkSpinButton ∗ spin_reproduction

  GtkSpinButton to set the reproduction ratio.
- GtkLabel ∗ label_adaptation

  GtkLabel to set the adaptation ratio.
- GtkSpinButton ∗ spin_adaptation

  GtkSpinButton to set the adaptation ratio.
- GtkCheckButton ∗ check_direction

  GtkCheckButton to check running the direction search method.
- GtkGrid ∗ grid_direction

  GtkGrid to pack the direction search method widgets.
- GtkRadioButton ∗ button_direction [NDIRECTIONS]

  GtkRadioButtons array to set the direction estimate method.
- GtkLabel ∗ label_steps

  GtkLabel to set the steps number.
- GtkSpinButton ∗ spin_steps

  GtkSpinButton to set the steps number.
- GtkLabel ∗ label_estimates

  GtkLabel to set the estimates number.
- GtkSpinButton ∗ spin_estimates

  GtkSpinButton to set the estimates number.
- GtkLabel ∗ label_relaxation

  GtkLabel to set the relaxation parameter.
- GtkSpinButton ∗ spin_relaxation

  GtkSpinButton to set the relaxation parameter.
- GtkLabel ∗ label_threshold

  GtkLabel to set the threshold.
- GtkSpinButton ∗ spin_threshold

  GtkSpinButton to set the threshold.
- GtkScrolledWindow ∗ scrolled_threshold

  GtkScrolledWindow to set the threshold.
- GtkFrame ∗ frame_variable

  Variable GtkFrame.
- GtkGrid ∗ grid_variable

  Variable GtkGrid.
- GtkComboBoxText ∗ combo_variable

  GtkComboBoxEntry to select a variable.
- GtkButton ∗ button_add_variable

  GtkButton to add a variable.
- GtkButton ∗ button_remove_variable

  GtkButton to remove a variable.
- GtkLabel ∗ label_variable

  Variable GtkLabel.

- GtkEntry ∗ entry_variable

  GtkEntry to set the variable name.
- GtkLabel ∗ label_min

  Minimum GtkLabel.
- GtkSpinButton ∗ spin_min

  Minimum GtkSpinButton.
- GtkScrolledWindow ∗ scrolled_min

  Minimum GtkScrolledWindow.
- GtkLabel ∗ label_max

  Maximum GtkLabel.
- GtkSpinButton ∗ spin_max

  Maximum GtkSpinButton.
- GtkScrolledWindow ∗ scrolled_max

  Maximum GtkScrolledWindow.
- GtkCheckButton ∗ check_minabs

  Absolute minimum GtkCheckButton.
- GtkSpinButton ∗ spin_minabs

  Absolute minimum GtkSpinButton.
- GtkScrolledWindow ∗ scrolled_minabs

  Absolute minimum GtkScrolledWindow.
- GtkCheckButton ∗ check_maxabs

  Absolute maximum GtkCheckButton.
- GtkSpinButton ∗ spin_maxabs

  Absolute maximum GtkSpinButton.
- GtkScrolledWindow ∗ scrolled_maxabs

  Absolute maximum GtkScrolledWindow.
- GtkLabel ∗ label_precision

  Precision GtkLabel.
- GtkSpinButton ∗ spin_precision

  Precision digits GtkSpinButton.
- GtkLabel ∗ label_sweeps

  Sweeps number GtkLabel.
- GtkSpinButton ∗ spin_sweeps

  Sweeps number GtkSpinButton.
- GtkLabel ∗ label_bits

  Bits number GtkLabel.
- GtkSpinButton ∗ spin_bits

  Bits number GtkSpinButton.
- GtkLabel ∗ label_step

  GtkLabel to set the step.
- GtkSpinButton ∗ spin_step

  GtkSpinButton to set the step.
- GtkScrolledWindow ∗ scrolled_step

  step GtkScrolledWindow.
- GtkFrame ∗ frame_experiment

  Experiment GtkFrame.
- GtkGrid ∗ grid_experiment

  Experiment GtkGrid.
- GtkComboBoxText ∗ combo_experiment

  Experiment GtkComboBoxEntry.
- GtkButton ∗ button_add_experiment

GtkButton to add a experiment.
- GtkButton ∗ button_remove_experiment

  GtkButton to remove a experiment.
- GtkLabel ∗ label_experiment

  Experiment GtkLabel.
- GtkFileChooserButton ∗ button_experiment

  GtkFileChooserButton to set the experimental data file.
- GtkLabel ∗ label_weight

  Weight GtkLabel.
- GtkSpinButton ∗ spin_weight

  Weight GtkSpinButton.
- GtkCheckButton ∗ check_template [MAX_NINPUTS]

  Array of GtkCheckButtons to set the input templates.
- GtkFileChooserButton ∗ button_template [MAX_NINPUTS]

  Array of GtkFileChooserButtons to set the input templates.
- GdkPixbuf ∗ logo

  Logo GdkPixbuf.
- Experiment ∗ experiment

  Array of experiments data.
- Variable ∗ variable

  Array of variables data.
- char ∗ application_directory

  Application directory.
- gulong id_experiment

  Identifier of the combo_experiment signal.
- gulong id_experiment_name

  Identifier of the button_experiment signal.
- gulong id_variable

  Identifier of the combo_variable signal.
- gulong id_variable_label

  Identifier of the entry_variable signal.
- gulong id_template [MAX_NINPUTS]

  Array of identifiers of the check_template signal.
- gulong id_input [MAX_NINPUTS]

  Array of identifiers of the button_template signal.
- unsigned int nexperiments

  Number of experiments.
- unsigned int nvariables

  Number of variables.

4.8.1 Detailed Description

Struct to define the main window.

Definition at line 79 of file interface.h.

The documentation for this struct was generated from the following file:

- interface.h

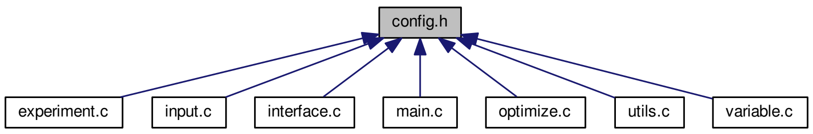
Chapter 5

File Documentation

5.1 config.h File Reference

Configuration header file.

This graph shows which files directly or indirectly include this file:



Macros

- #define MAX_NINPUTS 8

    Maximum number of input files in the simulator program.
- #define NALGORITHMS 3

    Number of stochastic algorithms.
- #define NDIRECTIONS 2

    Number of direction estimate methods.
- #define NNORMS 4

    Number of error norms.
- #define NPRECISIONS 15

    Number of precisions.
- #define DEFAULT_PRECISION (NPRECISIONS - 1)

    Default precision digits.
- #define DEFAULT_RANDOM_SEED 7007

    Default pseudo-random numbers seed.
- #define DEFAULT_RELAXATION 1.

    Default relaxation parameter.
- #define LOCALE_DIR "locales"

Locales directory.
- #define PROGRAM_INTERFACE "mpcotool"

  Name of the interface program.
- #define XML_ABSOLUTE_MINIMUM (const xmlChar∗)"absolute_minimum"

  absolute minimum XML label.
- #define XML_ABSOLUTE_MAXIMUM (const xmlChar∗)"absolute_maximum"

  absolute maximum XML label.
- #define XML_ADAPTATION (const xmlChar∗)"adaptation"

  adaption XML label.
- #define XML_ALGORITHM (const xmlChar∗)"algorithm"

  algoritm XML label.
- #define XML_OPTIMIZE (const xmlChar∗)"optimize"

  optimize XML label.
- #define XML_COORDINATES (const xmlChar∗)"coordinates"

  coordinates XML label.
- #define XML_DIRECTION (const xmlChar∗)"direction"

  direction XML label.
- #define XML_EUCLIDIAN (const xmlChar∗)"euclidian"

  euclidian XML label.
- #define XML_EVALUATOR (const xmlChar∗)"evaluator"

  evaluator XML label.
- #define XML_EXPERIMENT (const xmlChar∗)"experiment"

  experiment XML label.
- #define XML_GENETIC (const xmlChar∗)"genetic"

  genetic XML label.
- #define XML_MINIMUM (const xmlChar∗)"minimum"

  minimum XML label.
- #define XML_MAXIMUM (const xmlChar∗)"maximum"

  maximum XML label.
- #define XML_MONTE_CARLO (const xmlChar∗)"Monte-Carlo"

  Monte-Carlo XML label.
- #define XML_MUTATION (const xmlChar∗)"mutation"

  mutation XML label.
- #define XML_NAME (const xmlChar∗)"name"

  name XML label.
- #define XML_NBEST (const xmlChar∗)"nbest"

  nbest XML label.
- #define XML_NBITS (const xmlChar∗)"nbits"

  nbits XML label.
- #define XML_NESTIMATES (const xmlChar∗)"nestimates"

  nestimates XML label.
- #define XML_NGENERATIONS (const xmlChar∗)"ngenerations"

  ngenerations XML label.
- #define XML_NITERATIONS (const xmlChar∗)"niterations"

  niterations XML label.
- #define XML_NORM (const xmlChar∗)"norm"

  norm XML label.
- #define XML_NPOPULATION (const xmlChar∗)"npopulation"

  npopulation XML label.
- #define XML_NSIMULATIONS (const xmlChar∗)"nsimulations"

  nsimulations XML label.

- #define XML_NSTEPS (const xmlChar∗)"nsteps"

  nsteps XML label.
- #define XML_NSWEEPS (const xmlChar∗)"nsweeps"

  nsweeps XML label.
- #define XML_P (const xmlChar∗)"p"

  p XML label.
- #define XML_PRECISION (const xmlChar∗)"precision"

  precision XML label.
- #define XML_RANDOM (const xmlChar∗)"random"

  random XML label.
- #define XML_RELAXATION (const xmlChar∗)"relaxation"

  relaxation XML label.
- #define XML_REPRODUCTION (const xmlChar∗)"reproduction"

  reproduction XML label.
- #define XML_RESULT (const xmlChar∗)"result"

  result XML label.
- #define XML_SIMULATOR (const xmlChar∗)"simulator"

  simulator XML label.
- #define XML_SEED (const xmlChar∗)"seed"

  seed XML label.
- #define XML_STEP (const xmlChar∗)"step"

  step XML label.
- #define XML_SWEEP (const xmlChar∗)"sweep"

  sweep XML label.
- #define XML_TAXICAB (const xmlChar∗)"taxicab"

  taxicab XML label.
- #define XML_TEMPLATE1 (const xmlChar∗)"template1"

  template1 XML label.
- #define XML_TEMPLATE2 (const xmlChar∗)"template2"

  template2 XML label.
- #define XML_TEMPLATE3 (const xmlChar∗)"template3"

  template3 XML label.
- #define XML_TEMPLATE4 (const xmlChar∗)"template4"

  template4 XML label.
- #define XML_TEMPLATE5 (const xmlChar∗)"template5"

  template5 XML label.
- #define XML_TEMPLATE6 (const xmlChar∗)"template6"

  template6 XML label.
- #define XML_TEMPLATE7 (const xmlChar∗)"template7"

  template7 XML label.
- #define XML_TEMPLATE8 (const xmlChar∗)"template8"

  template8 XML label.
- #define XML_THRESHOLD (const xmlChar∗)"threshold"

  threshold XML label.
- #define XML_TOLERANCE (const xmlChar∗)"tolerance"

  tolerance XML label.
- #define XML_VARIABLE (const xmlChar∗)"variable"

  variable XML label.
- #define XML_VARIABLES (const xmlChar∗)"variables"

  variables XML label.
- #define XML_WEIGHT (const xmlChar∗)"weight"

  weight XML label.

5.1.1 Detailed Description

Configuration header file.

Authors

Javier Burguete and Borja Latorre.

Copyright

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Definition in file config.h.

5.2 config.h

```
/* config.h.  Generated from config.h.in by configure.  */
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#ifndef CONFIG__H
#define CONFIG__H 1

// Array sizes

#define MAX_NINPUTS 8
#define NALGORITHMS 3
#define NDIRECTIONS 2
#define NNORMS 4
#define NPRECISIONS 15

// Default choices

#define DEFAULT_PRECISION (NPRECISIONS - 1)
#define DEFAULT_RANDOM_SEED 7007
#define DEFAULT_RELAXATION 1.

// Interface labels

#define LOCALE_DIR "locales"
#define PROGRAM_INTERFACE "mpcotool"

// XML labels

```
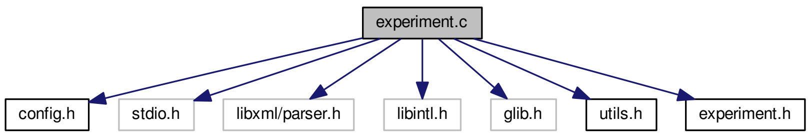

```
#define XML_ABSOLUTE_MINIMUM (const xmlChar*)"absolute_minimum"
#define XML_ABSOLUTE_MAXIMUM (const xmlChar*)"absolute_maximum"
#define XML_ADAPTATION (const xmlChar*)"adaptation"
#define XML_ALGORITHM (const xmlChar*)"algorithm"
#define XML_OPTIMIZE (const xmlChar*)"optimize"
#define XML_COORDINATES (const xmlChar*)"coordinates"
#define XML_DIRECTION (const xmlChar*)"direction"
#define XML_EUCLIDIAN (const xmlChar*)"euclidian"
#define XML_EVALUATOR (const xmlChar*)"evaluator"
#define XML_EXPERIMENT (const xmlChar*)"experiment"
#define XML_GENETIC (const xmlChar*)"genetic"
#define XML_MINIMUM (const xmlChar*)"minimum"
#define XML_MAXIMUM (const xmlChar*)"maximum"
#define XML_MONTE_CARLO (const xmlChar*)"Monte-Carlo"
#define XML_MUTATION (const xmlChar*)"mutation"
#define XML_NAME (const xmlChar*)"name"
#define XML_NBEST (const xmlChar*)"nbest"
#define XML_NBITS (const xmlChar*)"nbits"
#define XML_NESTIMATES (const xmlChar*)"nestimates"
#define XML_NGENERATIONS (const xmlChar*)"ngenerations"
#define XML_NITERATIONS (const xmlChar*)"niterations"
#define XML_NORM (const xmlChar*)"norm"
#define XML_NPOPULATION (const xmlChar*)"npopulation"
#define XML_NSIMULATIONS (const xmlChar*)"nsimulations"
#define XML_NSTEPS (const xmlChar*)"nsteps"
#define XML_NSWEEPS (const xmlChar*)"nsweeps"
#define XML_P (const xmlChar*)"p"
#define XML_PRECISION (const xmlChar*)"precision"
#define XML_RANDOM (const xmlChar*)"random"
#define XML_RELAXATION (const xmlChar*)"relaxation"
#define XML_REPRODUCTION (const xmlChar*)"reproduction"
#define XML_RESULT (const xmlChar*)"result"
#define XML_SIMULATOR (const xmlChar*)"simulator"
#define XML_SEED (const xmlChar*)"seed"
#define XML_STEP (const xmlChar*)"step"
#define XML_SWEEP (const xmlChar*)"sweep"
#define XML_TAXICAB (const xmlChar*)"taxicab"
#define XML_TEMPLATE1 (const xmlChar*)"template1"
#define XML_TEMPLATE2 (const xmlChar*)"template2"
#define XML_TEMPLATE3 (const xmlChar*)"template3"
#define XML_TEMPLATE4 (const xmlChar*)"template4"
#define XML_TEMPLATE5 (const xmlChar*)"template5"
#define XML_TEMPLATE6 (const xmlChar*)"template6"
#define XML_TEMPLATE7 (const xmlChar*)"template7"
#define XML_TEMPLATE8 (const xmlChar*)"template8"
#define XML_THRESHOLD (const xmlChar*)"threshold"
#define XML_TOLERANCE (const xmlChar*)"tolerance"
#define XML_VARIABLE (const xmlChar*)"variable"
#define XML_VARIABLES (const xmlChar*)"variables"
#define XML_WEIGHT (const xmlChar*)"weight"

#endif
```

5.3 experiment.c File Reference

Source file to define the experiment data.

```
#include "config.h"
#include <stdio.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include "utils.h"
#include "experiment.h"
```

Include dependency graph for experiment.c:



Macros

- #define **_GNU_SOURCE**
- #define DEBUG_EXPERIMENT 0

    Macro to debug experiment functions.

Functions

- void experiment_new (Experiment ∗experiment)

    Function to create a new Experiment struct.
- void experiment_free (Experiment ∗experiment)

    Function to free the memory of an Experiment struct.
- void experiment_error (Experiment ∗experiment, char ∗message)

    Function to print a message error opening an Experiment struct.
- int experiment_open (Experiment ∗experiment, xmlNode ∗node, unsigned int ninputs)

    Function to open the Experiment struct on a XML node.

Variables

- const xmlChar ∗ template [MAX_NINPUTS]

    Array of xmlChar strings with template labels.

5.3.1 Detailed Description

Source file to define the experiment data.

Authors

Javier Burguete and Borja Latorre.

Copyright

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Definition in file experiment.c.

5.3.2 Function Documentation

5.3.2.1 void experiment_error (**Experiment** ∗ ***experiment,*** char ∗ ***message***)

Function to print a message error opening an Experiment struct.

Parameters

experiment	Experiment struct.
message	Error message.

Definition at line 109 of file experiment.c.

```
00110 {
00111   char buffer[64];
00112   if (!experiment->name)
00113     snprintf (buffer, 64, "%s: %s", gettext ("Experiment"), message);
00114   else
00115     snprintf (buffer, 64, "%s %s: %s", gettext ("Experiment"), experiment->name,
00116               message);
00117   error_message = g_strdup (buffer);
00118 }
```

5.3.2.2 void experiment_free (Experiment ∗ *experiment*)

Function to free the memory of an Experiment struct.

Parameters

experiment	Experiment struct.

Definition at line 85 of file experiment.c.

```
00086 {
00087   unsigned int i;
00088 #if DEBUG_EXPERIMENT
00089   fprintf (stderr, "experiment_free: start\n");
00090 #endif
00091   for (i = 0; i < experiment->ninputs; ++i)
00092     xmlFree (experiment->template[i]);
00093   xmlFree (experiment->name);
00094   experiment->ninputs = 0;
00095 #if DEBUG_EXPERIMENT
00096   fprintf (stderr, "experiment_free: end\n");
00097 #endif
00098 }
```

5.3.2.3 void experiment_new (Experiment ∗ *experiment*)

Function to create a new Experiment struct.

Parameters

experiment	Experiment struct.

Definition at line 63 of file experiment.c.

```
00064 {
00065   unsigned int i;
00066 #if DEBUG_EXPERIMENT
00067   fprintf (stderr, "experiment_new: start\n");
00068 #endif
00069   experiment->name = NULL;
00070   experiment->ninputs = 0;
00071   for (i = 0; i < MAX_NINPUTS; ++i)
00072     experiment->template[i] = NULL;
00073 #if DEBUG_EXPERIMENT
00074   fprintf (stderr, "input_new: end\n");
00075 #endif
00076 }
```

5.3.2.4 int experiment_open (Experiment ∗ *experiment,* xmlNode ∗ *node,* unsigned int *ninputs*)

Function to open the Experiment struct on a XML node.

Parameters

experiment	Experiment struct.
node	XML node.
ninputs	Number of the simulator input files.

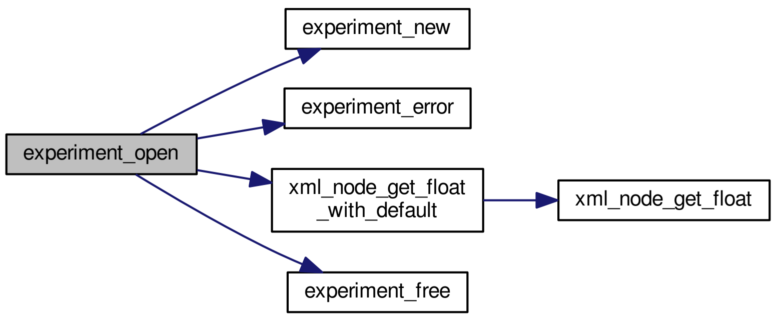
Returns

1 on success, 0 on error.

Definition at line 133 of file experiment.c.

```
{
  char buffer[64];
  int error_code;
  unsigned int i;

#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: start\n");
#endif

  // Resetting experiment data
  experiment_new (experiment);

  // Reading the experimental data
  experiment->name = (char *) xmlGetProp (node, XML_NAME);
  if (!experiment->name)
    {
      experiment_error (experiment, gettext ("no data file name"));
      goto exit_on_error;
    }
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: name=%s\n", experiment->name);
#endif
  experiment->weight
    = xml_node_get_float_with_default (node,
XML_WEIGHT, 1., &error_code);
  if (error_code)
    {
      experiment_error (experiment, gettext ("bad weight"));
      goto exit_on_error;
    }
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: weight=%lg\n", experiment->weight);
#endif
  experiment->template[0] = (char *) xmlGetProp (node, template[0]);
  if (experiment->template[0])
    {
#if DEBUG_EXPERIMENT
      fprintf (stderr, "experiment_open: experiment=%s template1=%s\n",
               experiment->name, buffer2[0]);
#endif
      ++experiment->ninputs;
    }
  else
    {
      experiment_error (experiment, gettext ("no template"));
      goto exit_on_error;
    }
  for (i = 1; i < MAX_NINPUTS; ++i)
    {
#if DEBUG_EXPERIMENT
      fprintf (stderr, "experiment_open: template%u\n", i + 1);
#endif
      if (xmlHasProp (node, template[i]))
        {
          if (ninputs && ninputs <= i)
            {
              experiment_error (experiment, gettext ("bad templates number"));
              goto exit_on_error;
            }
          experiment->template[i] = (char *) xmlGetProp (node, template[i]);
#if DEBUG_EXPERIMENT
          fprintf (stderr, "experiment_open: experiment=%s template%u=%s\n",
                   experiment->nexperiments, experiment->name,
                   experiment->template[i]);
#endif
          ++experiment->ninputs;
        }
      else if (ninputs && ninputs > i)
        {
          snprintf (buffer, 64, "%s%u", gettext ("no template"), i + 1);
          experiment_error (experiment, buffer);
          goto exit_on_error;
        }
      else
        break;
    }

#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: end\n");
#endif
  return 1;

exit_on_error:
  experiment_free (experiment);
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: end\n");
#endif
  return 0;
}
```

Here is the call graph for this function:



5.3.3 Variable Documentation

5.3.3.1 const xmlChar∗ template[MAX_NINPUTS]

Initial value:

```
= {
  XML_TEMPLATE1, XML_TEMPLATE2, XML_TEMPLATE3,
      XML_TEMPLATE4,
  XML_TEMPLATE5, XML_TEMPLATE6, XML_TEMPLATE7,
      XML_TEMPLATE8
}
```

Array of xmlChar strings with template labels.

Definition at line 49 of file experiment.c.

5.4 experiment.c

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#define _GNU_SOURCE
#include "config.h"
#include <stdio.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include "utils.h"
#include "experiment.h"

#define DEBUG_EXPERIMENT 0

const xmlChar *template[MAX_NINPUTS] = {
  XML_TEMPLATE1, XML_TEMPLATE2, XML_TEMPLATE3, XML_TEMPLATE4,
  XML_TEMPLATE5, XML_TEMPLATE6, XML_TEMPLATE7, XML_TEMPLATE8
};


void
experiment_new (Experiment * experiment)
{
  unsigned int i;
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_new: start\n");
#endif
  experiment->name = NULL;
  experiment->ninputs = 0;
  for (i = 0; i < MAX_NINPUTS; ++i)
    experiment->template[i] = NULL;
#if DEBUG_EXPERIMENT
  fprintf (stderr, "input_new: end\n");
#endif
}

void
experiment_free (Experiment * experiment)
{
  unsigned int i;
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_free: start\n");
#endif
  for (i = 0; i < experiment->ninputs; ++i)
    xmlFree (experiment->template[i]);
  xmlFree (experiment->name);
  experiment->ninputs = 0;
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_free: end\n");
#endif
}

void
experiment_error (Experiment * experiment, char *message)
```
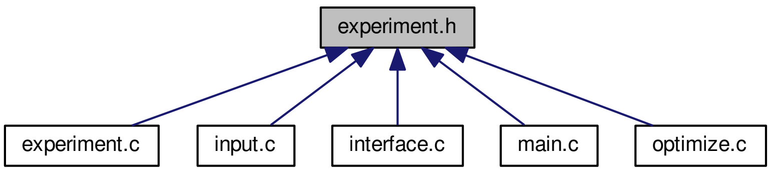

```
{
  char buffer[64];
  if (!experiment->name)
    snprintf (buffer, 64, "%s: %s", gettext ("Experiment"), message);
  else
    snprintf (buffer, 64, "%s %s: %s", gettext ("Experiment"), experiment->name,
              message);
  error_message = g_strdup (buffer);
}

int
experiment_open (Experiment * experiment, xmlNode * node, unsigned int ninputs)
{
  char buffer[64];
  int error_code;
  unsigned int i;

#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: start\n");
#endif

  // Resetting experiment data
  experiment_new (experiment);

  // Reading the experimental data
  experiment->name = (char *) xmlGetProp (node, XML_NAME);
  if (!experiment->name)
    {
      experiment_error (experiment, gettext ("no data file name"));
      goto exit_on_error;
    }
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: name=%s\n", experiment->name);
#endif
  experiment->weight
    = xml_node_get_float_with_default (node,
XML_WEIGHT, 1., &error_code);
  if (error_code)
    {
      experiment_error (experiment, gettext ("bad weight"));
      goto exit_on_error;
    }
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: weight=%lg\n", experiment->weight);
#endif
  experiment->template[0] = (char *) xmlGetProp (node, template[0]);
  if (experiment->template[0])
    {
#if DEBUG_EXPERIMENT
      fprintf (stderr, "experiment_open: experiment=%s template1=%s\n",
               experiment->name, buffer2[0]);
#endif
      ++experiment->ninputs;
    }
  else
    {
      experiment_error (experiment, gettext ("no template"));
      goto exit_on_error;
    }
  for (i = 1; i < MAX_NINPUTS; ++i)
    {
#if DEBUG_EXPERIMENT
      fprintf (stderr, "experiment_open: template%u\n", i + 1);
#endif
      if (xmlHasProp (node, template[i]))
        {
          if (ninputs && ninputs <= i)
            {
              experiment_error (experiment, gettext ("bad templates number"));
              goto exit_on_error;
            }
          experiment->template[i] = (char *) xmlGetProp (node, template[i]);
#if DEBUG_EXPERIMENT
          fprintf (stderr, "experiment_open: experiment=%s template%u=%s\n",
                   experiment->nexperiments, experiment->name,
                   experiment->template[i]);
#endif
          ++experiment->ninputs;
        }
      else if (ninputs && ninputs > i)
        {
          snprintf (buffer, 64, "%s%u", gettext ("no template"), i + 1);
          experiment_error (experiment, buffer);
          goto exit_on_error;
        }
      else
        break;
    }

#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: end\n");
#endif
  return 1;

exit_on_error:
  experiment_free (experiment);
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: end\n");
#endif
  return 0;
}
```

5.5 experiment.h File Reference

Header file to define the experiment data.

This graph shows which files directly or indirectly include this file:



Data Structures

- struct Experiment

  Struct to define the experiment data.

Functions

- void experiment_new (Experiment ∗experiment)

  Function to create a new Experiment struct.
- void experiment_free (Experiment ∗experiment)

  Function to free the memory of an Experiment struct.
- void experiment_error (Experiment ∗experiment, char ∗message)

  Function to print a message error opening an Experiment struct.
- int experiment_open (Experiment ∗experiment, xmlNode ∗node, unsigned int ninputs)

  Function to open the Experiment struct on a XML node.

Variables

- const xmlChar ∗ template [MAX_NINPUTS]

  Array of xmlChar strings with template labels.

5.5.1 Detailed Description

Header file to define the experiment data.

Authors

Javier Burguete.

Copyright

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Definition in file experiment.h.

5.5.2 Function Documentation

5.5.2.1 void experiment_error (**Experiment** ∗ *experiment,* char ∗ *message*)

Function to print a message error opening an Experiment struct.

Parameters

experiment	Experiment struct.
message	Error message.

Definition at line 109 of file experiment.c.

```
{
  char buffer[64];
  if (!experiment->name)
    snprintf (buffer, 64, "%s: %s", gettext ("Experiment"), message);
  else
    snprintf (buffer, 64, "%s %s: %s", gettext ("Experiment"), experiment->name,
              message);
  error_message = g_strdup (buffer);
}
```

5.5.2.2 void experiment_free (**Experiment** ∗ *experiment*)

Function to free the memory of an Experiment struct.

Parameters

experiment	Experiment struct.

Definition at line 85 of file experiment.c.

```
{
  unsigned int i;
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_free: start\n");
#endif
  for (i = 0; i < experiment->ninputs; ++i)
    xmlFree (experiment->template[i]);
  xmlFree (experiment->name);
  experiment->ninputs = 0;
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_free: end\n");
#endif
}
```

5.5.2.3 void experiment_new (Experiment ∗ *experiment*)

Function to create a new Experiment struct.

Parameters

experiment	Experiment struct.

Definition at line 63 of file experiment.c.

```
{
  unsigned int i;
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_new: start\n");
#endif
  experiment->name = NULL;
  experiment->ninputs = 0;
  for (i = 0; i < MAX_NINPUTS; ++i)
    experiment->template[i] = NULL;
#if DEBUG_EXPERIMENT
  fprintf (stderr, "input_new: end\n");
#endif
}
```

5.5.2.4 int experiment_open (Experiment ∗ *experiment,* xmlNode ∗ *node,* unsigned int *ninputs*)

Function to open the Experiment struct on a XML node.

Parameters

experiment	Experiment struct.
node	XML node.
ninputs	Number of the simulator input files.

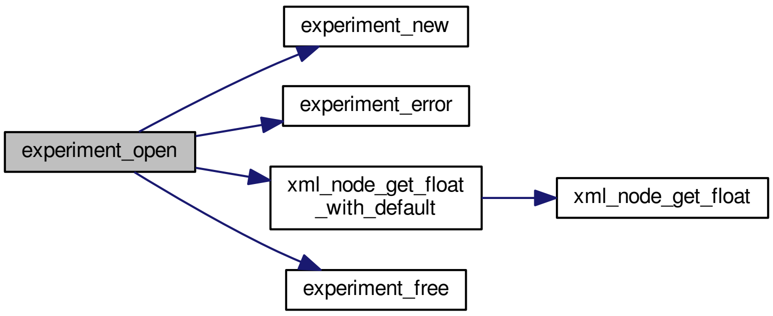
Returns

1 on success, 0 on error.

Definition at line 133 of file experiment.c.

```
{
  char buffer[64];
  int error_code;
  unsigned int i;

#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: start\n");
#endif

  // Resetting experiment data
  experiment_new (experiment);

  // Reading the experimental data
  experiment->name = (char *) xmlGetProp (node, XML_NAME);
  if (!experiment->name)
    {
      experiment_error (experiment, gettext ("no data file name"));
      goto exit_on_error;
    }
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: name=%s\n", experiment->name);
#endif
  experiment->weight
    = xml_node_get_float_with_default (node,
XML_WEIGHT, 1., &error_code);
  if (error_code)
    {
      experiment_error (experiment, gettext ("bad weight"));
      goto exit_on_error;
    }
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: weight=%lg\n", experiment->weight);
#endif
  experiment->template[0] = (char *) xmlGetProp (node, template[0]);
  if (experiment->template[0])
    {
#if DEBUG_EXPERIMENT
      fprintf (stderr, "experiment_open: experiment=%s template1=%s\n",
               experiment->name, buffer2[0]);
#endif
      ++experiment->ninputs;
    }
  else
    {
      experiment_error (experiment, gettext ("no template"));
      goto exit_on_error;
    }
  for (i = 1; i < MAX_NINPUTS; ++i)
    {
#if DEBUG_EXPERIMENT
      fprintf (stderr, "experiment_open: template%u\n", i + 1);
#endif
      if (xmlHasProp (node, template[i]))
        {
          if (ninputs && ninputs <= i)
            {
              experiment_error (experiment, gettext ("bad templates number"));
              goto exit_on_error;
            }
          experiment->template[i] = (char *) xmlGetProp (node, template[i]);
#if DEBUG_EXPERIMENT
          fprintf (stderr, "experiment_open: experiment=%s template%u=%s\n",
                   experiment->nexperiments, experiment->name,
                   experiment->template[i]);
#endif
          ++experiment->ninputs;
        }
      else if (ninputs && ninputs > i)
        {
          snprintf (buffer, 64, "%s%u", gettext ("no template"), i + 1);
          experiment_error (experiment, buffer);
          goto exit_on_error;
        }
      else
        break;
    }

#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: end\n");
#endif
  return 1;

exit_on_error:
  experiment_free (experiment);
#if DEBUG_EXPERIMENT
  fprintf (stderr, "experiment_open: end\n");
#endif
  return 0;
}
```

Here is the call graph for this function:



5.6 experiment.h

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#ifndef EXPERIMENT__H
#define EXPERIMENT__H 1

typedef struct
{
  char *name;
  char *template[MAX_NINPUTS];
  double weight;
  unsigned int ninputs;
} Experiment;

extern const xmlChar *template[MAX_NINPUTS];

// Public functions
void experiment_new (Experiment * experiment);
void experiment_free (Experiment * experiment);
void experiment_error (Experiment * experiment, char *message);
int experiment_open (Experiment * experiment, xmlNode * node,
                     unsigned int ninputs);

#endif
```
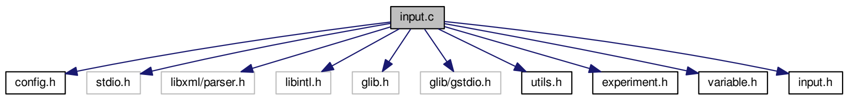

5.7 input.c File Reference

Source file to define the input functions.

```
#include "config.h"
#include <stdio.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include <glib/gstdio.h>
#include "utils.h"
#include "experiment.h"
#include "variable.h"
#include "input.h"
```

Include dependency graph for input.c:



Macros

- #define **_GNU_SOURCE**
- #define DEBUG_INPUT 0

  Macro to debug input functions.

Functions

- void input_new ()

  Function to create a new Input struct.
- void input_free ()

  Function to free the memory of the input file data.
- void input_error (char ∗message)

  Function to print an error message opening an Input struct.
- int input_open (char ∗filename)

  Function to open the input file.

Variables

- Input **input** [1]
- const xmlChar ∗ result_name = (xmlChar ∗) "result"

  Name of the result file.
- const xmlChar ∗ variables_name = (xmlChar ∗) "variables"

  Name of the variables file.

5.7.1 Detailed Description

Source file to define the input functions.

Authors

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Definition in file input.c.

5.7.2 Function Documentation

5.7.2.1 void input_error (char ∗ *message*)

Function to print an error message opening an Input struct.

Parameters

message	Error message.

Definition at line 114 of file input.c.

```
{
  char buffer[64];
  snprintf (buffer, 64, "%s: %s\n", gettext ("Input"), message);
  error_message = g_strdup (buffer);
}
```

5.7.2.2 int input_open (char ∗ *filename*)

Function to open the input file.

Parameters

filename	Input data file name.

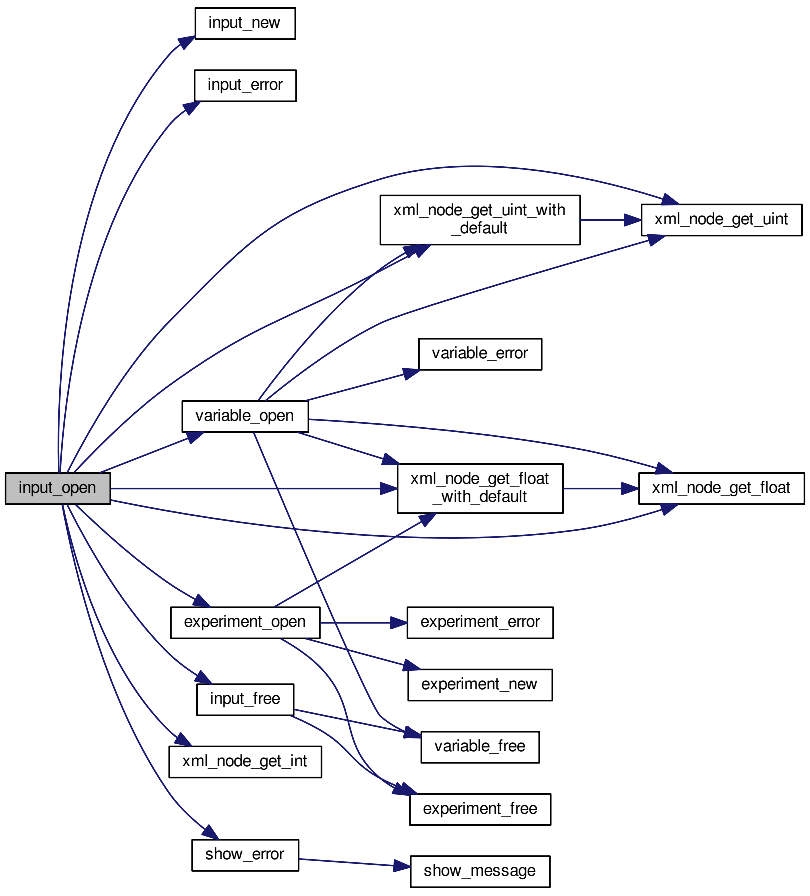
Returns

1_on_success, 0_on_error.

Definition at line 129 of file input.c.

```
{
  char buffer2[64];
  xmlDoc *doc;
  xmlNode *node, *child;
  xmlChar *buffer;
  int error_code;
  unsigned int i;

#if DEBUG_INPUT
  fprintf (stderr, "input_open: start\n");
#endif

  // Resetting input data
  buffer = NULL;
  input_new ();

  // Parsing the input file
#if DEBUG_INPUT
  fprintf (stderr, "input_open: parsing the input file %s\n", filename);
#endif
  doc = xmlParseFile (filename);
  if (!doc)
    {
      input_error (gettext ("Unable to parse the input file"));
      goto exit_on_error;
    }

  // Getting the root node
#if DEBUG_INPUT
  fprintf (stderr, "input_open: getting the root node\n");
#endif
  node = xmlDocGetRootElement (doc);
  if (xmlStrcmp (node->name, XML_OPTIMIZE))
    {
      input_error (gettext ("Bad root XML node"));
      goto exit_on_error;
    }

  // Getting result and variables file names
  if (!input->result)
    {
      input->result = (char *) xmlGetProp (node, XML_RESULT);
      if (!input->result)
        input->result = (char *) xmlStrdup (result_name);
    }
  if (!input->variables)
    {
      input->variables = (char *) xmlGetProp (node, XML_VARIABLES);
      if (!input->variables)
        input->variables = (char *) xmlStrdup (variables_name);
    }

  // Opening simulator program name
  input->simulator = (char *) xmlGetProp (node, XML_SIMULATOR);
  if (!input->simulator)
    {
      input_error (gettext ("Bad simulator program"));
      goto exit_on_error;
    }

  // Opening evaluator program name
  input->evaluator = (char *) xmlGetProp (node, XML_EVALUATOR);

  // Obtaining pseudo-random numbers generator seed
  input->seed
    = xml_node_get_uint_with_default (node,
XML_SEED, DEFAULT_RANDOM_SEED,
                                      &error_code);
  if (error_code)
    {
      input_error (gettext ("Bad pseudo-random numbers generator seed"));
      goto exit_on_error;
    }

  // Opening algorithm
  buffer = xmlGetProp (node, XML_ALGORITHM);
  if (!xmlStrcmp (buffer, XML_MONTE_CARLO))
    {
      input->algorithm = ALGORITHM_MONTE_CARLO;

      // Obtaining simulations number
      input->nsimulations
        = xml_node_get_int (node, XML_NSIMULATIONS, &error_code);
      if (error_code)
        {
          input_error (gettext ("Bad simulations number"));
          goto exit_on_error;
        }
    }
  else if (!xmlStrcmp (buffer, XML_SWEEP))
    input->algorithm = ALGORITHM_SWEEP;
  else if (!xmlStrcmp (buffer, XML_GENETIC))
    {
      input->algorithm = ALGORITHM_GENETIC;

      // Obtaining population
      if (xmlHasProp (node, XML_NPOPULATION))
        {
          input->nsimulations
            = xml_node_get_uint (node, XML_NPOPULATION, &error_code);
          if (error_code || input->nsimulations < 3)
            {
              input_error (gettext ("Invalid population number"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No population number"));
          goto exit_on_error;
        }

      // Obtaining generations
      if (xmlHasProp (node, XML_NGENERATIONS))
        {
          input->niterations
            = xml_node_get_uint (node, XML_NGENERATIONS, &error_code);
          if (error_code || !input->niterations)
            {
              input_error (gettext ("Invalid generations number"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No generations number"));
          goto exit_on_error;
        }

      // Obtaining mutation probability
      if (xmlHasProp (node, XML_MUTATION))
        {
          input->mutation_ratio
            = xml_node_get_float (node, XML_MUTATION, &error_code);
          if (error_code || input->mutation_ratio < 0.
              || input->mutation_ratio >= 1.)
            {
              input_error (gettext ("Invalid mutation probability"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No mutation probability"));
          goto exit_on_error;
        }

      // Obtaining reproduction probability
      if (xmlHasProp (node, XML_REPRODUCTION))
        {
          input->reproduction_ratio
            = xml_node_get_float (node, XML_REPRODUCTION, &error_code);
          if (error_code || input->reproduction_ratio < 0.
              || input->reproduction_ratio >= 1.0)
            {
              input_error (gettext ("Invalid reproduction probability"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No reproduction probability"));
          goto exit_on_error;
        }

      // Obtaining adaptation probability
      if (xmlHasProp (node, XML_ADAPTATION))
        {
          input->adaptation_ratio
            = xml_node_get_float (node, XML_ADAPTATION, &error_code);
          if (error_code || input->adaptation_ratio < 0.
              || input->adaptation_ratio >= 1.)
            {
              input_error (gettext ("Invalid adaptation probability"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No adaptation probability"));
          goto exit_on_error;
        }

      // Checking survivals
      i = input->mutation_ratio * input->nsimulations;
      i += input->reproduction_ratio * input->nsimulations;
      i += input->adaptation_ratio * input->nsimulations;
      if (i > input->nsimulations - 2)
        {
          input_error
            (gettext
             ("No enough survival entities to reproduce the population"));
          goto exit_on_error;
        }
    }
  else
    {
      input_error (gettext ("Unknown algorithm"));
      goto exit_on_error;
    }
  xmlFree (buffer);
  buffer = NULL;

  if (input->algorithm == ALGORITHM_MONTE_CARLO
      || input->algorithm == ALGORITHM_SWEEP)
    {

      // Obtaining iterations number
      input->niterations
        = xml_node_get_uint (node, XML_NITERATIONS, &error_code);
      if (error_code == 1)
        input->niterations = 1;
      else if (error_code)
        {
          input_error (gettext ("Bad iterations number"));
          goto exit_on_error;
        }

      // Obtaining best number
      input->nbest
        = xml_node_get_uint_with_default (node,
XML_NBEST, 1, &error_code);
      if (error_code || !input->nbest)
        {
          input_error (gettext ("Invalid best number"));
          goto exit_on_error;
        }

      // Obtaining tolerance
      input->tolerance
        = xml_node_get_float_with_default (node,
XML_TOLERANCE, 0.,
                                           &error_code);
      if (error_code || input->tolerance < 0.)
        {
          input_error (gettext ("Invalid tolerance"));
          goto exit_on_error;
        }

      // Getting direction search method parameters
      if (xmlHasProp (node, XML_NSTEPS))
        {
          input->nsteps = xml_node_get_uint (node,
XML_NSTEPS, &error_code);
          if (error_code || !input->nsteps)
            {
              input_error (gettext ("Invalid steps number"));
              goto exit_on_error;
            }
          buffer = xmlGetProp (node, XML_DIRECTION);
          if (!xmlStrcmp (buffer, XML_COORDINATES))
            input->direction = DIRECTION_METHOD_COORDINATES;
          else if (!xmlStrcmp (buffer, XML_RANDOM))
            {
              input->direction = DIRECTION_METHOD_RANDOM;
              input->nestimates
                = xml_node_get_uint (node, XML_NESTIMATES, &error_code);
              if (error_code || !input->nestimates)
                {
                  input_error (gettext ("Invalid estimates number"));
                  goto exit_on_error;
                }
            }
          else
            {
              input_error
                (gettext ("Unknown method to estimate the direction search"));
              goto exit_on_error;
            }
          xmlFree (buffer);
          buffer = NULL;
          input->relaxation
            = xml_node_get_float_with_default (node, XML_RELAXATION,
                                               DEFAULT_RELAXATION, &error_code);
          if (error_code || input->relaxation < 0. || input->relaxation > 2.)
            {
              input_error (gettext ("Invalid relaxation parameter"));
              goto exit_on_error;
            }
        }
      else
        input->nsteps = 0;
    }
  // Obtaining the threshold
  input->threshold = xml_node_get_float_with_default (node, XML_THRESHOLD, 0.,
                                                      &error_code);
  if (error_code)
    {
      input_error (gettext ("Invalid threshold"));
      goto exit_on_error;
    }

  // Reading the experimental data
  for (child = node->children; child; child = child->next)
    {
      if (xmlStrcmp (child->name, XML_EXPERIMENT))
        break;
#if DEBUG_INPUT
      fprintf (stderr, "input_open: nexperiments=%u\n", input->nexperiments);
#endif
      input->experiment = (Experiment *)
        g_realloc (input->experiment,
                   (1 + input->nexperiments) * sizeof (Experiment));
      if (!input->nexperiments)
        {
          if (!experiment_open (input->experiment, child, 0))
            goto exit_on_error;
        }
      else
        {
          if (!experiment_open (input->experiment + input->nexperiments, child,
                                input->experiment->ninputs))
            goto exit_on_error;
        }
      ++input->nexperiments;
#if DEBUG_INPUT
      fprintf (stderr, "input_open: nexperiments=%u\n", input->nexperiments);
#endif
    }
  if (!input->nexperiments)
    {
      input_error (gettext ("No optimization experiments"));
      goto exit_on_error;
    }
  buffer = NULL;

  // Reading the variables data
  for (; child; child = child->next)
    {
#if DEBUG_INPUT
      fprintf (stderr, "input_open: nvariables=%u\n", input->nvariables);
#endif
      if (xmlStrcmp (child->name, XML_VARIABLE))
        {
          snprintf (buffer2, 64, "%s %u: %s",
                    gettext ("Variable"),
                    input->nvariables + 1, gettext ("bad XML node"));
          input_error (buffer2);
          goto exit_on_error;
        }
      input->variable = (Variable *)
        g_realloc (input->variable,
                   (1 + input->nvariables) * sizeof (Variable));
      if (!variable_open (input->variable + input->nvariables, child,
                            input->algorithm, input->nsteps))
        goto exit_on_error;
      ++input->nvariables;
    }
  if (!input->nvariables)
    {
      input_error (gettext ("No optimization variables"));
      goto exit_on_error;
    }
  buffer = NULL;

  // Obtaining the error norm
  if (xmlHasProp (node, XML_NORM))
    {
      buffer = xmlGetProp (node, XML_NORM);
      if (!xmlStrcmp (buffer, XML_EUCLIDIAN))
        input->norm = ERROR_NORM_EUCLIDIAN;
      else if (!xmlStrcmp (buffer, XML_MAXIMUM))
        input->norm = ERROR_NORM_MAXIMUM;
      else if (!xmlStrcmp (buffer, XML_P))
        {
          input->norm = ERROR_NORM_P;
          input->p = xml_node_get_float (node, XML_P, &error_code);
          if (!error_code)
            {
              input_error (gettext ("Bad P parameter"));
              goto exit_on_error;
            }
        }
      else if (!xmlStrcmp (buffer, XML_TAXICAB))
        input->norm = ERROR_NORM_TAXICAB;
      else
        {
          input_error (gettext ("Unknown error norm"));
          goto exit_on_error;
        }
      xmlFree (buffer);
    }
  else
    input->norm = ERROR_NORM_EUCLIDIAN;

  // Getting the working directory
  input->directory = g_path_get_dirname (filename);
  input->name = g_path_get_basename (filename);

  // Closing the XML document
  xmlFreeDoc (doc);

#if DEBUG_INPUT
  fprintf (stderr, "input_open: end\n");
#endif
  return 1;

exit_on_error:
  xmlFree (buffer);
  xmlFreeDoc (doc);
  show_error (error_message);
  g_free (error_message);
  input_free ();
#if DEBUG_INPUT
  fprintf (stderr, "input_open: end\n");
#endif
  return 0;
}
```

Here is the call graph for this function:



5.8 input.c

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

Copyright 2012-2016, AUTHORS.

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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
```
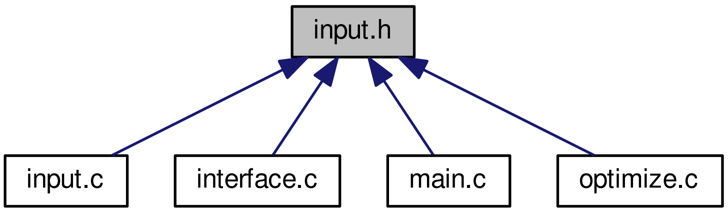

```
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#define _GNU_SOURCE
#include "config.h"
#include <stdio.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include <glib/gstdio.h>
#include "utils.h"
#include "experiment.h"
#include "variable.h"
#include "input.h"

#define DEBUG_INPUT 0

Input input[1];

const xmlChar *result_name = (xmlChar *) "result";
const xmlChar *variables_name = (xmlChar *) "variables";

void
input_new ()
{
#if DEBUG_INPUT
  fprintf (stderr, "input_new: start\n");
#endif
  input->nvariables = input->nexperiments = input->nsteps = 0;
  input->simulator = input->evaluator = input->directory = input->name = NULL;
  input->experiment = NULL;
  input->variable = NULL;
#if DEBUG_INPUT
  fprintf (stderr, "input_new: end\n");
#endif
}

void
input_free ()
{
  unsigned int i;
#if DEBUG_INPUT
  fprintf (stderr, "input_free: start\n");
#endif
  g_free (input->name);
  g_free (input->directory);
  for (i = 0; i < input->nexperiments; ++i)
    experiment_free (input->experiment + i);
  g_free (input->experiment);
  for (i = 0; i < input->nvariables; ++i)
    variable_free (input->variable + i);
  g_free (input->variable);
  xmlFree (input->evaluator);
  xmlFree (input->simulator);
  xmlFree (input->result);
  xmlFree (input->variables);
  input->nexperiments = input->nvariables = input->nsteps = 0;
#if DEBUG_INPUT
  fprintf (stderr, "input_free: end\n");
#endif
}

void
input_error (char *message)
{
  char buffer[64];
  snprintf (buffer, 64, "%s: %s\n", gettext ("Input"), message);
  error_message = g_strdup (buffer);
}

int
input_open (char *filename)
{
  char buffer2[64];
  xmlDoc *doc;
  xmlNode *node, *child;
  xmlChar *buffer;
  int error_code;
  unsigned int i;

#if DEBUG_INPUT
  fprintf (stderr, "input_open: start\n");
#endif

  // Resetting input data
  buffer = NULL;
  input_new ();

  // Parsing the input file
#if DEBUG_INPUT
  fprintf (stderr, "input_open: parsing the input file %s\n", filename);
#endif
  doc = xmlParseFile (filename);
  if (!doc)
    {
      input_error (gettext ("Unable to parse the input file"));
      goto exit_on_error;
    }

  // Getting the root node
#if DEBUG_INPUT
  fprintf (stderr, "input_open: getting the root node\n");
#endif
  node = xmlDocGetRootElement (doc);
  if (xmlStrcmp (node->name, XML_OPTIMIZE))
    {
      input_error (gettext ("Bad root XML node"));
      goto exit_on_error;
    }

  // Getting result and variables file names
  if (!input->result)
    {
      input->result = (char *) xmlGetProp (node, XML_RESULT);
      if (!input->result)
        input->result = (char *) xmlStrdup (result_name);
    }
  if (!input->variables)
    {
      input->variables = (char *) xmlGetProp (node, XML_VARIABLES);
      if (!input->variables)
        input->variables = (char *) xmlStrdup (variables_name);
    }

  // Opening simulator program name
  input->simulator = (char *) xmlGetProp (node, XML_SIMULATOR);
  if (!input->simulator)
    {
      input_error (gettext ("Bad simulator program"));
      goto exit_on_error;
    }

  // Opening evaluator program name
  input->evaluator = (char *) xmlGetProp (node, XML_EVALUATOR);

  // Obtaining pseudo-random numbers generator seed
  input->seed
    = xml_node_get_uint_with_default (node,
XML_SEED, DEFAULT_RANDOM_SEED,
                                      &error_code);
  if (error_code)
    {
      input_error (gettext ("Bad pseudo-random numbers generator seed"));
      goto exit_on_error;
    }

  // Opening algorithm
  buffer = xmlGetProp (node, XML_ALGORITHM);
  if (!xmlStrcmp (buffer, XML_MONTE_CARLO))
    {
      input->algorithm = ALGORITHM_MONTE_CARLO;

      // Obtaining simulations number
      input->nsimulations
        = xml_node_get_int (node, XML_NSIMULATIONS, &error_code);
      if (error_code)
        {
          input_error (gettext ("Bad simulations number"));
          goto exit_on_error;
        }
    }
  else if (!xmlStrcmp (buffer, XML_SWEEP))
    input->algorithm = ALGORITHM_SWEEP;
  else if (!xmlStrcmp (buffer, XML_GENETIC))
    {
      input->algorithm = ALGORITHM_GENETIC;

      // Obtaining population
      if (xmlHasProp (node, XML_NPOPULATION))
        {
          input->nsimulations
            = xml_node_get_uint (node, XML_NPOPULATION, &error_code);
          if (error_code || input->nsimulations < 3)
            {
              input_error (gettext ("Invalid population number"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No population number"));
          goto exit_on_error;
        }

      // Obtaining generations
      if (xmlHasProp (node, XML_NGENERATIONS))
        {
          input->niterations
            = xml_node_get_uint (node, XML_NGENERATIONS, &error_code);
          if (error_code || !input->niterations)
            {
              input_error (gettext ("Invalid generations number"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No generations number"));
          goto exit_on_error;
        }

      // Obtaining mutation probability
      if (xmlHasProp (node, XML_MUTATION))
        {
          input->mutation_ratio
            = xml_node_get_float (node, XML_MUTATION, &error_code);
          if (error_code || input->mutation_ratio < 0.
              || input->mutation_ratio >= 1.)
            {
              input_error (gettext ("Invalid mutation probability"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No mutation probability"));
          goto exit_on_error;
        }

      // Obtaining reproduction probability
      if (xmlHasProp (node, XML_REPRODUCTION))
        {
          input->reproduction_ratio
            = xml_node_get_float (node, XML_REPRODUCTION, &error_code);
          if (error_code || input->reproduction_ratio < 0.
              || input->reproduction_ratio >= 1.0)
            {
              input_error (gettext ("Invalid reproduction probability"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No reproduction probability"));
          goto exit_on_error;
        }

      // Obtaining adaptation probability
      if (xmlHasProp (node, XML_ADAPTATION))
        {
          input->adaptation_ratio
            = xml_node_get_float (node, XML_ADAPTATION, &error_code);
          if (error_code || input->adaptation_ratio < 0.
              || input->adaptation_ratio >= 1.)
            {
              input_error (gettext ("Invalid adaptation probability"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No adaptation probability"));
          goto exit_on_error;
        }

      // Checking survivals
      i = input->mutation_ratio * input->nsimulations;
      i += input->reproduction_ratio * input->nsimulations;
      i += input->adaptation_ratio * input->nsimulations;
      if (i > input->nsimulations - 2)
        {
          input_error
            (gettext
             ("No enough survival entities to reproduce the population"));
          goto exit_on_error;
        }
    }
  else
    {
      input_error (gettext ("Unknown algorithm"));
      goto exit_on_error;
    }
  xmlFree (buffer);
  buffer = NULL;

  if (input->algorithm == ALGORITHM_MONTE_CARLO
      || input->algorithm == ALGORITHM_SWEEP)
    {

      // Obtaining iterations number
      input->niterations
        = xml_node_get_uint (node, XML_NITERATIONS, &error_code);
      if (error_code == 1)
        input->niterations = 1;
      else if (error_code)
        {
          input_error (gettext ("Bad iterations number"));
          goto exit_on_error;
        }

      // Obtaining best number
      input->nbest
        = xml_node_get_uint_with_default (node,
XML_NBEST, 1, &error_code);
      if (error_code || !input->nbest)
        {
          input_error (gettext ("Invalid best number"));
          goto exit_on_error;
        }

      // Obtaining tolerance
      input->tolerance
        = xml_node_get_float_with_default (node,
XML_TOLERANCE, 0.,
                                           &error_code);
      if (error_code || input->tolerance < 0.)
        {
          input_error (gettext ("Invalid tolerance"));
          goto exit_on_error;
        }

      // Getting direction search method parameters
      if (xmlHasProp (node, XML_NSTEPS))
        {
          input->nsteps = xml_node_get_uint (node,
XML_NSTEPS, &error_code);
          if (error_code || !input->nsteps)
            {
              input_error (gettext ("Invalid steps number"));
              goto exit_on_error;
            }
          buffer = xmlGetProp (node, XML_DIRECTION);
          if (!xmlStrcmp (buffer, XML_COORDINATES))
            input->direction = DIRECTION_METHOD_COORDINATES;
          else if (!xmlStrcmp (buffer, XML_RANDOM))
            {
              input->direction = DIRECTION_METHOD_RANDOM;
              input->nestimates
                = xml_node_get_uint (node, XML_NESTIMATES, &error_code);
              if (error_code || !input->nestimates)
                {
                  input_error (gettext ("Invalid estimates number"));
                  goto exit_on_error;
                }
            }
          else
            {
              input_error
                (gettext ("Unknown method to estimate the direction search"));
              goto exit_on_error;
            }
          xmlFree (buffer);
          buffer = NULL;
          input->relaxation
            = xml_node_get_float_with_default (node,
XML_RELAXATION,
                                               DEFAULT_RELAXATION, &error_code);
          if (error_code || input->relaxation < 0. || input->
relaxation > 2.)
            {
              input_error (gettext ("Invalid relaxation parameter"));
              goto exit_on_error;
            }
        }
      else
        input->nsteps = 0;
    }
  // Obtaining the threshold
  input->threshold = xml_node_get_float_with_default (node,
XML_THRESHOLD, 0.,
                                                      &error_code);
  if (error_code)
    {
      input_error (gettext ("Invalid threshold"));
      goto exit_on_error;
    }

  // Reading the experimental data
  for (child = node->children; child; child = child->next)
    {
      if (xmlStrcmp (child->name, XML_EXPERIMENT))
        break;
#if DEBUG_INPUT
      fprintf (stderr, "input_open: nexperiments=%u\n", input->nexperiments);
#endif
      input->experiment = (Experiment *)
        g_realloc (input->experiment,
                   (1 + input->nexperiments) * sizeof (Experiment));
      if (!input->nexperiments)
        {
          if (!experiment_open (input->experiment, child, 0))
            goto exit_on_error;
        }
      else
        {
          if (!experiment_open (input->experiment + input->
nexperiments, child,
                                input->experiment->ninputs))
            goto exit_on_error;
        }
      ++input->nexperiments;
#if DEBUG_INPUT
      fprintf (stderr, "input_open: nexperiments=%u\n", input->nexperiments);
#endif
    }
  if (!input->nexperiments)
    {
      input_error (gettext ("No optimization experiments"));
      goto exit_on_error;
    }
  buffer = NULL;

  // Reading the variables data
  for (; child; child = child->next)
    {
#if DEBUG_INPUT
      fprintf (stderr, "input_open: nvariables=%u\n", input->nvariables);
#endif
      if (xmlStrcmp (child->name, XML_VARIABLE))
        {
          snprintf (buffer2, 64, "%s %u: %s",
                    gettext ("Variable"),
                    input->nvariables + 1, gettext ("bad XML node"));
          input_error (buffer2);
          goto exit_on_error;
        }
      input->variable = (Variable *)
        g_realloc (input->variable,
                   (1 + input->nvariables) * sizeof (Variable));
      if (!variable_open (input->variable + input->
nvariables, child,
                          input->algorithm, input->nsteps))
        goto exit_on_error;
      ++input->nvariables;
    }
  if (!input->nvariables)
    {
      input_error (gettext ("No optimization variables"));
      goto exit_on_error;
    }
  buffer = NULL;

  // Obtaining the error norm
  if (xmlHasProp (node, XML_NORM))
    {
      buffer = xmlGetProp (node, XML_NORM);
      if (!xmlStrcmp (buffer, XML_EUCLIDIAN))
        input->norm = ERROR_NORM_EUCLIDIAN;
      else if (!xmlStrcmp (buffer, XML_MAXIMUM))
        input->norm = ERROR_NORM_MAXIMUM;
      else if (!xmlStrcmp (buffer, XML_P))
        {
          input->norm = ERROR_NORM_P;
          input->p = xml_node_get_float (node, XML_P, &error_code);
          if (!error_code)
            {
              input_error (gettext ("Bad P parameter"));
              goto exit_on_error;
            }
        }
      else if (!xmlStrcmp (buffer, XML_TAXICAB))
        input->norm = ERROR_NORM_TAXICAB;
      else
        {
          input_error (gettext ("Unknown error norm"));
          goto exit_on_error;
        }
      xmlFree (buffer);
    }
  else
    input->norm = ERROR_NORM_EUCLIDIAN;

  // Getting the working directory
  input->directory = g_path_get_dirname (filename);
  input->name = g_path_get_basename (filename);

  // Closing the XML document
  xmlFreeDoc (doc);

#if DEBUG_INPUT
  fprintf (stderr, "input_open: end\n");
#endif
  return 1;

exit_on_error:
  xmlFree (buffer);
  xmlFreeDoc (doc);
  show_error (error_message);
  g_free (error_message);
  input_free ();
#if DEBUG_INPUT
  fprintf (stderr, "input_open: end\n");
#endif
  return 0;
}
```

5.9 input.h File Reference

Header file to define the input functions.

This graph shows which files directly or indirectly include this file:



Data Structures

- struct Input

  Struct to define the optimization input file.

Enumerations

- enum DirectionMethod { DIRECTION_METHOD_COORDINATES = 0, DIRECTION_METHOD_RANDOM = 1 }

  Enum to define the methods to estimate the direction search.
- enum ErrorNorm { ERROR_NORM_EUCLIDIAN = 0, ERROR_NORM_MAXIMUM = 1, ERROR_NORM_P = 2, ERROR_NORM_TAXICAB = 3 }

  Enum to define the error norm.

Functions

- void input_new ()

  Function to create a new Input struct.
- void input_free ()

  Function to free the memory of the input file data.
- void input_error (char ∗message)

  Function to print an error message opening an Input struct.
- int input_open (char ∗filename)

  Function to open the input file.

Variables

- Input **input** [1]
- const xmlChar ∗ result_name

  Name of the result file.
- const xmlChar ∗ variables_name

  Name of the variables file.

5.9.1 Detailed Description

Header file to define the input functions.

Authors

Javier Burguete.

Copyright

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Definition in file input.h.

5.9.2 Enumeration Type Documentation

5.9.2.1 enum DirectionMethod

Enum to define the methods to estimate the direction search.

Enumerator

DIRECTION_METHOD_COORDINATES Coordinates descent method.

DIRECTION_METHOD_RANDOM Random method.

Definition at line 45 of file input.h.

```
{
  DIRECTION_METHOD_COORDINATES = 0,
  DIRECTION_METHOD_RANDOM = 1,
};
```

5.9.2.2 enum ErrorNorm

Enum to define the error norm.

Enumerator

ERROR_NORM_EUCLIDIAN Euclidian norm: $\sqrt{\sum_i \left(w_i\,x_i\right)^2}$.

ERROR_NORM_MAXIMUM Maximum norm: $\max_i \left|w_i\,x_i\right|$.

ERROR_NORM_P P-norm $\sqrt[p]{\sum_i \left|w_i\,x_i\right|^p}$.

ERROR_NORM_TAXICAB Taxicab norm $\sum_i \left|w_i\,x_i\right|$.

Definition at line 55 of file input.h.

```
{
  ERROR_NORM_EUCLIDIAN = 0,
  ERROR_NORM_MAXIMUM = 1,
  ERROR_NORM_P = 2,
  ERROR_NORM_TAXICAB = 3
};
```

5.9.3 Function Documentation

5.9.3.1 void input_error (char * *message*)

Function to print an error message opening an Input struct.

Parameters

message	Error message.

Definition at line 114 of file input.c.

```
{
  char buffer[64];
  snprintf (buffer, 64, "%s: %s\n", gettext ("Input"), message);
  error_message = g_strdup (buffer);
}
```

5.9.3.2 int input_open (char * *filename*)

Function to open the input file.

Parameters

filename	Input data file name.

Returns

1_on_success, 0_on_error.

Definition at line 129 of file input.c.

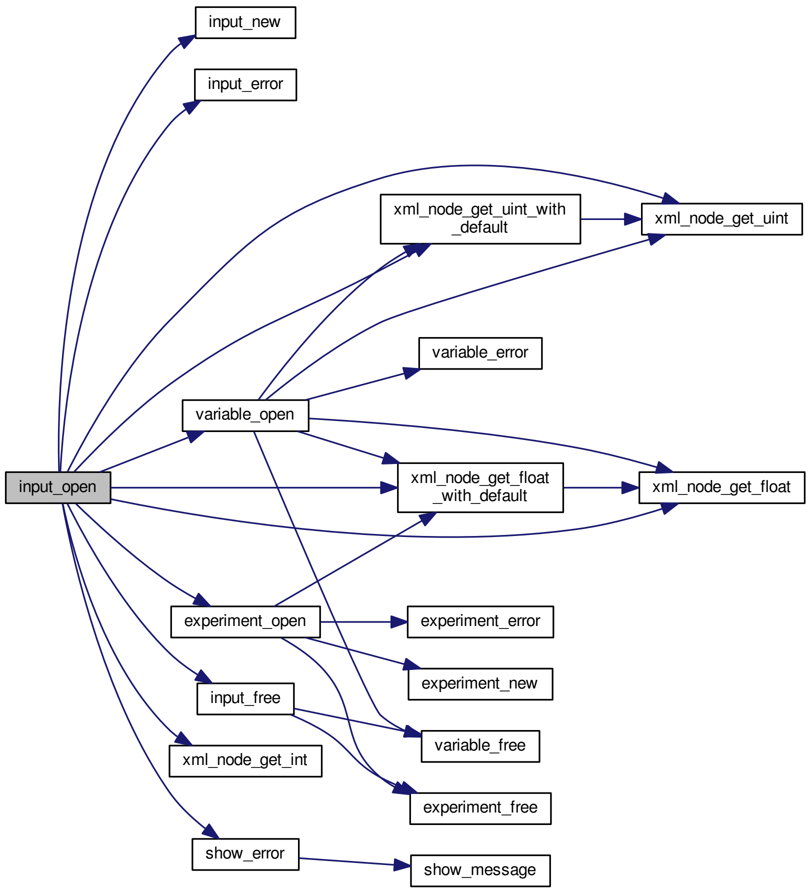
```
{
  char buffer2[64];
  xmlDoc *doc;
  xmlNode *node, *child;
  xmlChar *buffer;
  int error_code;
  unsigned int i;

#if DEBUG_INPUT
  fprintf (stderr, "input_open: start\n");
#endif

  // Resetting input data
  buffer = NULL;
  input_new ();

  // Parsing the input file
#if DEBUG_INPUT
  fprintf (stderr, "input_open: parsing the input file %s\n", filename);
#endif
  doc = xmlParseFile (filename);
  if (!doc)
    {
      input_error (gettext ("Unable to parse the input file"));
      goto exit_on_error;
    }

  // Getting the root node
#if DEBUG_INPUT
  fprintf (stderr, "input_open: getting the root node\n");
#endif
  node = xmlDocGetRootElement (doc);
  if (xmlStrcmp (node->name, XML_OPTIMIZE))
    {
      input_error (gettext ("Bad root XML node"));
      goto exit_on_error;
    }

  // Getting result and variables file names
  if (!input->result)
    {
      input->result = (char *) xmlGetProp (node, XML_RESULT);
      if (!input->result)
        input->result = (char *) xmlStrdup (result_name);
    }
  if (!input->variables)
    {
      input->variables = (char *) xmlGetProp (node, XML_VARIABLES);
      if (!input->variables)
        input->variables = (char *) xmlStrdup (variables_name);
    }

  // Opening simulator program name
  input->simulator = (char *) xmlGetProp (node, XML_SIMULATOR);
  if (!input->simulator)
    {
      input_error (gettext ("Bad simulator program"));
      goto exit_on_error;
    }

  // Opening evaluator program name
  input->evaluator = (char *) xmlGetProp (node, XML_EVALUATOR);

  // Obtaining pseudo-random numbers generator seed
  input->seed
    = xml_node_get_uint_with_default (node,
XML_SEED, DEFAULT_RANDOM_SEED,
                                      &error_code);
  if (error_code)
    {
      input_error (gettext ("Bad pseudo-random numbers generator seed"));
      goto exit_on_error;
    }

  // Opening algorithm
  buffer = xmlGetProp (node, XML_ALGORITHM);
  if (!xmlStrcmp (buffer, XML_MONTE_CARLO))
    {
      input->algorithm = ALGORITHM_MONTE_CARLO;

      // Obtaining simulations number
      input->nsimulations
        = xml_node_get_int (node, XML_NSIMULATIONS, &error_code);
      if (error_code)
        {
          input_error (gettext ("Bad simulations number"));
          goto exit_on_error;
        }
    }
  else if (!xmlStrcmp (buffer, XML_SWEEP))
    input->algorithm = ALGORITHM_SWEEP;
  else if (!xmlStrcmp (buffer, XML_GENETIC))
    {
      input->algorithm = ALGORITHM_GENETIC;

      // Obtaining population
      if (xmlHasProp (node, XML_NPOPULATION))
        {
          input->nsimulations
            = xml_node_get_uint (node, XML_NPOPULATION, &error_code);
          if (error_code || input->nsimulations < 3)
            {
              input_error (gettext ("Invalid population number"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No population number"));
          goto exit_on_error;
        }

      // Obtaining generations
      if (xmlHasProp (node, XML_NGENERATIONS))
        {
          input->niterations
            = xml_node_get_uint (node, XML_NGENERATIONS, &error_code);
          if (error_code || !input->niterations)
            {
              input_error (gettext ("Invalid generations number"));
              goto exit_on_error;
            }
        }
      else
        {
          input_error (gettext ("No generations number"));
          goto exit_on_error;
        }

      // Obtaining mutation probability
      if (xmlHasProp (node, XML_MUTATION))
        {
          input->mutation_ratio
            = xml_node_get_float (node, XML_MUTATION, &error_code);
          if (error_code || input->mutation_ratio < 0.
              || input->mutation_ratio >= 1.)
            {
              input_error (gettext ("Invalid mutation probability"));
```

```
                goto exit_on_error;
              }
          }
        else
          {
            input_error (gettext ("No mutation probability"));
            goto exit_on_error;
          }

        // Obtaining reproduction probability
        if (xmlHasProp (node, XML_REPRODUCTION))
          {
            input->reproduction_ratio
              = xml_node_get_float (node, XML_REPRODUCTION, &error_code);
            if (error_code || input->reproduction_ratio < 0.
                || input->reproduction_ratio >= 1.0)
              {
                input_error (gettext ("Invalid reproduction probability"));
                goto exit_on_error;
              }
          }
        else
          {
            input_error (gettext ("No reproduction probability"));
            goto exit_on_error;
          }

        // Obtaining adaptation probability
        if (xmlHasProp (node, XML_ADAPTATION))
          {
            input->adaptation_ratio
              = xml_node_get_float (node, XML_ADAPTATION, &error_code);
            if (error_code || input->adaptation_ratio < 0.
                || input->adaptation_ratio >= 1.)
              {
                input_error (gettext ("Invalid adaptation probability"));
                goto exit_on_error;
              }
          }
        else
          {
            input_error (gettext ("No adaptation probability"));
            goto exit_on_error;
          }

        // Checking survivals
        i = input->mutation_ratio * input->nsimulations;
        i += input->reproduction_ratio * input->nsimulations;
        i += input->adaptation_ratio * input->nsimulations;
        if (i > input->nsimulations - 2)
          {
            input_error
              (gettext
               ("No enough survival entities to reproduce the population"));
            goto exit_on_error;
          }
      }
    else
      {
        input_error (gettext ("Unknown algorithm"));
        goto exit_on_error;
      }
    xmlFree (buffer);
    buffer = NULL;

    if (input->algorithm == ALGORITHM_MONTE_CARLO
        || input->algorithm == ALGORITHM_SWEEP)
      {

        // Obtaining iterations number
        input->niterations
          = xml_node_get_uint (node, XML_NITERATIONS, &error_code);
        if (error_code == 1)
          input->niterations = 1;
        else if (error_code)
          {
            input_error (gettext ("Bad iterations number"));
            goto exit_on_error;
          }

        // Obtaining best number
        input->nbest
          = xml_node_get_uint_with_default (node,
  XML_NBEST, 1, &error_code);
        if (error_code || !input->nbest)
          {
            input_error (gettext ("Invalid best number"));
            goto exit_on_error;
          }

        // Obtaining tolerance
        input->tolerance
          = xml_node_get_float_with_default (node,
  XML_TOLERANCE, 0.,
                                             &error_code);
        if (error_code || input->tolerance < 0.)
          {
            input_error (gettext ("Invalid tolerance"));
            goto exit_on_error;
          }

        // Getting direction search method parameters
        if (xmlHasProp (node, XML_NSTEPS))
          {
            input->nsteps = xml_node_get_uint (node,
  XML_NSTEPS, &error_code);
            if (error_code || !input->nsteps)
              {
                input_error (gettext ("Invalid steps number"));
                goto exit_on_error;
              }
            buffer = xmlGetProp (node, XML_DIRECTION);
            if (!xmlStrcmp (buffer, XML_COORDINATES))
              input->direction = DIRECTION_METHOD_COORDINATES;
            else if (!xmlStrcmp (buffer, XML_RANDOM))
              {
                input->direction = DIRECTION_METHOD_RANDOM;
                input->nestimates
                  = xml_node_get_uint (node, XML_NESTIMATES, &error_code);
                if (error_code || !input->nestimates)
                  {
                    input_error (gettext ("Invalid estimates number"));
                    goto exit_on_error;
                  }
              }
            else
              {
                input_error
                  (gettext ("Unknown method to estimate the direction search"));
                goto exit_on_error;
              }
            xmlFree (buffer);
            buffer = NULL;
            input->relaxation
              = xml_node_get_float_with_default (node,
  XML_RELAXATION,
                                                 DEFAULT_RELAXATION, &error_code);
            if (error_code || input->relaxation < 0. || input->
  relaxation > 2.)
              {
                input_error (gettext ("Invalid relaxation parameter"));
                goto exit_on_error;
              }
          }
        else
          input->nsteps = 0;
      }
    // Obtaining the threshold
    input->threshold = xml_node_get_float_with_default (node,
  XML_THRESHOLD, 0.,
                                                        &error_code);
    if (error_code)
      {
        input_error (gettext ("Invalid threshold"));
        goto exit_on_error;
      }

    // Reading the experimental data
    for (child = node->children; child; child = child->next)
      {
        if (xmlStrcmp (child->name, XML_EXPERIMENT))
          break;
  #if DEBUG_INPUT
        fprintf (stderr, "input_open: nexperiments=%u\n", input->nexperiments);
  #endif
        input->experiment = (Experiment *)
          g_realloc (input->experiment,
                     (1 + input->nexperiments) * sizeof (Experiment));
        if (!input->nexperiments)
          {
            if (!experiment_open (input->experiment, child, 0))
              goto exit_on_error;
          }
        else
```

```
        {
          if (!experiment_open (input->experiment + input->nexperiments, child,
                                input->experiment->ninputs))
            goto exit_on_error;
        }
      ++input->nexperiments;
#if DEBUG_INPUT
      fprintf (stderr, "input_open: nexperiments=%u\n", input->nexperiments);
#endif
    }
  if (!input->nexperiments)
    {
      input_error (gettext ("No optimization experiments"));
      goto exit_on_error;
    }
  buffer = NULL;

  // Reading the variables data
  for (; child; child = child->next)
    {
#if DEBUG_INPUT
      fprintf (stderr, "input_open: nvariables=%u\n", input->nvariables);
#endif
      if (xmlStrcmp (child->name, XML_VARIABLE))
        {
          snprintf (buffer2, 64, "%s %u: %s",
                    gettext ("Variable"),
                    input->nvariables + 1, gettext ("bad XML node"));
          input_error (buffer2);
          goto exit_on_error;
        }
      input->variable = (Variable *)
        g_realloc (input->variable,
                   (1 + input->nvariables) * sizeof (Variable));
      if (!variable_open (input->variable + input->nvariables, child,
                          input->algorithm, input->nsteps))
        goto exit_on_error;
      ++input->nvariables;
    }
  if (!input->nvariables)
    {
      input_error (gettext ("No optimization variables"));
      goto exit_on_error;
    }
  buffer = NULL;

  // Obtaining the error norm
  if (xmlHasProp (node, XML_NORM))
    {
      buffer = xmlGetProp (node, XML_NORM);
      if (!xmlStrcmp (buffer, XML_EUCLIDIAN))
        input->norm = ERROR_NORM_EUCLIDIAN;
      else if (!xmlStrcmp (buffer, XML_MAXIMUM))
        input->norm = ERROR_NORM_MAXIMUM;
      else if (!xmlStrcmp (buffer, XML_P))
        {
          input->norm = ERROR_NORM_P;
          input->p = xml_node_get_float (node, XML_P, &error_code);
          if (!error_code)
            {
              input_error (gettext ("Bad P parameter"));
              goto exit_on_error;
            }
        }
      else if (!xmlStrcmp (buffer, XML_TAXICAB))
        input->norm = ERROR_NORM_TAXICAB;
      else
        {
          input_error (gettext ("Unknown error norm"));
          goto exit_on_error;
        }
      xmlFree (buffer);
    }
  else
    input->norm = ERROR_NORM_EUCLIDIAN;

  // Getting the working directory
  input->directory = g_path_get_dirname (filename);
  input->name = g_path_get_basename (filename);

  // Closing the XML document
  xmlFreeDoc (doc);

#if DEBUG_INPUT
  fprintf (stderr, "input_open: end\n");
```

```
#endif
  return 1;

exit_on_error:
  xmlFree (buffer);
  xmlFreeDoc (doc);
  show_error (error_message);
  g_free (error_message);
  input_free ();
#if DEBUG_INPUT
  fprintf (stderr, "input_open: end\n");
#endif
  return 0;
}
```

Here is the call graph for this function:



5.10 input.h

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

Copyright 2012-2016, AUTHORS.

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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#ifndef INPUT__H
#define INPUT__H 1

enum DirectionMethod
{
  DIRECTION_METHOD_COORDINATES = 0,
  DIRECTION_METHOD_RANDOM = 1,
};

enum ErrorNorm
{
  ERROR_NORM_EUCLIDIAN = 0,
  ERROR_NORM_MAXIMUM = 1,
  ERROR_NORM_P = 2,
  ERROR_NORM_TAXICAB = 3
};

typedef struct
{
  Experiment *experiment;
  Variable *variable;
  char *result;
  char *variables;
  char *simulator;
  char *evaluator;
  char *directory;
  char *name;
  double tolerance;
  double mutation_ratio;
  double reproduction_ratio;
  double adaptation_ratio;
  double relaxation;
  double p;
  double threshold;
  unsigned long int seed;
  unsigned int nvariables;
  unsigned int nexperiments;
  unsigned int nsimulations;
  unsigned int algorithm;
  unsigned int nsteps;
  unsigned int direction;
  unsigned int nestimates;
  unsigned int niterations;
  unsigned int nbest;
  unsigned int norm;
} Input;

extern Input input[1];
extern const xmlChar *result_name;
extern const xmlChar *variables_name;

// Public functions
void input_new ();
void input_free ();
void input_error (char *message);
int input_open (char *filename);

#endif
```
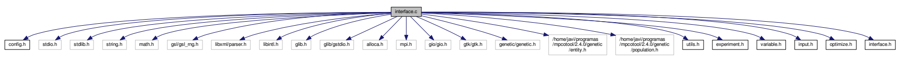

5.11 interface.c File Reference

Source file to define the graphical interface functions.

```
#include "config.h"
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <gsl/gsl_rng.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include <glib/gstdio.h>
#include <alloca.h>
#include <mpi.h>
#include <gio/gio.h>
#include <gtk/gtk.h>
#include "genetic/genetic.h"
#include "utils.h"
#include "experiment.h"
#include "variable.h"
#include "input.h"
#include "optimize.h"
#include "interface.h"
```

Include dependency graph for interface.c:



Macros

- #define **_GNU_SOURCE**
- #define DEBUG_INTERFACE 1

    Macro to debug interface functions.
- #define INPUT_FILE "test-ga.xml"

    Macro to define the initial input file.

Functions

- void input_save_direction (xmlNode ∗node)

    Function to save the direction search method data in a XML node.
- void input_save (char ∗filename)

    Function to save the input file.
- void options_new ()

    Function to open the options dialog.
- void running_new ()

    Function to open the running dialog.
- unsigned int window_get_algorithm ()

    Function to get the stochastic algorithm number.
- unsigned int window_get_direction ()

    Function to get the direction search method number.
- unsigned int window_get_norm ()

    Function to get the norm method number.
- void window_save_direction ()

Function to save the direction search method data in the input file.
- int window_save ()

    Function to save the input file.
- void window_run ()

    Function to run a optimization.
- void window_help ()

    Function to show a help dialog.
- void window_about ()

    Function to show an about dialog.
- void window_update_direction ()

    Function to update direction search method widgets view in the main window.
- void window_update ()

    Function to update the main window view.
- void window_set_algorithm ()

    Function to avoid memory errors changing the algorithm.
- void window_set_experiment ()

    Function to set the experiment data in the main window.
- void window_remove_experiment ()

    Function to remove an experiment in the main window.
- void window_add_experiment ()

    Function to add an experiment in the main window.
- void window_name_experiment ()

    Function to set the experiment name in the main window.
- void window_weight_experiment ()

    Function to update the experiment weight in the main window.
- void window_inputs_experiment ()

    Function to update the experiment input templates number in the main window.
- void window_template_experiment (void ∗data)

    Function to update the experiment i-th input template in the main window.
- void window_set_variable ()

    Function to set the variable data in the main window.
- void window_remove_variable ()

    Function to remove a variable in the main window.
- void window_add_variable ()

    Function to add a variable in the main window.
- void window_label_variable ()

    Function to set the variable label in the main window.
- void window_precision_variable ()

    Function to update the variable precision in the main window.
- void window_rangemin_variable ()

    Function to update the variable rangemin in the main window.
- void window_rangemax_variable ()

    Function to update the variable rangemax in the main window.
- void window_rangeminabs_variable ()

    Function to update the variable rangeminabs in the main window.
- void window_rangemaxabs_variable ()

    Function to update the variable rangemaxabs in the main window.
- void window_step_variable ()

    Function to update the variable step in the main window.
- void window_update_variable ()

    Function to update the variable data in the main window.

- int window_read (char ∗filename)

  Function to read the input data of a file.
- void window_open ()

  Function to open the input data.
- void window_new ()

  Function to open the main window.

Variables

- const char ∗ logo [ ]

  Logo pixmap.
- Options options [1]

  Options struct to define the options dialog.
- Running running [1]

  Running struct to define the running dialog.
- Window window [1]

  Window struct to define the main interface window.

5.11.1 Detailed Description

Source file to define the graphical interface functions.

Authors

Javier Burguete and Borja Latorre.

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Definition in file interface.c.

5.11.2 Function Documentation

5.11.2.1 void input_save (char ∗ *filename*)

Function to save the input file.

Parameters

filename	Input file name.

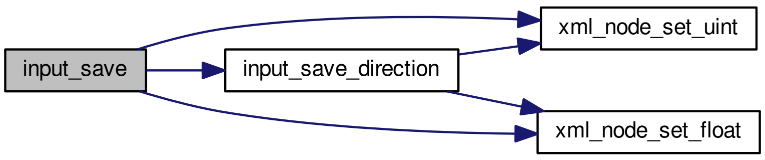
Definition at line 204 of file interface.c.

```
00205 {
00206   unsigned int i, j;
```

```
  char *buffer;
  xmlDoc *doc;
  xmlNode *node, *child;
  GFile *file, *file2;

#if DEBUG_INTERFACE
  fprintf (stderr, "input_save: start\n");
#endif

  // Getting the input file directory
  input->name = g_path_get_basename (filename);
  input->directory = g_path_get_dirname (filename);
  file = g_file_new_for_path (input->directory);

  // Opening the input file
  doc = xmlNewDoc ((const xmlChar *) "1.0");

  // Setting root XML node
  node = xmlNewDocNode (doc, 0, XML_OPTIMIZE, 0);
  xmlDocSetRootElement (doc, node);

  // Adding properties to the root XML node
  if (xmlStrcmp ((const xmlChar *) input->result, result_name))
    xmlSetProp (node, XML_RESULT, (xmlChar *) input->result);
  if (xmlStrcmp ((const xmlChar *) input->variables, variables_name))
    xmlSetProp (node, XML_VARIABLES, (xmlChar *) input->variables);
  file2 = g_file_new_for_path (input->simulator);
  buffer = g_file_get_relative_path (file, file2);
  g_object_unref (file2);
  xmlSetProp (node, XML_SIMULATOR, (xmlChar *) buffer);
  g_free (buffer);
  if (input->evaluator)
    {
      file2 = g_file_new_for_path (input->evaluator);
      buffer = g_file_get_relative_path (file, file2);
      g_object_unref (file2);
      if (xmlStrlen ((xmlChar *) buffer))
        xmlSetProp (node, XML_EVALUATOR, (xmlChar *) buffer);
      g_free (buffer);
    }
  if (input->seed != DEFAULT_RANDOM_SEED)
    xml_node_set_uint (node, XML_SEED, input->seed);

  // Setting the algorithm
  buffer = (char *) g_slice_alloc (64);
  switch (input->algorithm)
    {
    case ALGORITHM_MONTE_CARLO:
      xmlSetProp (node, XML_ALGORITHM, XML_MONTE_CARLO);
      snprintf (buffer, 64, "%u", input->nsimulations);
      xmlSetProp (node, XML_NSIMULATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NITERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->tolerance);
      xmlSetProp (node, XML_TOLERANCE, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->nbest);
      xmlSetProp (node, XML_NBEST, (xmlChar *) buffer);
      input_save_direction (node);
      break;
    case ALGORITHM_SWEEP:
      xmlSetProp (node, XML_ALGORITHM, XML_SWEEP);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NITERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->tolerance);
      xmlSetProp (node, XML_TOLERANCE, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->nbest);
      xmlSetProp (node, XML_NBEST, (xmlChar *) buffer);
      input_save_direction (node);
      break;
    default:
      xmlSetProp (node, XML_ALGORITHM, XML_GENETIC);
      snprintf (buffer, 64, "%u", input->nsimulations);
      xmlSetProp (node, XML_NPOPULATION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NGENERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->mutation_ratio);
      xmlSetProp (node, XML_MUTATION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->reproduction_ratio);
      xmlSetProp (node, XML_REPRODUCTION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->adaptation_ratio);
      xmlSetProp (node, XML_ADAPTATION, (xmlChar *) buffer);
      break;
    }
  g_slice_free1 (64, buffer);
  if (input->threshold != 0.)
    xml_node_set_float (node, XML_THRESHOLD, input->
threshold);
```

```

  // Setting the experimental data
  for (i = 0; i < input->nexperiments; ++i)
    {
      child = xmlNewChild (node, 0, XML_EXPERIMENT, 0);
      xmlSetProp (child, XML_NAME, (xmlChar *) input->experiment[i].name);
      if (input->experiment[i].weight != 1.)
        xml_node_set_float (child, XML_WEIGHT, input->experiment[i].weight);
      for (j = 0; j < input->experiment->ninputs; ++j)
        xmlSetProp (child, template[j],
                    (xmlChar *) input->experiment[i].template[j]);
    }

  // Setting the variables data
  for (i = 0; i < input->nvariables; ++i)
    {
      child = xmlNewChild (node, 0, XML_VARIABLE, 0);
      xmlSetProp (child, XML_NAME, (xmlChar *) input->variable[i].name);
      xml_node_set_float (child, XML_MINIMUM, input->variable[i].rangemin);
      if (input->variable[i].rangeminabs != -G_MAXDOUBLE)
        xml_node_set_float (child, XML_ABSOLUTE_MINIMUM,
                            input->variable[i].rangeminabs);
      xml_node_set_float (child, XML_MAXIMUM, input->variable[i].rangemax);
      if (input->variable[i].rangemaxabs != G_MAXDOUBLE)
        xml_node_set_float (child, XML_ABSOLUTE_MAXIMUM,
                            input->variable[i].rangemaxabs);
      if (input->variable[i].precision != DEFAULT_PRECISION)
        xml_node_set_uint (child, XML_PRECISION, input->variable[i].precision);
      if (input->algorithm == ALGORITHM_SWEEP)
        xml_node_set_uint (child, XML_NSWEEPS, input->variable[i].nsweeps);
      else if (input->algorithm == ALGORITHM_GENETIC)
        xml_node_set_uint (child, XML_NBITS, input->variable[i].nbits);
      if (input->nsteps)
        xml_node_set_float (child, XML_STEP, input->variable[i].step);
    }

  // Saving the error norm
  switch (input->norm)
    {
    case ERROR_NORM_MAXIMUM:
      xmlSetProp (node, XML_NORM, XML_MAXIMUM);
      break;
    case ERROR_NORM_P:
      xmlSetProp (node, XML_NORM, XML_P);
      xml_node_set_float (node, XML_P, input->p);
      break;
    case ERROR_NORM_TAXICAB:
      xmlSetProp (node, XML_NORM, XML_TAXICAB);
    }

  // Saving the XML file
  xmlSaveFormatFile (filename, doc, 1);

  // Freeing memory
  xmlFreeDoc (doc);

#if DEBUG_INTERFACE
  fprintf (stderr, "input_save: end\n");
#endif
}
```

Here is the call graph for this function:



5.11.2.2 void input_save_direction (xmlNode ∗ *node*)

Function to save the direction search method data in a XML node.

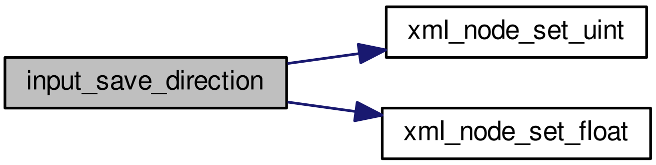
Parameters

node	XML node.

Definition at line 172 of file interface.c.

```
{
#if DEBUG_INTERFACE
  fprintf (stderr, "input_save_direction: start\n");
#endif
  if (input->nsteps)
    {
      xml_node_set_uint (node, XML_NSTEPS, input->
nsteps);
      if (input->relaxation != DEFAULT_RELAXATION)
        xml_node_set_float (node, XML_RELAXATION, input->
relaxation);
      switch (input->direction)
        {
        case DIRECTION_METHOD_COORDINATES:
          xmlSetProp (node, XML_DIRECTION, XML_COORDINATES);
          break;
        default:
          xmlSetProp (node, XML_DIRECTION, XML_RANDOM);
          xml_node_set_uint (node, XML_NESTIMATES, input->
nestimates);
        }
    }
#if DEBUG_INTERFACE
  fprintf (stderr, "input_save_direction: end\n");
#endif
}
```

Here is the call graph for this function:



5.11.2.3 unsigned int window_get_algorithm ( )

Function to get the stochastic algorithm number.

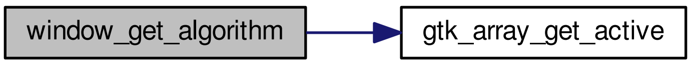
Returns

Stochastic algorithm number.

Definition at line 461 of file interface.c.

```
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_algorithm: start\n");
#endif
  i = gtk_array_get_active (window->button_algorithm,
NALGORITHMS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_algorithm: %u\n", i);
  fprintf (stderr, "window_get_algorithm: end\n");
#endif
  return i;
}
```

Here is the call graph for this function:



5.11.2.4 unsigned int window_get_direction ( )

Function to get the direction search method number.

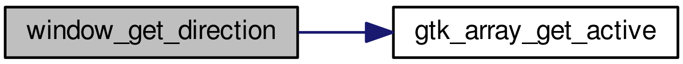
Returns

Direction search method number.

Definition at line 481 of file interface.c.

```
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_direction: start\n");
#endif
  i = gtk_array_get_active (window->button_direction,
NDIRECTIONS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_direction: %u\n", i);
  fprintf (stderr, "window_get_direction: end\n");
#endif
  return i;
}
```

Here is the call graph for this function:



5.11.2.5 unsigned int window_get_norm ( )

Function to get the norm method number.

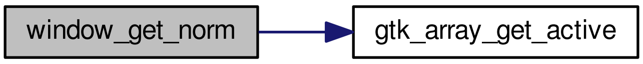
Returns

Norm method number.

Definition at line 501 of file interface.c.

```
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_norm: start\n");
#endif
  i = gtk_array_get_active (window->button_norm,
NNORMS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_norm: %u\n", i);
  fprintf (stderr, "window_get_norm: end\n");
#endif
  return i;
}
```

Here is the call graph for this function:



5.11.2.6 int window_read (char ∗ *filename*)

Function to read the input data of a file.

Parameters

filename	File name.

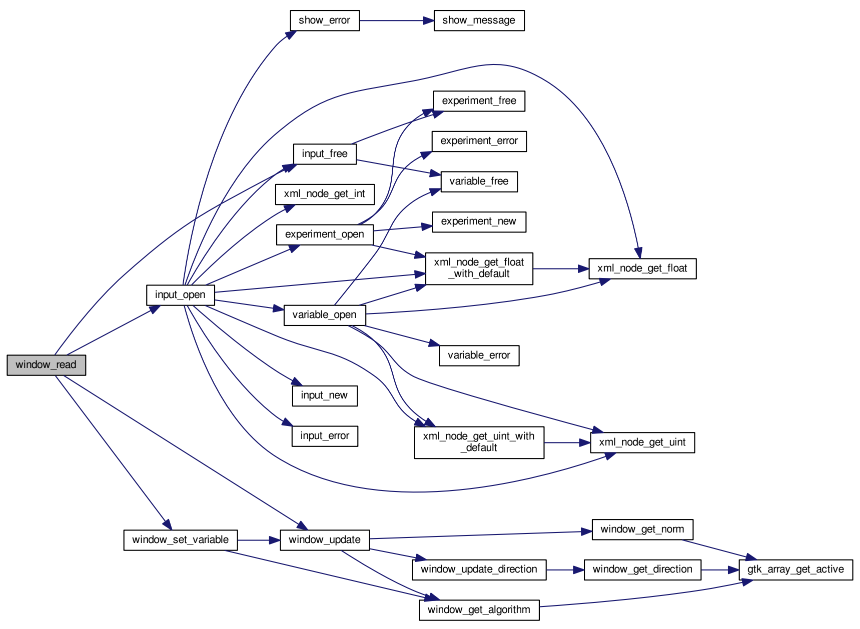
Returns

1 on succes, 0 on error.

Definition at line 1560 of file interface.c.

```
{
  unsigned int i;
  char *buffer;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_read: start\n");
#endif

  // Reading new input file
  input_free ();
  if (!input_open (filename))
    {
#if DEBUG_INTERFACE
      fprintf (stderr, "window_read: end\n");
#endif
      return 0;
    }

  // Setting GTK+ widgets data
  gtk_entry_set_text (window->entry_result, input->result);
  gtk_entry_set_text (window->entry_variables, input->
variables);
  buffer = g_build_filename (input->directory, input->simulator, NULL);
  gtk_file_chooser_set_filename (GTK_FILE_CHOOSER
                                 (window->button_simulator), buffer);
  g_free (buffer);
  gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (window->check_evaluator),
                                (size_t) input->evaluator);
  if (input->evaluator)
    {
      buffer = g_build_filename (input->directory, input->evaluator, NULL);
      gtk_file_chooser_set_filename (GTK_FILE_CHOOSER
                                     (window->button_evaluator), buffer);
      g_free (buffer);
    }
  gtk_toggle_button_set_active
    (GTK_TOGGLE_BUTTON (window->button_algorithm[input->
algorithm]), TRUE);
  switch (input->algorithm)
    {
    case ALGORITHM_MONTE_CARLO:
      gtk_spin_button_set_value (window->spin_simulations,
                                 (gdouble) input->nsimulations);
    case ALGORITHM_SWEEP:
      gtk_spin_button_set_value (window->spin_iterations,
                                 (gdouble) input->niterations);
      gtk_spin_button_set_value (window->spin_bests, (gdouble) input->nbest);
      gtk_spin_button_set_value (window->spin_tolerance, input->tolerance);
      gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (window->check_direction),
                                    input->nsteps);
      if (input->nsteps)
        {
          gtk_toggle_button_set_active
            (GTK_TOGGLE_BUTTON (window->button_direction
                                [input->direction]), TRUE);
          gtk_spin_button_set_value (window->spin_steps,
                                     (gdouble) input->nsteps);
          gtk_spin_button_set_value (window->spin_relaxation,
                                     (gdouble) input->relaxation);
          switch (input->direction)
            {
            case DIRECTION_METHOD_RANDOM:
              gtk_spin_button_set_value (window->spin_estimates,
                                         (gdouble) input->nestimates);
            }
        }
      break;
    default:
      gtk_spin_button_set_value (window->spin_population,
                                 (gdouble) input->nsimulations);
      gtk_spin_button_set_value (window->spin_generations,
                                 (gdouble) input->niterations);
      gtk_spin_button_set_value (window->spin_mutation, input->mutation_ratio);
      gtk_spin_button_set_value (window->spin_reproduction,
                                 input->reproduction_ratio);
      gtk_spin_button_set_value (window->spin_adaptation,
                                 input->adaptation_ratio);
    }
  gtk_toggle_button_set_active
    (GTK_TOGGLE_BUTTON (window->button_norm[input->norm]), TRUE);
  gtk_spin_button_set_value (window->spin_p, input->p);
  gtk_spin_button_set_value (window->spin_threshold, input->threshold);
  g_signal_handler_block (window->combo_experiment, window->id_experiment);
  g_signal_handler_block (window->button_experiment,
                          window->id_experiment_name);
  gtk_combo_box_text_remove_all (window->combo_experiment);
  for (i = 0; i < input->nexperiments; ++i)
    gtk_combo_box_text_append_text (window->combo_experiment,
                                    input->experiment[i].name);
  g_signal_handler_unblock
    (window->button_experiment, window->id_experiment_name);
  g_signal_handler_unblock (window->combo_experiment, window->id_experiment);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_experiment), 0);
  g_signal_handler_block (window->combo_variable, window->id_variable);
  g_signal_handler_block (window->entry_variable, window->id_variable_label);
  gtk_combo_box_text_remove_all (window->combo_variable);
  for (i = 0; i < input->nvariables; ++i)
    gtk_combo_box_text_append_text (window->combo_variable,
                                    input->variable[i].name);
  g_signal_handler_unblock (window->entry_variable, window->id_variable_label);
  g_signal_handler_unblock (window->combo_variable, window->id_variable);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_variable), 0);
  window_set_variable ();
  window_update ();

#if DEBUG_INTERFACE
  fprintf (stderr, "window_read: end\n");
#endif
  return 1;
}
```

Here is the call graph for this function:



5.11.2.7 int window_save ( )

Function to save the input file.

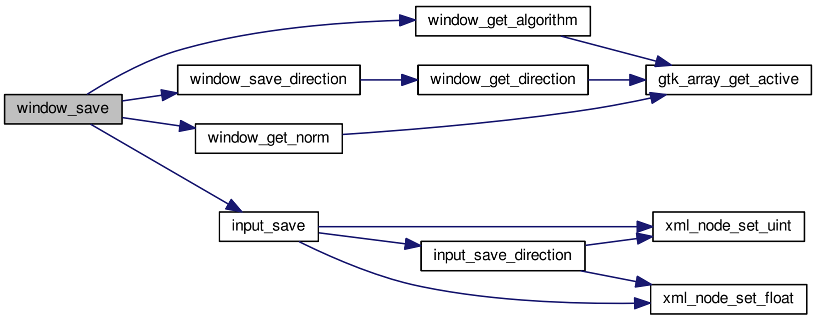
Returns

1 on OK, 0 on Cancel.

Definition at line 554 of file interface.c.

```
{
  GtkFileChooserDialog *dlg;
  GtkFileFilter *filter;
  char *buffer;

#if DEBUG_INTERFACE
  fprintf (stderr, "window_save: start\n");
#endif

  // Opening the saving dialog
  dlg = (GtkFileChooserDialog *)
    gtk_file_chooser_dialog_new (gettext ("Save file"),
                                 window->window,
                                 GTK_FILE_CHOOSER_ACTION_SAVE,
                                 gettext ("_Cancel"),
                                 GTK_RESPONSE_CANCEL,
                                 gettext ("_OK"), GTK_RESPONSE_OK, NULL);
  gtk_file_chooser_set_do_overwrite_confirmation (GTK_FILE_CHOOSER (dlg), TRUE);
  buffer = g_build_filename (input->directory, input->name, NULL);
  gtk_file_chooser_set_filename (GTK_FILE_CHOOSER (dlg), buffer);
  g_free (buffer);

  // Adding XML filter
  filter = (GtkFileFilter *) gtk_file_filter_new ();
  gtk_file_filter_set_name (filter, "XML");
  gtk_file_filter_add_pattern (filter, "*.xml");
  gtk_file_filter_add_pattern (filter, "*.XML");
  gtk_file_chooser_add_filter (GTK_FILE_CHOOSER (dlg), filter);

  // If OK response then saving
  if (gtk_dialog_run (GTK_DIALOG (dlg)) == GTK_RESPONSE_OK)
    {

      // Adding properties to the root XML node
      input->simulator = gtk_file_chooser_get_filename
        (GTK_FILE_CHOOSER (window->button_simulator));
      if (gtk_toggle_button_get_active
          (GTK_TOGGLE_BUTTON (window->check_evaluator)))
        input->evaluator = gtk_file_chooser_get_filename
          (GTK_FILE_CHOOSER (window->button_evaluator));
      else
        input->evaluator = NULL;
      input->result
        = (char *) xmlStrdup ((const xmlChar *)
                              gtk_entry_get_text (window->entry_result));
      input->variables
        = (char *) xmlStrdup ((const xmlChar *)
                              gtk_entry_get_text (window->entry_variables));

      // Setting the algorithm
      switch (window_get_algorithm ())
        {
        case ALGORITHM_MONTE_CARLO:
          input->algorithm = ALGORITHM_MONTE_CARLO;
          input->nsimulations
            = gtk_spin_button_get_value_as_int (window->spin_simulations);
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_iterations);
          input->tolerance = gtk_spin_button_get_value (window->spin_tolerance);
          input->nbest = gtk_spin_button_get_value_as_int (window->spin_bests);
          window_save_direction ();
          break;
        case ALGORITHM_SWEEP:
          input->algorithm = ALGORITHM_SWEEP;
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_iterations);
          input->tolerance = gtk_spin_button_get_value (window->spin_tolerance);
          input->nbest = gtk_spin_button_get_value_as_int (window->spin_bests);
          window_save_direction ();
          break;
        default:
          input->algorithm = ALGORITHM_GENETIC;
          input->nsimulations
            = gtk_spin_button_get_value_as_int (window->spin_population);
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_generations);
          input->mutation_ratio
            = gtk_spin_button_get_value (window->spin_mutation);
          input->reproduction_ratio
            = gtk_spin_button_get_value (window->spin_reproduction);
          input->adaptation_ratio
            = gtk_spin_button_get_value (window->spin_adaptation);
          break;
        }
      input->norm = window_get_norm ();
      input->p = gtk_spin_button_get_value (window->spin_p);
      input->threshold = gtk_spin_button_get_value (window->spin_threshold);

      // Saving the XML file
      buffer = gtk_file_chooser_get_filename (GTK_FILE_CHOOSER (dlg));
      input_save (buffer);

      // Closing and freeing memory
      g_free (buffer);
      gtk_widget_destroy (GTK_WIDGET (dlg));
#if DEBUG_INTERFACE
      fprintf (stderr, "window_save: end\n");
#endif
      return 1;
    }

  // Closing and freeing memory
  gtk_widget_destroy (GTK_WIDGET (dlg));
#if DEBUG_INTERFACE
  fprintf (stderr, "window_save: end\n");
#endif
  return 0;
}
```

Here is the call graph for this function:



5.11.2.8 void window_template_experiment (void ∗ *data*)

Function to update the experiment i-th input template in the main window.

Parameters

data	Callback data (i-th input template).

Definition at line 1210 of file interface.c.

```
{
  unsigned int i, j;
  char *buffer;
  GFile *file1, *file2;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_template_experiment: start\n");
#endif
  i = (size_t) data;
  j = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_experiment));
  file1
    = gtk_file_chooser_get_file (GTK_FILE_CHOOSER (window->button_template[i]));
  file2 = g_file_new_for_path (input->directory);
  buffer = g_file_get_relative_path (file2, file1);
  input->experiment[j].template[i] = (char *) xmlStrdup ((xmlChar *) buffer);
  g_free (buffer);
  g_object_unref (file2);
  g_object_unref (file1);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_template_experiment: end\n");
#endif
}
```

5.12 interface.c

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

Copyright 2012-2016, AUTHORS.

```

```
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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#define _GNU_SOURCE
#include "config.h"
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <gsl/gsl_rng.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include <glib/gstdio.h>
#ifdef G_OS_WIN32
#include <windows.h>
#elif !defined (__BSD_VISIBLE)
#include <alloca.h>
#endif
#if HAVE_MPI
#include <mpi.h>
#endif
#include <gio/gio.h>
#include <gtk/gtk.h>
#include "genetic/genetic.h"
#include "utils.h"
#include "experiment.h"
#include "variable.h"
#include "input.h"
#include "optimize.h"
#include "interface.h"

#define DEBUG_INTERFACE 1


#ifdef G_OS_WIN32
#define INPUT_FILE "test-ga-win.xml"
#else
#define INPUT_FILE "test-ga.xml"
#endif

const char *logo[] = {
  "32 32 3 1",
  "     c None",
  ".    c #0000FF",
  "+    c #FF0000",
  "                                ",
  "                                ",
  "                                ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "     .      .     +++     .     ",
  "     .      .    +++++    .     ",
  "     .      .    +++++    .     ",
  "     .      .    +++++    .     ",
  "    +++     .     +++    +++    ",
  "   +++++    .      .    +++++   ",
  "   +++++    .      .    +++++   ",
  "   +++++    .      .    +++++   ",
  "    +++     .      .     +++    ",
  "     .      .      .      .     ",
  "     .     +++     .      .     ",
  "     .    +++++    .      .     ",
  "     .    +++++    .      .     ",
  "     .    +++++    .      .     ",
  "     .     +++     .      .     ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "     .      .      .      .     ",
  "                                ",
  "                                ",
  "                                "
};

/*
const char * logo[] = {
"32 32 3 1",
"     c #FFFFFFFFFFFF",
".    c #00000000FFFF",
"X    c #FFFF00000000",
"                                ",
"                                ",
"                                ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"     .      .     XXX     .     ",
"     .      .    XXXXX    .     ",
"     .      .    XXXXX    .     ",
"     .      .    XXXXX    .     ",
"    XXX     .     XXX    XXX    ",
"   XXXXX    .      .    XXXXX   ",
"   XXXXX    .      .    XXXXX   ",
"   XXXXX    .      .    XXXXX   ",
"    XXX     .      .     XXX    ",
"     .      .      .      .     ",
"     .     XXX     .      .     ",
"     .    XXXXX    .      .     ",
"     .    XXXXX    .      .     ",
"     .    XXXXX    .      .     ",
"     .     XXX     .      .     ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"     .      .      .      .     ",
"                                ",
"                                ",
"                                "};
*/

Options options[1];
Running running[1];
Window window[1];

void
input_save_direction (xmlNode * node)
{
#if DEBUG_INTERFACE
  fprintf (stderr, "input_save_direction: start\n");
#endif
  if (input->nsteps)
    {
      xml_node_set_uint (node, XML_NSTEPS, input->nsteps);
      if (input->relaxation != DEFAULT_RELAXATION)
        xml_node_set_float (node, XML_RELAXATION, input->relaxation);
      switch (input->direction)
        {
        case DIRECTION_METHOD_COORDINATES:
          xmlSetProp (node, XML_DIRECTION, XML_COORDINATES);
          break;
        default:
          xmlSetProp (node, XML_DIRECTION, XML_RANDOM);
          xml_node_set_uint (node, XML_NESTIMATES, input->nestimates);
        }
    }
#if DEBUG_INTERFACE
  fprintf (stderr, "input_save_direction: end\n");
#endif
}

void
input_save (char *filename)
```

```
{
  unsigned int i, j;
  char *buffer;
  xmlDoc *doc;
  xmlNode *node, *child;
  GFile *file, *file2;

#if DEBUG_INTERFACE
  fprintf (stderr, "input_save: start\n");
#endif

  // Getting the input file directory
  input->name = g_path_get_basename (filename);
  input->directory = g_path_get_dirname (filename);
  file = g_file_new_for_path (input->directory);

  // Opening the input file
  doc = xmlNewDoc ((const xmlChar *) "1.0");

  // Setting root XML node
  node = xmlNewDocNode (doc, 0, XML_OPTIMIZE, 0);
  xmlDocSetRootElement (doc, node);

  // Adding properties to the root XML node
  if (xmlStrcmp ((const xmlChar *) input->result, result_name))
    xmlSetProp (node, XML_RESULT, (xmlChar *) input->result);
  if (xmlStrcmp ((const xmlChar *) input->variables, variables_name))
    xmlSetProp (node, XML_VARIABLES, (xmlChar *) input->variables);
  file2 = g_file_new_for_path (input->simulator);
  buffer = g_file_get_relative_path (file, file2);
  g_object_unref (file2);
  xmlSetProp (node, XML_SIMULATOR, (xmlChar *) buffer);
  g_free (buffer);
  if (input->evaluator)
    {
      file2 = g_file_new_for_path (input->evaluator);
      buffer = g_file_get_relative_path (file, file2);
      g_object_unref (file2);
      if (xmlStrlen ((xmlChar *) buffer))
        xmlSetProp (node, XML_EVALUATOR, (xmlChar *) buffer);
      g_free (buffer);
    }
  if (input->seed != DEFAULT_RANDOM_SEED)
    xml_node_set_uint (node, XML_SEED, input->seed);

  // Setting the algorithm
  buffer = (char *) g_slice_alloc (64);
  switch (input->algorithm)
    {
    case ALGORITHM_MONTE_CARLO:
      xmlSetProp (node, XML_ALGORITHM, XML_MONTE_CARLO);
      snprintf (buffer, 64, "%u", input->nsimulations);
      xmlSetProp (node, XML_NSIMULATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NITERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->tolerance);
      xmlSetProp (node, XML_TOLERANCE, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->nbest);
      xmlSetProp (node, XML_NBEST, (xmlChar *) buffer);
      input_save_direction (node);
      break;
    case ALGORITHM_SWEEP:
      xmlSetProp (node, XML_ALGORITHM, XML_SWEEP);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NITERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->tolerance);
      xmlSetProp (node, XML_TOLERANCE, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->nbest);
      xmlSetProp (node, XML_NBEST, (xmlChar *) buffer);
      input_save_direction (node);
      break;
    default:
      xmlSetProp (node, XML_ALGORITHM, XML_GENETIC);
      snprintf (buffer, 64, "%u", input->nsimulations);
      xmlSetProp (node, XML_NPOPULATION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NGENERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->mutation_ratio);
      xmlSetProp (node, XML_MUTATION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->reproduction_ratio);
      xmlSetProp (node, XML_REPRODUCTION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->adaptation_ratio);
      xmlSetProp (node, XML_ADAPTATION, (xmlChar *) buffer);
      break;
    }
  g_slice_free1 (64, buffer);
  if (input->threshold != 0.)
```

```
    xml_node_set_float (node, XML_THRESHOLD, input->
threshold);

  // Setting the experimental data
  for (i = 0; i < input->nexperiments; ++i)
    {
      child = xmlNewChild (node, 0, XML_EXPERIMENT, 0);
      xmlSetProp (child, XML_NAME, (xmlChar *) input->experiment[i].
name);
      if (input->experiment[i].weight != 1.)
        xml_node_set_float (child, XML_WEIGHT, input->
experiment[i].weight);
      for (j = 0; j < input->experiment->ninputs; ++j)
        xmlSetProp (child, template[j],
                    (xmlChar *) input->experiment[i].template[j]);
    }

  // Setting the variables data
  for (i = 0; i < input->nvariables; ++i)
    {
      child = xmlNewChild (node, 0, XML_VARIABLE, 0);
      xmlSetProp (child, XML_NAME, (xmlChar *) input->variable[i].
name);
      xml_node_set_float (child, XML_MINIMUM, input->
variable[i].rangemin);
      if (input->variable[i].rangeminabs != -G_MAXDOUBLE)
        xml_node_set_float (child, XML_ABSOLUTE_MINIMUM,
                            input->variable[i].rangeminabs);
      xml_node_set_float (child, XML_MAXIMUM, input->
variable[i].rangemax);
      if (input->variable[i].rangemaxabs != G_MAXDOUBLE)
        xml_node_set_float (child, XML_ABSOLUTE_MAXIMUM,
                            input->variable[i].rangemaxabs);
      if (input->variable[i].precision != DEFAULT_PRECISION)
        xml_node_set_uint (child, XML_PRECISION, input->
variable[i].precision);
      if (input->algorithm == ALGORITHM_SWEEP)
        xml_node_set_uint (child, XML_NSWEEPS, input->
variable[i].nsweeps);
      else if (input->algorithm == ALGORITHM_GENETIC)
        xml_node_set_uint (child, XML_NBITS, input->
variable[i].nbits);
      if (input->nsteps)
        xml_node_set_float (child, XML_STEP, input->
variable[i].step);
    }

  // Saving the error norm
  switch (input->norm)
    {
    case ERROR_NORM_MAXIMUM:
      xmlSetProp (node, XML_NORM, XML_MAXIMUM);
      break;
    case ERROR_NORM_P:
      xmlSetProp (node, XML_NORM, XML_P);
      xml_node_set_float (node, XML_P, input->p);
      break;
    case ERROR_NORM_TAXICAB:
      xmlSetProp (node, XML_NORM, XML_TAXICAB);
    }

  // Saving the XML file
  xmlSaveFormatFile (filename, doc, 1);

  // Freeing memory
  xmlFreeDoc (doc);

#if DEBUG_INTERFACE
  fprintf (stderr, "input_save: end\n");
#endif
}

void
options_new ()
{
#if DEBUG_INTERFACE
  fprintf (stderr, "options_new: start\n");
#endif
  options->label_seed = (GtkLabel *)
    gtk_label_new (gettext ("Pseudo-random numbers generator seed"));
  options->spin_seed = (GtkSpinButton *)
    gtk_spin_button_new_with_range (0., (gdouble) G_MAXULONG, 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (options->spin_seed),
     gettext ("Seed to init the pseudo-random numbers generator"));
  gtk_spin_button_set_value (options->spin_seed, (gdouble) input->seed);
  options->label_threads = (GtkLabel *)
```

```
    gtk_label_new (gettext ("Threads number for the stochastic algorithm"));
  options->spin_threads
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 64., 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (options->spin_threads),
     gettext ("Number of threads to perform the calibration/optimization for "
              "the stochastic algorithm"));
  gtk_spin_button_set_value (options->spin_threads, (gdouble)
nthreads);
  options->label_direction = (GtkLabel *)
    gtk_label_new (gettext ("Threads number for the direction search method"));
  options->spin_direction
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 64., 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (options->spin_direction),
     gettext ("Number of threads to perform the calibration/optimization for "
              "the direction search method"));
  gtk_spin_button_set_value (options->spin_direction,
                             (gdouble) nthreads_direction);
  options->grid = (GtkGrid *) gtk_grid_new ();
  gtk_grid_attach (options->grid, GTK_WIDGET (options->label_seed), 0, 0, 1, 1);
  gtk_grid_attach (options->grid, GTK_WIDGET (options->spin_seed), 1, 0, 1, 1);
  gtk_grid_attach (options->grid, GTK_WIDGET (options->label_threads),
                   0, 1, 1, 1);
  gtk_grid_attach (options->grid, GTK_WIDGET (options->spin_threads),
                   1, 1, 1, 1);
  gtk_grid_attach (options->grid, GTK_WIDGET (options->label_direction),
                   0, 2, 1, 1);
  gtk_grid_attach (options->grid, GTK_WIDGET (options->spin_direction),
                   1, 2, 1, 1);
  gtk_widget_show_all (GTK_WIDGET (options->grid));
  options->dialog = (GtkDialog *)
    gtk_dialog_new_with_buttons (gettext ("Options"),
                                 window->window,
                                 GTK_DIALOG_MODAL,
                                 gettext ("_OK"), GTK_RESPONSE_OK,
                                 gettext ("_Cancel"), GTK_RESPONSE_CANCEL,
                                 NULL);
  gtk_container_add
    (GTK_CONTAINER (gtk_dialog_get_content_area (options->dialog)),
     GTK_WIDGET (options->grid));
  if (gtk_dialog_run (options->dialog) == GTK_RESPONSE_OK)
    {
      input->seed
        = (unsigned long int) gtk_spin_button_get_value (options->spin_seed);
      nthreads = gtk_spin_button_get_value_as_int (options->spin_threads);
      nthreads_direction
        = gtk_spin_button_get_value_as_int (options->spin_direction);
    }
  gtk_widget_destroy (GTK_WIDGET (options->dialog));
#if DEBUG_INTERFACE
  fprintf (stderr, "options_new: end\n");
#endif
}

void
running_new ()
{
#if DEBUG_INTERFACE
  fprintf (stderr, "running_new: start\n");
#endif
  running->label = (GtkLabel *) gtk_label_new (gettext ("Calculating ..."));
  running->spinner = (GtkSpinner *) gtk_spinner_new ();
  running->grid = (GtkGrid *) gtk_grid_new ();
  gtk_grid_attach (running->grid, GTK_WIDGET (running->label), 0, 0, 1, 1);
  gtk_grid_attach (running->grid, GTK_WIDGET (running->spinner), 0, 1, 1, 1);
  running->dialog = (GtkDialog *)
    gtk_dialog_new_with_buttons (gettext ("Calculating"),
                                 window->window, GTK_DIALOG_MODAL, NULL, NULL);
  gtk_container_add
    (GTK_CONTAINER (gtk_dialog_get_content_area (running->dialog)),
     GTK_WIDGET (running->grid));
  gtk_spinner_start (running->spinner);
  gtk_widget_show_all (GTK_WIDGET (running->dialog));
#if DEBUG_INTERFACE
  fprintf (stderr, "running_new: end\n");
#endif
}

unsigned int
window_get_algorithm ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_algorithm: start\n");
#endif
  i = gtk_array_get_active (window->button_algorithm,
NALGORITHMS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_algorithm: %u\n", i);
  fprintf (stderr, "window_get_algorithm: end\n");
#endif
  return i;
}

unsigned int
window_get_direction ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_direction: start\n");
#endif
  i = gtk_array_get_active (window->button_direction,
NDIRECTIONS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_direction: %u\n", i);
  fprintf (stderr, "window_get_direction: end\n");
#endif
  return i;
}

unsigned int
window_get_norm ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_norm: start\n");
#endif
  i = gtk_array_get_active (window->button_norm,
NNORMS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_norm: %u\n", i);
  fprintf (stderr, "window_get_norm: end\n");
#endif
  return i;
}

void
window_save_direction ()
{
#if DEBUG_INTERFACE
  fprintf (stderr, "window_save_direction: start\n");
#endif
  if (gtk_toggle_button_get_active
      (GTK_TOGGLE_BUTTON (window->check_direction)))
    {
      input->nsteps = gtk_spin_button_get_value_as_int (window->spin_steps);
      input->relaxation = gtk_spin_button_get_value (window->
spin_relaxation);
      switch (window_get_direction ())
        {
        case DIRECTION_METHOD_COORDINATES:
          input->direction = DIRECTION_METHOD_COORDINATES;
          break;
        default:
          input->direction = DIRECTION_METHOD_RANDOM;
          input->nestimates
            = gtk_spin_button_get_value_as_int (window->spin_estimates);
        }
    }
  else
    input->nsteps = 0;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_save_direction: end\n");
#endif
}

int
window_save ()
{
  GtkFileChooserDialog *dlg;
  GtkFileFilter *filter;
  char *buffer;

#if DEBUG_INTERFACE
  fprintf (stderr, "window_save: start\n");
#endif

  // Opening the saving dialog
  dlg = (GtkFileChooserDialog *)
    gtk_file_chooser_dialog_new (gettext ("Save file"),
                                 window->window,
                                 GTK_FILE_CHOOSER_ACTION_SAVE,
                                 gettext ("_Cancel"),
                                 GTK_RESPONSE_CANCEL,
                                 gettext ("_OK"), GTK_RESPONSE_OK, NULL);
  gtk_file_chooser_set_do_overwrite_confirmation (GTK_FILE_CHOOSER (dlg), TRUE);
  buffer = g_build_filename (input->directory, input->name, NULL);
  gtk_file_chooser_set_filename (GTK_FILE_CHOOSER (dlg), buffer);
  g_free (buffer);

  // Adding XML filter
  filter = (GtkFileFilter *) gtk_file_filter_new ();
  gtk_file_filter_set_name (filter, "XML");
  gtk_file_filter_add_pattern (filter, "*.xml");
  gtk_file_filter_add_pattern (filter, "*.XML");
  gtk_file_chooser_add_filter (GTK_FILE_CHOOSER (dlg), filter);

  // If OK response then saving
  if (gtk_dialog_run (GTK_DIALOG (dlg)) == GTK_RESPONSE_OK)
    {

      // Adding properties to the root XML node
      input->simulator = gtk_file_chooser_get_filename
        (GTK_FILE_CHOOSER (window->button_simulator));
      if (gtk_toggle_button_get_active
          (GTK_TOGGLE_BUTTON (window->check_evaluator)))
        input->evaluator = gtk_file_chooser_get_filename
          (GTK_FILE_CHOOSER (window->button_evaluator));
      else
        input->evaluator = NULL;
      input->result
        = (char *) xmlStrdup ((const xmlChar *)
                              gtk_entry_get_text (window->entry_result));
      input->variables
        = (char *) xmlStrdup ((const xmlChar *)
                              gtk_entry_get_text (window->entry_variables));

      // Setting the algorithm
      switch (window_get_algorithm ())
        {
        case ALGORITHM_MONTE_CARLO:
          input->algorithm = ALGORITHM_MONTE_CARLO;
          input->nsimulations
            = gtk_spin_button_get_value_as_int (window->spin_simulations);
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_iterations);
          input->tolerance = gtk_spin_button_get_value (window->
spin_tolerance);
          input->nbest = gtk_spin_button_get_value_as_int (window->
spin_bests);
          window_save_direction ();
          break;
        case ALGORITHM_SWEEP:
          input->algorithm = ALGORITHM_SWEEP;
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_iterations);
          input->tolerance = gtk_spin_button_get_value (window->
spin_tolerance);
          input->nbest = gtk_spin_button_get_value_as_int (window->
spin_bests);
          window_save_direction ();
          break;
        default:
          input->algorithm = ALGORITHM_GENETIC;
          input->nsimulations
            = gtk_spin_button_get_value_as_int (window->spin_population);
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_generations);
          input->mutation_ratio
            = gtk_spin_button_get_value (window->spin_mutation);
          input->reproduction_ratio
            = gtk_spin_button_get_value (window->spin_reproduction);
          input->adaptation_ratio
            = gtk_spin_button_get_value (window->spin_adaptation);
          break;
        }
      input->norm = window_get_norm ();
      input->p = gtk_spin_button_get_value (window->spin_p);
      input->threshold = gtk_spin_button_get_value (window->
spin_threshold);

      // Saving the XML file
      buffer = gtk_file_chooser_get_filename (GTK_FILE_CHOOSER (dlg));
      input_save (buffer);

      // Closing and freeing memory
      g_free (buffer);
      gtk_widget_destroy (GTK_WIDGET (dlg));
#if DEBUG_INTERFACE
      fprintf (stderr, "window_save: end\n");
```

```
#endif
      return 1;
    }

  // Closing and freeing memory
  gtk_widget_destroy (GTK_WIDGET (dlg));
#if DEBUG_INTERFACE
  fprintf (stderr, "window_save: end\n");
#endif
  return 0;
}

void
window_run ()
{
  unsigned int i;
  char *msg, *msg2, buffer[64], buffer2[64];
#if DEBUG_INTERFACE
  fprintf (stderr, "window_run: start\n");
#endif
  if (!window_save ())
    {
#if DEBUG_INTERFACE
      fprintf (stderr, "window_run: end\n");
#endif
      return;
    }
  running_new ();
  while (gtk_events_pending ())
    gtk_main_iteration ();
  optimize_open ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_run: closing running dialog\n");
#endif
  gtk_spinner_stop (running->spinner);
  gtk_widget_destroy (GTK_WIDGET (running->dialog));
#if DEBUG_INTERFACE
  fprintf (stderr, "window_run: displaying results\n");
#endif
  snprintf (buffer, 64, "error = %.15le\n", optimize->error_old[0]);
  msg2 = g_strdup (buffer);
  for (i = 0; i < optimize->nvariables; ++i, msg2 = msg)
    {
      snprintf (buffer, 64, "%s = %s\n",
                input->variable[i].name, format[input->
variable[i].precision]);
      snprintf (buffer2, 64, buffer, optimize->value_old[i]);
      msg = g_strconcat (msg2, buffer2, NULL);
      g_free (msg2);
    }
  snprintf (buffer, 64, "%s = %.6lg s", gettext ("Calculation time"),
            optimize->calculation_time);
  msg = g_strconcat (msg2, buffer, NULL);
  g_free (msg2);
  show_message (gettext ("Best result"), msg, INFO_TYPE);
  g_free (msg);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_run: freeing memory\n");
#endif
  optimize_free ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_run: end\n");
#endif
}

void
window_help ()
{
  char *buffer, *buffer2;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_help: start\n");
#endif
  buffer2 = g_build_filename (window->application_directory, "..", "manuals",
                              gettext ("user-manual.pdf"), NULL);
  buffer = g_filename_to_uri (buffer2, NULL, NULL);
  g_free (buffer2);
  gtk_show_uri (NULL, buffer, GDK_CURRENT_TIME, NULL);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_help: uri=%s\n", buffer);
#endif
  g_free (buffer);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_help: end\n");
#endif
}

void
```

```
window_about ()
{
  static const gchar *authors[] = {
    "Javier Burguete Tolosa <jburguete@eead.csic.es>",
    "Borja Latorre Garcés <borja.latorre@csic.es>",
    NULL
  };
#if DEBUG_INTERFACE
  fprintf (stderr, "window_about: start\n");
#endif
  gtk_show_about_dialog
    (window->window,
     "program_name", "MPCOTool",
     "comments",
     gettext ("The Multi-Purposes Calibration and Optimization Tool.\n"
              "A software to perform calibrations or optimizations of "
              "empirical parameters"),
     "authors", authors,
     "translator-credits", "Javier Burguete Tolosa <jburguete@eead.csic.es>",
     "version", "2.4.0",
     "copyright", "Copyright 2012-2016 Javier Burguete Tolosa",
     "logo", window->logo,
     "website", "https://github.com/jburguete/mpcotool",
     "license-type", GTK_LICENSE_BSD, NULL);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_about: end\n");
#endif
}

void
window_update_direction ()
{
#if DEBUG_INTERFACE
  fprintf (stderr, "window_update_direction: start\n");
#endif
  gtk_widget_show (GTK_WIDGET (window->check_direction));
  if (gtk_toggle_button_get_active
      (GTK_TOGGLE_BUTTON (window->check_direction)))
    {
      gtk_widget_show (GTK_WIDGET (window->grid_direction));
      gtk_widget_show (GTK_WIDGET (window->label_step));
      gtk_widget_show (GTK_WIDGET (window->spin_step));
    }
  switch (window_get_direction ())
    {
    case DIRECTION_METHOD_COORDINATES:
      gtk_widget_hide (GTK_WIDGET (window->label_estimates));
      gtk_widget_hide (GTK_WIDGET (window->spin_estimates));
      break;
    default:
      gtk_widget_show (GTK_WIDGET (window->label_estimates));
      gtk_widget_show (GTK_WIDGET (window->spin_estimates));
    }
#if DEBUG_INTERFACE
  fprintf (stderr, "window_update_direction: end\n");
#endif
}

void
window_update ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_update: start\n");
#endif
  gtk_widget_set_sensitive
    (GTK_WIDGET (window->button_evaluator),
     gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON
                                   (window->check_evaluator)));
  gtk_widget_hide (GTK_WIDGET (window->label_simulations));
  gtk_widget_hide (GTK_WIDGET (window->spin_simulations));
  gtk_widget_hide (GTK_WIDGET (window->label_iterations));
  gtk_widget_hide (GTK_WIDGET (window->spin_iterations));
  gtk_widget_hide (GTK_WIDGET (window->label_tolerance));
  gtk_widget_hide (GTK_WIDGET (window->spin_tolerance));
  gtk_widget_hide (GTK_WIDGET (window->label_bests));
  gtk_widget_hide (GTK_WIDGET (window->spin_bests));
  gtk_widget_hide (GTK_WIDGET (window->label_population));
  gtk_widget_hide (GTK_WIDGET (window->spin_population));
  gtk_widget_hide (GTK_WIDGET (window->label_generations));
  gtk_widget_hide (GTK_WIDGET (window->spin_generations));
  gtk_widget_hide (GTK_WIDGET (window->label_mutation));
  gtk_widget_hide (GTK_WIDGET (window->spin_mutation));
  gtk_widget_hide (GTK_WIDGET (window->label_reproduction));
  gtk_widget_hide (GTK_WIDGET (window->spin_reproduction));
  gtk_widget_hide (GTK_WIDGET (window->label_adaptation));
  gtk_widget_hide (GTK_WIDGET (window->spin_adaptation));
  gtk_widget_hide (GTK_WIDGET (window->label_sweeps));
  gtk_widget_hide (GTK_WIDGET (window->spin_sweeps));
  gtk_widget_hide (GTK_WIDGET (window->label_bits));
  gtk_widget_hide (GTK_WIDGET (window->spin_bits));
  gtk_widget_hide (GTK_WIDGET (window->check_direction));
  gtk_widget_hide (GTK_WIDGET (window->grid_direction));
  gtk_widget_hide (GTK_WIDGET (window->label_step));
  gtk_widget_hide (GTK_WIDGET (window->spin_step));
  gtk_widget_hide (GTK_WIDGET (window->label_p));
  gtk_widget_hide (GTK_WIDGET (window->spin_p));
  i = gtk_spin_button_get_value_as_int (window->spin_iterations);
  switch (window_get_algorithm ())
    {
    case ALGORITHM_MONTE_CARLO:
      gtk_widget_show (GTK_WIDGET (window->label_simulations));
      gtk_widget_show (GTK_WIDGET (window->spin_simulations));
      gtk_widget_show (GTK_WIDGET (window->label_iterations));
      gtk_widget_show (GTK_WIDGET (window->spin_iterations));
      if (i > 1)
        {
          gtk_widget_show (GTK_WIDGET (window->label_tolerance));
          gtk_widget_show (GTK_WIDGET (window->spin_tolerance));
          gtk_widget_show (GTK_WIDGET (window->label_bests));
          gtk_widget_show (GTK_WIDGET (window->spin_bests));
        }
      window_update_direction ();
      break;
    case ALGORITHM_SWEEP:
      gtk_widget_show (GTK_WIDGET (window->label_iterations));
      gtk_widget_show (GTK_WIDGET (window->spin_iterations));
      if (i > 1)
        {
          gtk_widget_show (GTK_WIDGET (window->label_tolerance));
          gtk_widget_show (GTK_WIDGET (window->spin_tolerance));
          gtk_widget_show (GTK_WIDGET (window->label_bests));
          gtk_widget_show (GTK_WIDGET (window->spin_bests));
        }
      gtk_widget_show (GTK_WIDGET (window->label_sweeps));
      gtk_widget_show (GTK_WIDGET (window->spin_sweeps));
      gtk_widget_show (GTK_WIDGET (window->check_direction));
      window_update_direction ();
      break;
    default:
      gtk_widget_show (GTK_WIDGET (window->label_population));
      gtk_widget_show (GTK_WIDGET (window->spin_population));
      gtk_widget_show (GTK_WIDGET (window->label_generations));
      gtk_widget_show (GTK_WIDGET (window->spin_generations));
      gtk_widget_show (GTK_WIDGET (window->label_mutation));
      gtk_widget_show (GTK_WIDGET (window->spin_mutation));
      gtk_widget_show (GTK_WIDGET (window->label_reproduction));
      gtk_widget_show (GTK_WIDGET (window->spin_reproduction));
      gtk_widget_show (GTK_WIDGET (window->label_adaptation));
      gtk_widget_show (GTK_WIDGET (window->spin_adaptation));
      gtk_widget_show (GTK_WIDGET (window->label_bits));
      gtk_widget_show (GTK_WIDGET (window->spin_bits));
    }
  gtk_widget_set_sensitive
    (GTK_WIDGET (window->button_remove_experiment), input->
nexperiments > 1);
  gtk_widget_set_sensitive
    (GTK_WIDGET (window->button_remove_variable), input->
nvariables > 1);
  for (i = 0; i < input->experiment->ninputs; ++i)
    {
      gtk_widget_show (GTK_WIDGET (window->check_template[i]));
      gtk_widget_show (GTK_WIDGET (window->button_template[i]));
      gtk_widget_set_sensitive (GTK_WIDGET (window->check_template[i]), 0);
      gtk_widget_set_sensitive (GTK_WIDGET (window->button_template[i]), 1);
      g_signal_handler_block
        (window->check_template[i], window->id_template[i]);
      g_signal_handler_block (window->button_template[i], window->
id_input[i]);
      gtk_toggle_button_set_active
        (GTK_TOGGLE_BUTTON (window->check_template[i]), 1);
      g_signal_handler_unblock
        (window->button_template[i], window->id_input[i]);
      g_signal_handler_unblock
        (window->check_template[i], window->id_template[i]);
    }
  if (i > 0)
    {
      gtk_widget_set_sensitive (GTK_WIDGET (window->check_template[i - 1]), 1);
      gtk_widget_set_sensitive
        (GTK_WIDGET (window->button_template[i - 1]),
         gtk_toggle_button_get_active
         GTK_TOGGLE_BUTTON (window->check_template[i - 1]));
    }
  if (i < MAX_NINPUTS)
    {
      gtk_widget_show (GTK_WIDGET (window->check_template[i]));
      gtk_widget_show (GTK_WIDGET (window->button_template[i]));
      gtk_widget_set_sensitive (GTK_WIDGET (window->check_template[i]), 1);
      gtk_widget_set_sensitive
        (GTK_WIDGET (window->button_template[i]),
         gtk_toggle_button_get_active
         GTK_TOGGLE_BUTTON (window->check_template[i]));
      g_signal_handler_block
        (window->check_template[i], window->id_template[i]);
      g_signal_handler_block (window->button_template[i], window->
id_input[i]);
      gtk_toggle_button_set_active
        (GTK_TOGGLE_BUTTON (window->check_template[i]), 0);
      g_signal_handler_unblock
        (window->button_template[i], window->id_input[i]);
      g_signal_handler_unblock
        (window->check_template[i], window->id_template[i]);
    }
  while (++i < MAX_NINPUTS)
    {
      gtk_widget_hide (GTK_WIDGET (window->check_template[i]));
      gtk_widget_hide (GTK_WIDGET (window->button_template[i]));
    }
  gtk_widget_set_sensitive
    (GTK_WIDGET (window->spin_minabs),
     gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON (window->check_minabs)));
  gtk_widget_set_sensitive
    (GTK_WIDGET (window->spin_maxabs),
     gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON (window->check_maxabs)));
  if (window_get_norm () == ERROR_NORM_P)
    {
      gtk_widget_show (GTK_WIDGET (window->label_p));
      gtk_widget_show (GTK_WIDGET (window->spin_p));
    }
#if DEBUG_INTERFACE
  fprintf (stderr, "window_update: end\n");
#endif
}

void
window_set_algorithm ()
{
  int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_set_algorithm: start\n");
#endif
  i = window_get_algorithm ();
  switch (i)
    {
    case ALGORITHM_SWEEP:
      i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
      if (i < 0)
        i = 0;
      gtk_spin_button_set_value (window->spin_sweeps,
                                 (gdouble) input->variable[i].nsweeps);
      break;
    case ALGORITHM_GENETIC:
      i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
      if (i < 0)
        i = 0;
      gtk_spin_button_set_value (window->spin_bits,
                                 (gdouble) input->variable[i].nbits);
    }
  window_update ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_set_algorithm: end\n");
#endif
}

void
window_set_experiment ()
{
  unsigned int i, j;
  char *buffer1, *buffer2;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_set_experiment: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_experiment));
  gtk_spin_button_set_value (window->spin_weight, input->experiment[i].
weight);
  buffer1 = gtk_combo_box_text_get_active_text (window->combo_experiment);
  buffer2 = g_build_filename (input->directory, buffer1, NULL);
  g_free (buffer1);
  g_signal_handler_block
    (window->button_experiment, window->id_experiment_name);
  gtk_file_chooser_set_filename
    (GTK_FILE_CHOOSER (window->button_experiment), buffer2);
  g_signal_handler_unblock
    (window->button_experiment, window->id_experiment_name);
  g_free (buffer2);
  for (j = 0; j < input->experiment->ninputs; ++j)
    {
      g_signal_handler_block (window->button_template[j], window->
id_input[j]);
      buffer2 = g_build_filename (input->directory,
                                  input->experiment[i].template[j], NULL);
      gtk_file_chooser_set_filename
        (GTK_FILE_CHOOSER (window->button_template[j]), buffer2);
      g_free (buffer2);
      g_signal_handler_unblock
        (window->button_template[j], window->id_input[j]);
    }
#if DEBUG_INTERFACE
  fprintf (stderr, "window_set_experiment: end\n");
#endif
}

void
window_remove_experiment ()
{
  unsigned int i, j;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_remove_experiment: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_experiment));
  g_signal_handler_block (window->combo_experiment, window->
id_experiment);
  gtk_combo_box_text_remove (window->combo_experiment, i);
  g_signal_handler_unblock (window->combo_experiment, window->
id_experiment);
  experiment_free (input->experiment + i);
  --input->nexperiments;
  for (j = i; j < input->nexperiments; ++j)
    memcpy (input->experiment + j, input->experiment + j + 1,
            sizeof (Experiment));
  j = input->nexperiments - 1;
  if (i > j)
    i = j;
  for (j = 0; j < input->experiment->ninputs; ++j)
    g_signal_handler_block (window->button_template[j], window->
id_input[j]);
  g_signal_handler_block
    (window->button_experiment, window->id_experiment_name);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_experiment), i);
  g_signal_handler_unblock
    (window->button_experiment, window->id_experiment_name);
  for (j = 0; j < input->experiment->ninputs; ++j)
    g_signal_handler_unblock (window->button_template[j], window->
id_input[j]);
  window_update ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_remove_experiment: end\n");
#endif
}

void
window_add_experiment ()
{
  unsigned int i, j;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_add_experiment: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_experiment));
  g_signal_handler_block (window->combo_experiment, window->
id_experiment);
  gtk_combo_box_text_insert_text
    (window->combo_experiment, i, input->experiment[i].
name);
  g_signal_handler_unblock (window->combo_experiment, window->
id_experiment);
  input->experiment = (Experiment *) g_realloc
    (input->experiment, (input->nexperiments + 1) * sizeof (
Experiment));
  for (j = input->nexperiments - 1; j > i; --j)
    memcpy (input->experiment + j + 1, input->experiment + j,
            sizeof (Experiment));
  input->experiment[j + 1].name
    = (char *) xmlStrdup ((xmlChar *) input->experiment[j].name);
  input->experiment[j + 1].weight = input->experiment[j].
weight;
  input->experiment[j + 1].ninputs = input->experiment[j].
ninputs;
```

```
  for (j = 0; j < input->experiment->ninputs; ++j)
    input->experiment[i + 1].template[j]
      = (char *) xmlStrdup ((xmlChar *) input->experiment[i].template[j]);
  ++input->nexperiments;
  for (j = 0; j < input->experiment->ninputs; ++j)
    g_signal_handler_block (window->button_template[j], window->id_input[j]);
  g_signal_handler_block
    (window->button_experiment, window->id_experiment_name);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_experiment), i + 1);
  g_signal_handler_unblock
    (window->button_experiment, window->id_experiment_name);
  for (j = 0; j < input->experiment->ninputs; ++j)
    g_signal_handler_unblock (window->button_template[j], window->id_input[j]);
  window_update ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_add_experiment: end\n");
#endif
}

void
window_name_experiment ()
{
  unsigned int i;
  char *buffer;
  GFile *file1, *file2;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_name_experiment: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_experiment));
  file1
    = gtk_file_chooser_get_file (GTK_FILE_CHOOSER (window->button_experiment));
  file2 = g_file_new_for_path (input->directory);
  buffer = g_file_get_relative_path (file2, file1);
  g_signal_handler_block (window->combo_experiment, window->id_experiment);
  gtk_combo_box_text_remove (window->combo_experiment, i);
  gtk_combo_box_text_insert_text (window->combo_experiment, i, buffer);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_experiment), i);
  g_signal_handler_unblock (window->combo_experiment, window->id_experiment);
  g_free (buffer);
  g_object_unref (file2);
  g_object_unref (file1);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_name_experiment: end\n");
#endif
}

void
window_weight_experiment ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_weight_experiment: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_experiment));
  input->experiment[i].weight = gtk_spin_button_get_value (window->spin_weight);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_weight_experiment: end\n");
#endif
}

void
window_inputs_experiment ()
{
  unsigned int j;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_inputs_experiment: start\n");
#endif
  j = input->experiment->ninputs - 1;
  if (j
      && !gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON
                                        (window->check_template[j])))
    --input->experiment->ninputs;
  if (input->experiment->ninputs < MAX_NINPUTS
      && gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON
                                       (window->check_template[j])))
    ++input->experiment->ninputs;
  window_update ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_inputs_experiment: end\n");
#endif
}
```

```
void
window_template_experiment (void *data)
{
  unsigned int i, j;
  char *buffer;
  GFile *file1, *file2;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_template_experiment: start\n");
#endif
  i = (size_t) data;
  j = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_experiment));
  file1
    = gtk_file_chooser_get_file (GTK_FILE_CHOOSER (window->button_template[i]));
  file2 = g_file_new_for_path (input->directory);
  buffer = g_file_get_relative_path (file2, file1);
  input->experiment[j].template[i] = (char *) xmlStrdup ((xmlChar *) buffer);
  g_free (buffer);
  g_object_unref (file2);
  g_object_unref (file1);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_template_experiment: end\n");
#endif
}

void
window_set_variable ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_set_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  g_signal_handler_block (window->entry_variable, window->
id_variable_label);
  gtk_entry_set_text (window->entry_variable, input->variable[i].
name);
  g_signal_handler_unblock (window->entry_variable, window->
id_variable_label);
  gtk_spin_button_set_value (window->spin_min, input->variable[i].
rangemin);
  gtk_spin_button_set_value (window->spin_max, input->variable[i].
rangemax);
  if (input->variable[i].rangeminabs != -G_MAXDOUBLE)
    {
      gtk_spin_button_set_value (window->spin_minabs,
                                 input->variable[i].rangeminabs);
      gtk_toggle_button_set_active
        (GTK_TOGGLE_BUTTON (window->check_minabs), 1);
    }
  else
    {
      gtk_spin_button_set_value (window->spin_minabs, -G_MAXDOUBLE);
      gtk_toggle_button_set_active
        (GTK_TOGGLE_BUTTON (window->check_minabs), 0);
    }
  if (input->variable[i].rangemaxabs != G_MAXDOUBLE)
    {
      gtk_spin_button_set_value (window->spin_maxabs,
                                 input->variable[i].rangemaxabs);
      gtk_toggle_button_set_active
        (GTK_TOGGLE_BUTTON (window->check_maxabs), 1);
    }
  else
    {
      gtk_spin_button_set_value (window->spin_maxabs, G_MAXDOUBLE);
      gtk_toggle_button_set_active
        (GTK_TOGGLE_BUTTON (window->check_maxabs), 0);
    }
  gtk_spin_button_set_value (window->spin_precision,
                             input->variable[i].precision);
  gtk_spin_button_set_value (window->spin_steps, (gdouble) input->
nsteps);
  if (input->nsteps)
    gtk_spin_button_set_value (window->spin_step, input->variable[i].
step);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_set_variable: precision[%u]=%u\n", i,
           input->variable[i].precision);
#endif
  switch (window_get_algorithm ())
    {
    case ALGORITHM_SWEEP:
      gtk_spin_button_set_value (window->spin_sweeps,
                                 (gdouble) input->variable[i].nsweeps);
#if DEBUG_INTERFACE
      fprintf (stderr, "window_set_variable: nsweeps[%u]=%u\n", i,
               input->variable[i].nsweeps);
#endif
      break;
    case ALGORITHM_GENETIC:
      gtk_spin_button_set_value (window->spin_bits,
                                 (gdouble) input->variable[i].nbits);
#if DEBUG_INTERFACE
      fprintf (stderr, "window_set_variable: nbits[%u]=%u\n", i,
               input->variable[i].nbits);
#endif
      break;
    }
  window_update ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_set_variable: end\n");
#endif
}

void
window_remove_variable ()
{
  unsigned int i, j;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_remove_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  g_signal_handler_block (window->combo_variable, window->id_variable);
  gtk_combo_box_text_remove (window->combo_variable, i);
  g_signal_handler_unblock (window->combo_variable, window->id_variable);
  xmlFree (input->variable[i].name);
  --input->nvariables;
  for (j = i; j < input->nvariables; ++j)
    memcpy (input->variable + j, input->variable + j + 1, sizeof (Variable));
  j = input->nvariables - 1;
  if (i > j)
    i = j;
  g_signal_handler_block (window->entry_variable, window->id_variable_label);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_variable), i);
  g_signal_handler_unblock (window->entry_variable, window->id_variable_label);
  window_update ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_remove_variable: end\n");
#endif
}

void
window_add_variable ()
{
  unsigned int i, j;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_add_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  g_signal_handler_block (window->combo_variable, window->id_variable);
  gtk_combo_box_text_insert_text (window->combo_variable, i,
                                  input->variable[i].name);
  g_signal_handler_unblock (window->combo_variable, window->id_variable);
  input->variable = (Variable *) g_realloc
    (input->variable, (input->nvariables + 1) * sizeof (Variable));
  for (j = input->nvariables - 1; j > i; --j)
    memcpy (input->variable + j + 1, input->variable + j, sizeof (Variable));
  memcpy (input->variable + j + 1, input->variable + j, sizeof (Variable));
  input->variable[j + 1].name
    = (char *) xmlStrdup ((xmlChar *) input->variable[j].name);
  ++input->nvariables;
  g_signal_handler_block (window->entry_variable, window->id_variable_label);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_variable), i + 1);
  g_signal_handler_unblock (window->entry_variable, window->id_variable_label);
  window_update ();
#if DEBUG_INTERFACE
  fprintf (stderr, "window_add_variable: end\n");
#endif
}

void
window_label_variable ()
```

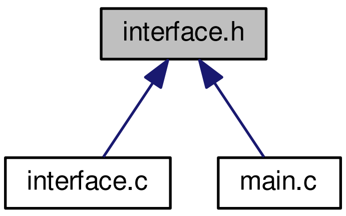
```
{
  unsigned int i;
  const char *buffer;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_label_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  buffer = gtk_entry_get_text (window->entry_variable);
  g_signal_handler_block (window->combo_variable, window->
id_variable);
  gtk_combo_box_text_remove (window->combo_variable, i);
  gtk_combo_box_text_insert_text (window->combo_variable, i, buffer);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_variable), i);
  g_signal_handler_unblock (window->combo_variable, window->
id_variable);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_label_variable: end\n");
#endif
}

void
window_precision_variable ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_precision_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  input->variable[i].precision
    = (unsigned int) gtk_spin_button_get_value_as_int (window->spin_precision);
  gtk_spin_button_set_digits (window->spin_min, input->variable[i].
precision);
  gtk_spin_button_set_digits (window->spin_max, input->variable[i].
precision);
  gtk_spin_button_set_digits (window->spin_minabs,
                              input->variable[i].precision);
  gtk_spin_button_set_digits (window->spin_maxabs,
                              input->variable[i].precision);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_precision_variable: end\n");
#endif
}

void
window_rangemin_variable ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_rangemin_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  input->variable[i].rangemin = gtk_spin_button_get_value (window->
spin_min);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_rangemin_variable: end\n");
#endif
}

void
window_rangemax_variable ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_rangemax_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  input->variable[i].rangemax = gtk_spin_button_get_value (window->
spin_max);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_rangemax_variable: end\n");
#endif
}

void
window_rangeminabs_variable ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_rangeminabs_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  input->variable[i].rangeminabs
    = gtk_spin_button_get_value (window->spin_minabs);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_rangeminabs_variable: end\n");
#endif
}
```

```
void
window_rangemaxabs_variable ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_rangemaxabs_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  input->variable[i].rangemaxabs
    = gtk_spin_button_get_value (window->spin_maxabs);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_rangemaxabs_variable: end\n");
#endif
}

void
window_step_variable ()
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_step_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  input->variable[i].step = gtk_spin_button_get_value (window->
spin_step);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_step_variable: end\n");
#endif
}

void
window_update_variable ()
{
  int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_update_variable: start\n");
#endif
  i = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_variable));
  if (i < 0)
    i = 0;
  switch (window_get_algorithm ())
    {
    case ALGORITHM_SWEEP:
      input->variable[i].nsweeps
        = gtk_spin_button_get_value_as_int (window->spin_sweeps);
#if DEBUG_INTERFACE
      fprintf (stderr, "window_update_variable: nsweeps[%d]=%u\n", i,
               input->variable[i].nsweeps);
#endif
      break;
    case ALGORITHM_GENETIC:
      input->variable[i].nbits
        = gtk_spin_button_get_value_as_int (window->spin_bits);
#if DEBUG_INTERFACE
      fprintf (stderr, "window_update_variable: nbits[%d]=%u\n", i,
               input->variable[i].nbits);
#endif
    }
#if DEBUG_INTERFACE
  fprintf (stderr, "window_update_variable: end\n");
#endif
}

int
window_read (char *filename)
{
  unsigned int i;
  char *buffer;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_read: start\n");
#endif

  // Reading new input file
  input_free ();
  if (!input_open (filename))
    {
#if DEBUG_INTERFACE
      fprintf (stderr, "window_read: end\n");
#endif
      return 0;
    }

  // Setting GTK+ widgets data
  gtk_entry_set_text (window->entry_result, input->result);
  gtk_entry_set_text (window->entry_variables, input->variables);
  buffer = g_build_filename (input->directory, input->simulator, NULL);
  gtk_file_chooser_set_filename (GTK_FILE_CHOOSER
                                 (window->button_simulator), buffer);
  g_free (buffer);
  gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (window->check_evaluator),
                                (size_t) input->evaluator);
  if (input->evaluator)
    {
      buffer = g_build_filename (input->directory, input->evaluator, NULL);
      gtk_file_chooser_set_filename (GTK_FILE_CHOOSER
                                     (window->button_evaluator), buffer);
      g_free (buffer);
    }
  gtk_toggle_button_set_active
    (GTK_TOGGLE_BUTTON (window->button_algorithm[input->algorithm]), TRUE);
  switch (input->algorithm)
    {
    case ALGORITHM_MONTE_CARLO:
      gtk_spin_button_set_value (window->spin_simulations,
                                 (gdouble) input->nsimulations);
    case ALGORITHM_SWEEP:
      gtk_spin_button_set_value (window->spin_iterations,
                                 (gdouble) input->niterations);
      gtk_spin_button_set_value (window->spin_bests, (gdouble) input->nbest);
      gtk_spin_button_set_value (window->spin_tolerance, input->tolerance);
      gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (window->check_direction),
                                    input->nsteps);
      if (input->nsteps)
        {
          gtk_toggle_button_set_active
            (GTK_TOGGLE_BUTTON (window->button_direction
                                [input->direction]), TRUE);
          gtk_spin_button_set_value (window->spin_steps,
                                     (gdouble) input->nsteps);
          gtk_spin_button_set_value (window->spin_relaxation,
                                     (gdouble) input->relaxation);
          switch (input->direction)
            {
            case DIRECTION_METHOD_RANDOM:
              gtk_spin_button_set_value (window->spin_estimates,
                                         (gdouble) input->nestimates);
            }
        }
      break;
    default:
      gtk_spin_button_set_value (window->spin_population,
                                 (gdouble) input->nsimulations);
      gtk_spin_button_set_value (window->spin_generations,
                                 (gdouble) input->niterations);
      gtk_spin_button_set_value (window->spin_mutation, input->mutation_ratio);
      gtk_spin_button_set_value (window->spin_reproduction,
                                 input->reproduction_ratio);
      gtk_spin_button_set_value (window->spin_adaptation,
                                 input->adaptation_ratio);
    }
  gtk_toggle_button_set_active
    (GTK_TOGGLE_BUTTON (window->button_norm[input->norm]), TRUE);
  gtk_spin_button_set_value (window->spin_p, input->p);
  gtk_spin_button_set_value (window->spin_threshold, input->threshold);
  g_signal_handler_block (window->combo_experiment, window->id_experiment);
  g_signal_handler_block (window->button_experiment,
                          window->id_experiment_name);
  gtk_combo_box_text_remove_all (window->combo_experiment);
  for (i = 0; i < input->nexperiments; ++i)
    gtk_combo_box_text_append_text (window->combo_experiment,
                                    input->experiment[i].name);
  g_signal_handler_unblock
    (window->button_experiment, window->id_experiment_name);
  g_signal_handler_unblock (window->combo_experiment, window->id_experiment);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_experiment), 0);
  g_signal_handler_block (window->combo_variable, window->id_variable);
  g_signal_handler_block (window->entry_variable, window->id_variable_label);
  gtk_combo_box_text_remove_all (window->combo_variable);
  for (i = 0; i < input->nvariables; ++i)
    gtk_combo_box_text_append_text (window->combo_variable,
                                    input->variable[i].name);
  g_signal_handler_unblock (window->entry_variable, window->id_variable_label);
  g_signal_handler_unblock (window->combo_variable, window->
id_variable);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_variable), 0);
  window_set_variable ();
  window_update ();

#if DEBUG_INTERFACE
  fprintf (stderr, "window_read: end\n");
#endif
  return 1;
}

void
window_open ()
{
  GtkFileChooserDialog *dlg;
  GtkFileFilter *filter;
  char *buffer, *directory, *name;

#if DEBUG_INTERFACE
  fprintf (stderr, "window_open: start\n");
#endif

  // Saving a backup of the current input file
  directory = g_strdup (input->directory);
  name = g_strdup (input->name);

  // Opening dialog
  dlg = (GtkFileChooserDialog *)
    gtk_file_chooser_dialog_new (gettext ("Open input file"),
                                 window->window,
                                 GTK_FILE_CHOOSER_ACTION_OPEN,
                                 gettext ("_Cancel"), GTK_RESPONSE_CANCEL,
                                 gettext ("_OK"), GTK_RESPONSE_OK, NULL);

  // Adding XML filter
  filter = (GtkFileFilter *) gtk_file_filter_new ();
  gtk_file_filter_set_name (filter, "XML");
  gtk_file_filter_add_pattern (filter, "*.xml");
  gtk_file_filter_add_pattern (filter, "*.XML");
  gtk_file_chooser_add_filter (GTK_FILE_CHOOSER (dlg), filter);

  // If OK saving
  while (gtk_dialog_run (GTK_DIALOG (dlg)) == GTK_RESPONSE_OK)
    {

      // Traying to open the input file
      buffer = gtk_file_chooser_get_filename (GTK_FILE_CHOOSER (dlg));
      if (!window_read (buffer))
        {
#if DEBUG_INTERFACE
          fprintf (stderr, "window_open: error reading input file\n");
#endif
          g_free (buffer);

          // Reading backup file on error
          buffer = g_build_filename (directory, name, NULL);
          if (!input_open (buffer))
            {

              // Closing on backup file reading error
#if DEBUG_INTERFACE
              fprintf (stderr, "window_read: error reading backup file\n");
#endif
              g_free (buffer);
              break;
            }
          g_free (buffer);
        }
      else
        {
          g_free (buffer);
          break;
        }
    }

  // Freeing and closing
  g_free (name);
  g_free (directory);
  gtk_widget_destroy (GTK_WIDGET (dlg));
#if DEBUG_INTERFACE
  fprintf (stderr, "window_open: end\n");
#endif
}

void
window_new ()
{
  unsigned int i;
  char *buffer, *buffer2, buffer3[64];
  char *label_algorithm[NALGORITHMS] = {
    "_Monte-Carlo", gettext ("_Sweep"), gettext ("_Genetic")
  };
  char *tip_algorithm[NALGORITHMS] = {
    gettext ("Monte-Carlo brute force algorithm"),
    gettext ("Sweep brute force algorithm"),
    gettext ("Genetic algorithm")
  };
  char *label_direction[NDIRECTIONS] = {
    gettext ("_Coordinates descent"), gettext ("_Random")
  };
  char *tip_direction[NDIRECTIONS] = {
    gettext ("Coordinates direction estimate method"),
    gettext ("Random direction estimate method")
  };
  char *label_norm[NNORMS] = { "L2", "L", "Lp", "L1" };
  char *tip_norm[NNORMS] = {
    gettext ("Euclidean error norm (L2)"),
    gettext ("Maximum error norm (L)"),
    gettext ("P error norm (Lp)"),
    gettext ("Taxicab error norm (L1)")
  };

#if DEBUG_INTERFACE
  fprintf (stderr, "window_new: start\n");
#endif

  // Creating the window
  window->window = main_window
    = (GtkWindow *) gtk_window_new (GTK_WINDOW_TOPLEVEL);

  // Finish when closing the window
  g_signal_connect (window->window, "delete-event", gtk_main_quit, NULL);

  // Setting the window title
  gtk_window_set_title (window->window, "MPCOTool");

  // Creating the open button
  window->button_open = (GtkToolButton *) gtk_tool_button_new
    (gtk_image_new_from_icon_name ("document-open",
                                   GTK_ICON_SIZE_LARGE_TOOLBAR),
     gettext ("Open"));
  g_signal_connect (window->button_open, "clicked", window_open, NULL);

  // Creating the save button
  window->button_save = (GtkToolButton *) gtk_tool_button_new
    (gtk_image_new_from_icon_name ("document-save",
                                   GTK_ICON_SIZE_LARGE_TOOLBAR),
     gettext ("Save"));
  g_signal_connect (window->button_save, "clicked", (void (*))
window_save,
                    NULL);

  // Creating the run button
  window->button_run = (GtkToolButton *) gtk_tool_button_new
    (gtk_image_new_from_icon_name ("system-run",
                                   GTK_ICON_SIZE_LARGE_TOOLBAR),
     gettext ("Run"));
  g_signal_connect (window->button_run, "clicked", window_run, NULL);

  // Creating the options button
  window->button_options = (GtkToolButton *) gtk_tool_button_new
    (gtk_image_new_from_icon_name ("preferences-system",
                                   GTK_ICON_SIZE_LARGE_TOOLBAR),
     gettext ("Options"));
  g_signal_connect (window->button_options, "clicked", options_new, NULL);

  // Creating the help button
  window->button_help = (GtkToolButton *) gtk_tool_button_new
    (gtk_image_new_from_icon_name ("help-browser",
                                   GTK_ICON_SIZE_LARGE_TOOLBAR),
     gettext ("Help"));
  g_signal_connect (window->button_help, "clicked", window_help, NULL);

  // Creating the about button
  window->button_about = (GtkToolButton *) gtk_tool_button_new
    (gtk_image_new_from_icon_name ("help-about",
                                   GTK_ICON_SIZE_LARGE_TOOLBAR),
     gettext ("About"));
  g_signal_connect (window->button_about, "clicked", window_about, NULL);

  // Creating the exit button
  window->button_exit = (GtkToolButton *) gtk_tool_button_new
    (gtk_image_new_from_icon_name ("application-exit",
                                   GTK_ICON_SIZE_LARGE_TOOLBAR),
     gettext ("Exit"));
  g_signal_connect (window->button_exit, "clicked", gtk_main_quit, NULL);

  // Creating the buttons bar
  window->bar_buttons = (GtkToolbar *) gtk_toolbar_new ();
  gtk_toolbar_insert
    (window->bar_buttons, GTK_TOOL_ITEM (window->button_open), 0);
  gtk_toolbar_insert
    (window->bar_buttons, GTK_TOOL_ITEM (window->button_save), 1);
  gtk_toolbar_insert
    (window->bar_buttons, GTK_TOOL_ITEM (window->button_run), 2);
  gtk_toolbar_insert
    (window->bar_buttons, GTK_TOOL_ITEM (window->button_options), 3);
  gtk_toolbar_insert
    (window->bar_buttons, GTK_TOOL_ITEM (window->button_help), 4);
  gtk_toolbar_insert
    (window->bar_buttons, GTK_TOOL_ITEM (window->button_about), 5);
  gtk_toolbar_insert
    (window->bar_buttons, GTK_TOOL_ITEM (window->button_exit), 6);
  gtk_toolbar_set_style (window->bar_buttons, GTK_TOOLBAR_BOTH);

  // Creating the simulator program label and entry
  window->label_simulator
    = (GtkLabel *) gtk_label_new (gettext ("Simulator program"));
  window->button_simulator = (GtkFileChooserButton *)
    gtk_file_chooser_button_new (gettext ("Simulator program"),
                                 GTK_FILE_CHOOSER_ACTION_OPEN);
  gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_simulator),
                               gettext ("Simulator program executable file"));
  gtk_widget_set_hexpand (GTK_WIDGET (window->button_simulator), TRUE);

  // Creating the evaluator program label and entry
  window->check_evaluator = (GtkCheckButton *)
    gtk_check_button_new_with_mnemonic (gettext ("_Evaluator program"));
  g_signal_connect (window->check_evaluator, "toggled",
window_update, NULL);
  window->button_evaluator = (GtkFileChooserButton *)
    gtk_file_chooser_button_new (gettext ("Evaluator program"),
                                 GTK_FILE_CHOOSER_ACTION_OPEN);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->button_evaluator),
     gettext ("Optional evaluator program executable file"));

  // Creating the results files labels and entries
  window->label_result = (GtkLabel *) gtk_label_new (gettext ("Result file"));
  window->entry_result = (GtkEntry *) gtk_entry_new ();
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->entry_result), gettext ("Best results file"));
  window->label_variables
    = (GtkLabel *) gtk_label_new (gettext ("Variables file"));
  window->entry_variables = (GtkEntry *) gtk_entry_new ();
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->entry_variables),
     gettext ("All simulated results file"));

  // Creating the files grid and attaching widgets
  window->grid_files = (GtkGrid *) gtk_grid_new ();
  gtk_grid_attach (window->grid_files, GTK_WIDGET (window->
label_simulator),
                   0, 0, 1, 1);
  gtk_grid_attach (window->grid_files, GTK_WIDGET (window->
button_simulator),
                   1, 0, 1, 1);
  gtk_grid_attach (window->grid_files, GTK_WIDGET (window->
check_evaluator),
                   0, 1, 1, 1);
  gtk_grid_attach (window->grid_files, GTK_WIDGET (window->
button_evaluator),
                   1, 1, 1, 1);
  gtk_grid_attach (window->grid_files, GTK_WIDGET (window->
label_result),
                   0, 2, 1, 1);
  gtk_grid_attach (window->grid_files, GTK_WIDGET (window->
entry_result),
                   1, 2, 1, 1);
  gtk_grid_attach (window->grid_files, GTK_WIDGET (window->
label_variables),
                   0, 3, 1, 1);
  gtk_grid_attach (window->grid_files, GTK_WIDGET (window->
entry_variables),
                   1, 3, 1, 1);

  // Creating the algorithm properties
  window->label_simulations = (GtkLabel *) gtk_label_new
    (gettext ("Simulations number"));
  window->spin_simulations
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 1.e12, 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_simulations),
     gettext ("Number of simulations to perform for each iteration"));
  gtk_widget_set_hexpand (GTK_WIDGET (window->spin_simulations), TRUE);
  window->label_iterations = (GtkLabel *)
    gtk_label_new (gettext ("Iterations number"));
  window->spin_iterations
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 1.e6, 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_iterations), gettext ("Number of iterations"));
  g_signal_connect
    (window->spin_iterations, "value-changed", window_update, NULL);
  gtk_widget_set_hexpand (GTK_WIDGET (window->spin_iterations), TRUE);
  window->label_tolerance = (GtkLabel *) gtk_label_new (gettext ("Tolerance"));
  window->spin_tolerance
    = (GtkSpinButton *) gtk_spin_button_new_with_range (0., 1., 0.001);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_tolerance),
     gettext ("Tolerance to set the variable interval on the next iteration"));
  window->label_bests = (GtkLabel *) gtk_label_new (gettext ("Bests number"));
  window->spin_bests
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 1.e6, 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_bests),
     gettext ("Number of best simulations used to set the variable interval "
              "on the next iteration"));
  window->label_population
    = (GtkLabel *) gtk_label_new (gettext ("Population number"));
  window->spin_population
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 1.e12, 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_population),
     gettext ("Number of population for the genetic algorithm"));
  gtk_widget_set_hexpand (GTK_WIDGET (window->spin_population), TRUE);
  window->label_generations
    = (GtkLabel *) gtk_label_new (gettext ("Generations number"));
  window->spin_generations
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 1.e6, 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_generations),
     gettext ("Number of generations for the genetic algorithm"));
  window->label_mutation
    = (GtkLabel *) gtk_label_new (gettext ("Mutation ratio"));
  window->spin_mutation
    = (GtkSpinButton *) gtk_spin_button_new_with_range (0., 1., 0.001);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_mutation),
     gettext ("Ratio of mutation for the genetic algorithm"));
  window->label_reproduction
    = (GtkLabel *) gtk_label_new (gettext ("Reproduction ratio"));
  window->spin_reproduction
    = (GtkSpinButton *) gtk_spin_button_new_with_range (0., 1., 0.001);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_reproduction),
     gettext ("Ratio of reproduction for the genetic algorithm"));
  window->label_adaptation
    = (GtkLabel *) gtk_label_new (gettext ("Adaptation ratio"));
  window->spin_adaptation
    = (GtkSpinButton *) gtk_spin_button_new_with_range (0., 1., 0.001);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_adaptation),
     gettext ("Ratio of adaptation for the genetic algorithm"));
  window->label_threshold = (GtkLabel *) gtk_label_new (gettext ("Threshold"));
  window->spin_threshold = (GtkSpinButton *) gtk_spin_button_new_with_range
    (-G_MAXDOUBLE, G_MAXDOUBLE, precision[DEFAULT_PRECISION]);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_threshold),
     gettext ("Threshold in the objective function to finish the simulations"));
  window->scrolled_threshold
    = (GtkScrolledWindow *) gtk_scrolled_window_new (NULL, NULL);
  gtk_container_add (GTK_CONTAINER (window->scrolled_threshold),
                     GTK_WIDGET (window->spin_threshold));
//  gtk_widget_set_hexpand (GTK_WIDGET (window->scrolled_threshold), TRUE);
//  gtk_widget_set_halign (GTK_WIDGET (window->scrolled_threshold),
//                                GTK_ALIGN_FILL);

  // Creating the direction search method properties
  window->check_direction = (GtkCheckButton *)
    gtk_check_button_new_with_mnemonic (gettext ("_Direction search method"));
  g_signal_connect (window->check_direction, "clicked",
window_update, NULL);
  window->grid_direction = (GtkGrid *) gtk_grid_new ();
  window->button_direction[0] = (GtkRadioButton *)
    gtk_radio_button_new_with_mnemonic (NULL, label_direction[0]);
  gtk_grid_attach (window->grid_direction,
                   GTK_WIDGET (window->button_direction[0]), 0, 0, 1, 1);
  g_signal_connect (window->button_direction[0], "clicked",
window_update,
                    NULL);
  for (i = 0; ++i < NDIRECTIONS;)
    {
      window->button_direction[i] = (GtkRadioButton *)
        gtk_radio_button_new_with_mnemonic
        (gtk_radio_button_get_group (window->button_direction[0]),
         label_direction[i]);
      gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_direction[i]),
                                   tip_direction[i]);
      gtk_grid_attach (window->grid_direction,
                       GTK_WIDGET (window->button_direction[i]), 0, i, 1, 1);
      g_signal_connect (window->button_direction[i], "clicked",
                        window_update, NULL);
    }
  window->label_steps = (GtkLabel *) gtk_label_new (gettext ("Steps number"));
  window->spin_steps = (GtkSpinButton *)
    gtk_spin_button_new_with_range (1., 1.e12, 1.);
  gtk_widget_set_hexpand (GTK_WIDGET (window->spin_steps), TRUE);
  window->label_estimates
    = (GtkLabel *) gtk_label_new (gettext ("Direction estimates number"));
  window->spin_estimates = (GtkSpinButton *)
    gtk_spin_button_new_with_range (1., 1.e3, 1.);
  window->label_relaxation
    = (GtkLabel *) gtk_label_new (gettext ("Relaxation parameter"));
  window->spin_relaxation = (GtkSpinButton *)
    gtk_spin_button_new_with_range (0., 2., 0.001);
  gtk_grid_attach (window->grid_direction, GTK_WIDGET (window->label_steps),
                   0, NDIRECTIONS, 1, 1);
  gtk_grid_attach (window->grid_direction, GTK_WIDGET (window->spin_steps),
                   1, NDIRECTIONS, 1, 1);
  gtk_grid_attach (window->grid_direction, GTK_WIDGET (window->label_estimates),
                   0, NDIRECTIONS + 1, 1, 1);
  gtk_grid_attach (window->grid_direction, GTK_WIDGET (window->spin_estimates),
                   1, NDIRECTIONS + 1, 1, 1);
  gtk_grid_attach (window->grid_direction,
                   GTK_WIDGET (window->label_relaxation), 0, NDIRECTIONS + 2, 1,
                   1);
  gtk_grid_attach (window->grid_direction, GTK_WIDGET (window->spin_relaxation),
                   1, NDIRECTIONS + 2, 1, 1);

  // Creating the array of algorithms
  window->grid_algorithm = (GtkGrid *) gtk_grid_new ();
  window->button_algorithm[0] = (GtkRadioButton *)
    gtk_radio_button_new_with_mnemonic (NULL, label_algorithm[0]);
  gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_algorithm[0]),
                               tip_algorithm[0]);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->button_algorithm[0]), 0, 0, 1, 1);
  g_signal_connect (window->button_algorithm[0], "clicked",
                    window_set_algorithm, NULL);
  for (i = 0; ++i < NALGORITHMS;)
    {
      window->button_algorithm[i] = (GtkRadioButton *)
        gtk_radio_button_new_with_mnemonic
        (gtk_radio_button_get_group (window->button_algorithm[0]),
         label_algorithm[i]);
      gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_algorithm[i]),
                                   tip_algorithm[i]);
      gtk_grid_attach (window->grid_algorithm,
                       GTK_WIDGET (window->button_algorithm[i]), 0, i, 1, 1);
      g_signal_connect (window->button_algorithm[i], "clicked",
                        window_set_algorithm, NULL);
    }
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_simulations), 0,
                   NALGORITHMS, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_simulations), 1, NALGORITHMS, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_iterations), 0,
                   NALGORITHMS + 1, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_iterations), 1,
                   NALGORITHMS + 1, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_tolerance), 0,
                   NALGORITHMS + 2, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_tolerance), 1,
                   NALGORITHMS + 2, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_bests), 0, NALGORITHMS + 3, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_bests), 1, NALGORITHMS + 3, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_population), 0,
                   NALGORITHMS + 4, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_population), 1,
                   NALGORITHMS + 4, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_generations), 0,
                   NALGORITHMS + 5, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_generations), 1,
                   NALGORITHMS + 5, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_mutation), 0,
                   NALGORITHMS + 6, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_mutation), 1,
                   NALGORITHMS + 6, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_reproduction), 0,
                   NALGORITHMS + 7, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_reproduction), 1,
                   NALGORITHMS + 7, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->label_adaptation), 0,
                   NALGORITHMS + 8, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->spin_adaptation), 1,
                   NALGORITHMS + 8, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->check_direction), 0,
                   NALGORITHMS + 9, 2, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->grid_direction), 0,
                   NALGORITHMS + 10, 2, 1);
  gtk_grid_attach (window->grid_algorithm, GTK_WIDGET (window->
label_threshold),
                   0, NALGORITHMS + 11, 1, 1);
  gtk_grid_attach (window->grid_algorithm,
                   GTK_WIDGET (window->scrolled_threshold), 1,
                   NALGORITHMS + 11, 1, 1);
  window->frame_algorithm = (GtkFrame *) gtk_frame_new (gettext ("Algorithm"));
  gtk_container_add (GTK_CONTAINER (window->frame_algorithm),
                     GTK_WIDGET (window->grid_algorithm));

  // Creating the variable widgets
  window->combo_variable = (GtkComboBoxText *) gtk_combo_box_text_new ();
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->combo_variable), gettext ("Variables selector"));
  window->id_variable = g_signal_connect
    (window->combo_variable, "changed", window_set_variable, NULL);
  window->button_add_variable
    = (GtkButton *) gtk_button_new_from_icon_name ("list-add",
                                                   GTK_ICON_SIZE_BUTTON);
  g_signal_connect
    (window->button_add_variable, "clicked",
window_add_variable, NULL);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->button_add_variable), gettext ("Add variable"));
  window->button_remove_variable
    = (GtkButton *) gtk_button_new_from_icon_name ("list-remove",
                                                   GTK_ICON_SIZE_BUTTON);
  g_signal_connect
    (window->button_remove_variable, "clicked",
window_remove_variable, NULL);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->button_remove_variable), gettext ("Remove variable"));
  window->label_variable = (GtkLabel *) gtk_label_new (gettext ("Name"));
  window->entry_variable = (GtkEntry *) gtk_entry_new ();
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->entry_variable), gettext ("Variable name"));
  gtk_widget_set_hexpand (GTK_WIDGET (window->entry_variable), TRUE);
  window->id_variable_label = g_signal_connect
    (window->entry_variable, "changed", window_label_variable, NULL);
  window->label_min = (GtkLabel *) gtk_label_new (gettext ("Minimum"));
  window->spin_min = (GtkSpinButton *) gtk_spin_button_new_with_range
    (-G_MAXDOUBLE, G_MAXDOUBLE, precision[DEFAULT_PRECISION]);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_min),
     gettext ("Minimum initial value of the variable"));
  window->scrolled_min
    = (GtkScrolledWindow *) gtk_scrolled_window_new (NULL, NULL);
  gtk_container_add (GTK_CONTAINER (window->scrolled_min),
                     GTK_WIDGET (window->spin_min));
  g_signal_connect (window->spin_min, "value-changed",
                    window_rangemin_variable, NULL);
  window->label_max = (GtkLabel *) gtk_label_new (gettext ("Maximum"));
  window->spin_max = (GtkSpinButton *) gtk_spin_button_new_with_range
    (-G_MAXDOUBLE, G_MAXDOUBLE, precision[DEFAULT_PRECISION]);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_max),
     gettext ("Maximum initial value of the variable"));
  window->scrolled_max
    = (GtkScrolledWindow *) gtk_scrolled_window_new (NULL, NULL);
  gtk_container_add (GTK_CONTAINER (window->scrolled_max),
                     GTK_WIDGET (window->spin_max));
  g_signal_connect (window->spin_max, "value-changed",
                    window_rangemax_variable, NULL);
  window->check_minabs = (GtkCheckButton *)
    gtk_check_button_new_with_mnemonic (gettext ("_Absolute minimum"));
  g_signal_connect (window->check_minabs, "toggled", window_update, NULL);
  window->spin_minabs = (GtkSpinButton *) gtk_spin_button_new_with_range
    (-G_MAXDOUBLE, G_MAXDOUBLE, precision[DEFAULT_PRECISION]);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_minabs),
     gettext ("Minimum allowed value of the variable"));
  window->scrolled_minabs
    = (GtkScrolledWindow *) gtk_scrolled_window_new (NULL, NULL);
  gtk_container_add (GTK_CONTAINER (window->scrolled_minabs),
                     GTK_WIDGET (window->spin_minabs));
  g_signal_connect (window->spin_minabs, "value-changed",
                    window_rangeminabs_variable, NULL);
  window->check_maxabs = (GtkCheckButton *)
    gtk_check_button_new_with_mnemonic (gettext ("_Absolute maximum"));
  g_signal_connect (window->check_maxabs, "toggled", window_update, NULL);
  window->spin_maxabs = (GtkSpinButton *) gtk_spin_button_new_with_range
    (-G_MAXDOUBLE, G_MAXDOUBLE, precision[DEFAULT_PRECISION]);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_maxabs),
     gettext ("Maximum allowed value of the variable"));
  window->scrolled_maxabs
    = (GtkScrolledWindow *) gtk_scrolled_window_new (NULL, NULL);
  gtk_container_add (GTK_CONTAINER (window->scrolled_maxabs),
                     GTK_WIDGET (window->spin_maxabs));
  g_signal_connect (window->spin_maxabs, "value-changed",
                    window_rangemaxabs_variable, NULL);
  window->label_precision
    = (GtkLabel *) gtk_label_new (gettext ("Precision digits"));
  window->spin_precision = (GtkSpinButton *)
    gtk_spin_button_new_with_range (0., (gdouble) DEFAULT_PRECISION, 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_precision),
     gettext ("Number of precision floating point digits\n"
              "0 is for integer numbers"));
  g_signal_connect (window->spin_precision, "value-changed",
                    window_precision_variable, NULL);
  window->label_sweeps = (GtkLabel *) gtk_label_new (gettext ("Sweeps number"));
  window->spin_sweeps
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 1.e12, 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_sweeps),
     gettext ("Number of steps sweeping the variable"));
  g_signal_connect
    (window->spin_sweeps, "value-changed", window_update_variable, NULL);
  window->label_bits = (GtkLabel *) gtk_label_new (gettext ("Bits number"));
  window->spin_bits
    = (GtkSpinButton *) gtk_spin_button_new_with_range (1., 64., 1.);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_bits),
     gettext ("Number of bits to encode the variable"));
  g_signal_connect
    (window->spin_bits, "value-changed", window_update_variable, NULL);
  window->label_step = (GtkLabel *) gtk_label_new (gettext ("Step size"));
  window->spin_step = (GtkSpinButton *) gtk_spin_button_new_with_range
    (-G_MAXDOUBLE, G_MAXDOUBLE, precision[DEFAULT_PRECISION]);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_step),
     gettext ("Initial step size for the direction search method"));
  window->scrolled_step
    = (GtkScrolledWindow *) gtk_scrolled_window_new (NULL, NULL);
  gtk_container_add (GTK_CONTAINER (window->scrolled_step),
                     GTK_WIDGET (window->spin_step));
  g_signal_connect
    (window->spin_step, "value-changed", window_step_variable, NULL);
  window->grid_variable = (GtkGrid *) gtk_grid_new ();
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->combo_variable), 0, 0, 2, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->button_add_variable), 2, 0, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->button_remove_variable), 3, 0, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->label_variable), 0, 1, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->entry_variable), 1, 1, 3, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->label_min), 0, 2, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->scrolled_min), 1, 2, 3, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->label_max), 0, 3, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->scrolled_max), 1, 3, 3, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->check_minabs), 0, 4, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->scrolled_minabs), 1, 4, 3, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->check_maxabs), 0, 5, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->scrolled_maxabs), 1, 5, 3, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->label_precision), 0, 6, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->spin_precision), 1, 6, 3, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->label_sweeps), 0, 7, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->spin_sweeps), 1, 7, 3, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->label_bits), 0, 8, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->spin_bits), 1, 8, 3, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->label_step), 0, 9, 1, 1);
  gtk_grid_attach (window->grid_variable,
                   GTK_WIDGET (window->scrolled_step), 1, 9, 3, 1);
  window->frame_variable = (GtkFrame *) gtk_frame_new (gettext ("Variable"));
  gtk_container_add (GTK_CONTAINER (window->frame_variable),
                     GTK_WIDGET (window->grid_variable));

  // Creating the experiment widgets
  window->combo_experiment = (GtkComboBoxText *) gtk_combo_box_text_new ();
  gtk_widget_set_tooltip_text (GTK_WIDGET (window->combo_experiment),
                               gettext ("Experiment selector"));
  window->id_experiment = g_signal_connect
    (window->combo_experiment, "changed", window_set_experiment, NULL)
;
  window->button_add_experiment
    = (GtkButton *) gtk_button_new_from_icon_name ("list-add",
                                                   GTK_ICON_SIZE_BUTTON);
  g_signal_connect
    (window->button_add_experiment, "clicked",
window_add_experiment, NULL);
  gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_add_experiment),
                               gettext ("Add experiment"));
  window->button_remove_experiment
    = (GtkButton *) gtk_button_new_from_icon_name ("list-remove",
                                                   GTK_ICON_SIZE_BUTTON);
  g_signal_connect (window->button_remove_experiment, "clicked",
                    window_remove_experiment, NULL);
  gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_remove_experiment),
                               gettext ("Remove experiment"));
  window->label_experiment
    = (GtkLabel *) gtk_label_new (gettext ("Experimental data file"));
  window->button_experiment = (GtkFileChooserButton *)
    gtk_file_chooser_button_new (gettext ("Experimental data file"),
                                 GTK_FILE_CHOOSER_ACTION_OPEN);
  gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_experiment),
                               gettext ("Experimental data file"));
  window->id_experiment_name
    = g_signal_connect (window->button_experiment, "selection-changed",
                        window_name_experiment, NULL);
  gtk_widget_set_hexpand (GTK_WIDGET (window->button_experiment), TRUE);
  window->label_weight = (GtkLabel *) gtk_label_new (gettext ("Weight"));
  window->spin_weight
    = (GtkSpinButton *) gtk_spin_button_new_with_range (0., 1., 0.001);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_weight),
     gettext ("Weight factor to build the objective function"));
  g_signal_connect
    (window->spin_weight, "value-changed", window_weight_experiment,
NULL);
  window->grid_experiment = (GtkGrid *) gtk_grid_new ();
  gtk_grid_attach (window->grid_experiment,
                   GTK_WIDGET (window->combo_experiment), 0, 0, 2, 1);
  gtk_grid_attach (window->grid_experiment,
                      GTK_WIDGET (window->button_add_experiment), 2, 0, 1, 1);
  gtk_grid_attach (window->grid_experiment,
                      GTK_WIDGET (window->button_remove_experiment), 3, 0, 1, 1);
  gtk_grid_attach (window->grid_experiment,
                      GTK_WIDGET (window->label_experiment), 0, 1, 1, 1);
  gtk_grid_attach (window->grid_experiment,
                      GTK_WIDGET (window->button_experiment), 1, 1, 3, 1);
  gtk_grid_attach (window->grid_experiment,
                      GTK_WIDGET (window->label_weight), 0, 2, 1, 1);
  gtk_grid_attach (window->grid_experiment,
                      GTK_WIDGET (window->spin_weight), 1, 2, 3, 1);
  for (i = 0; i < MAX_NINPUTS; ++i)
    {
      snprintf (buffer3, 64, "%s %u", gettext ("Input template"), i + 1);
      window->check_template[i] = (GtkCheckButton *)
        gtk_check_button_new_with_label (buffer3);
      window->id_template[i]
        = g_signal_connect (window->check_template[i], "toggled",
                            window_inputs_experiment, NULL);
      gtk_grid_attach (window->grid_experiment,
                          GTK_WIDGET (window->check_template[i]), 0, 3 + i, 1, 1);
      window->button_template[i] = (GtkFileChooserButton *)
        gtk_file_chooser_button_new (gettext ("Input template"),
                                     GTK_FILE_CHOOSER_ACTION_OPEN);
      gtk_widget_set_tooltip_text
        (GTK_WIDGET (window->button_template[i]),
         gettext ("Experimental input template file"));
      window->id_input[i]
        = g_signal_connect_swapped (window->button_template[i],
                                    "selection-changed",
                                    (void (*)) window_template_experiment,
                                    (void *) (size_t) i);
      gtk_grid_attach (window->grid_experiment,
                          GTK_WIDGET (window->button_template[i]), 1, 3 + i, 3, 1);
    }
  window->frame_experiment
    = (GtkFrame *) gtk_frame_new (gettext ("Experiment"));
  gtk_container_add (GTK_CONTAINER (window->frame_experiment),
                       GTK_WIDGET (window->grid_experiment));

  // Creating the error norm widgets
  window->frame_norm = (GtkFrame *) gtk_frame_new (gettext ("Error norm"));
  window->grid_norm = (GtkGrid *) gtk_grid_new ();
  gtk_container_add (GTK_CONTAINER (window->frame_norm),
                       GTK_WIDGET (window->grid_norm));
  window->button_norm[0] = (GtkRadioButton *)
    gtk_radio_button_new_with_mnemonic (NULL, label_norm[0]);
  gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_norm[0]),
                                tip_norm[0]);
  gtk_grid_attach (window->grid_norm,
                      GTK_WIDGET (window->button_norm[0]), 0, 0, 1, 1);
  g_signal_connect (window->button_norm[0], "clicked", window_update, NULL);
  for (i = 0; ++i < NNORMS;)
    {
      window->button_norm[i] = (GtkRadioButton *)
        gtk_radio_button_new_with_mnemonic
        (gtk_radio_button_get_group (window->button_norm[0]), label_norm[i]);
      gtk_widget_set_tooltip_text (GTK_WIDGET (window->button_norm[i]),
                                    tip_norm[i]);
      gtk_grid_attach (window->grid_norm,
                          GTK_WIDGET (window->button_norm[i]), 0, i, 1, 1);
      g_signal_connect (window->button_norm[i], "clicked",
window_update, NULL);
    }
  window->label_p = (GtkLabel *) gtk_label_new (gettext ("P parameter"));
  gtk_grid_attach (window->grid_norm, GTK_WIDGET (window->label_p), 1, 1, 1, 1);
  window->spin_p = (GtkSpinButton *)
    gtk_spin_button_new_with_range (-G_MAXDOUBLE, G_MAXDOUBLE, 0.01);
  gtk_widget_set_tooltip_text
    (GTK_WIDGET (window->spin_p), gettext ("P parameter for the P error norm"));
  window->scrolled_p
    = (GtkScrolledWindow *) gtk_scrolled_window_new (NULL, NULL);
  gtk_container_add (GTK_CONTAINER (window->scrolled_p),
                       GTK_WIDGET (window->spin_p));
  gtk_widget_set_hexpand (GTK_WIDGET (window->scrolled_p), TRUE);
  gtk_widget_set_halign (GTK_WIDGET (window->scrolled_p), GTK_ALIGN_FILL);
  gtk_grid_attach (window->grid_norm, GTK_WIDGET (window->scrolled_p),
                      1, 2, 1, 2);

  // Creating the grid and attaching the widgets to the grid
  window->grid = (GtkGrid *) gtk_grid_new ();
  gtk_grid_attach (window->grid, GTK_WIDGET (window->bar_buttons), 0, 0, 3, 1);
  gtk_grid_attach (window->grid, GTK_WIDGET (window->grid_files), 0, 1, 1, 1);
  gtk_grid_attach (window->grid,
                      GTK_WIDGET (window->frame_algorithm), 0, 2, 1, 1);
  gtk_grid_attach (window->grid,
                      GTK_WIDGET (window->frame_variable), 1, 2, 1, 1);
  gtk_grid_attach (window->grid,
                   GTK_WIDGET (window->frame_experiment), 2, 2, 1, 1);
  gtk_grid_attach (window->grid, GTK_WIDGET (window->frame_norm), 1, 1, 2, 1);
  gtk_container_add (GTK_CONTAINER (window->window), GTK_WIDGET (window->
grid));

  // Setting the window logo
  window->logo = gdk_pixbuf_new_from_xpm_data (logo);
  gtk_window_set_icon (window->window, window->logo);

  // Showing the window
  gtk_widget_show_all (GTK_WIDGET (window->window));

  // In GTK+ 3.16 and 3.18 the default scrolled size is wrong
#if GTK_MINOR_VERSION >= 16
  gtk_widget_set_size_request (GTK_WIDGET (window->scrolled_min), -1, 40);
  gtk_widget_set_size_request (GTK_WIDGET (window->scrolled_max), -1, 40);
  gtk_widget_set_size_request (GTK_WIDGET (window->scrolled_minabs), -1, 40);
  gtk_widget_set_size_request (GTK_WIDGET (window->scrolled_maxabs), -1, 40);
  gtk_widget_set_size_request (GTK_WIDGET (window->scrolled_step), -1, 40);
  gtk_widget_set_size_request (GTK_WIDGET (window->scrolled_p), -1, 40);
  gtk_widget_set_size_request (GTK_WIDGET (window->scrolled_threshold), -1, 40);
#endif

  // Reading initial example
  input_new ();
  buffer2 = g_get_current_dir ();
  buffer = g_build_filename (buffer2, "..", "tests", "test1", INPUT_FILE, NULL);
  g_free (buffer2);
  window_read (buffer);
  g_free (buffer);

#if DEBUG_INTERFACE
  fprintf (stderr, "window_new: start\n");
#endif
}
```

5.13 interface.h File Reference

Header file to define the graphical interface functions.

This graph shows which files directly or indirectly include this file:



Data Structures

- struct Options

    Struct to define the options dialog.
- struct Running

    Struct to define the running dialog.
- struct Window

    Struct to define the main window.

Macros

- #define MAX_LENGTH (DEFAULT_PRECISION + 8)

  Max length of texts allowed in GtkSpinButtons.

Functions

- static GtkButton ∗ **gtk_button_new_from_icon_name** (const char ∗name, GtkIconSize size)
- unsigned int gtk_array_get_active (GtkRadioButton ∗array[ ], unsigned int n)

  Function to get the active GtkRadioButton.
- void input_save (char ∗filename)

  Function to save the input file.
- void options_new ()

  Function to open the options dialog.
- void running_new ()

  Function to open the running dialog.
- unsigned int window_get_algorithm ()

  Function to get the stochastic algorithm number.
- unsigned int window_get_direction ()

  Function to get the direction search method number.
- unsigned int window_get_norm ()

  Function to get the norm method number.
- void window_save_direction ()

  Function to save the direction search method data in the input file.
- int window_save ()

  Function to save the input file.
- void window_run ()

  Function to run a optimization.
- void window_help ()

  Function to show a help dialog.
- void window_update_direction ()

  Function to update direction search method widgets view in the main window.
- void window_update ()

  Function to update the main window view.
- void window_set_algorithm ()

  Function to avoid memory errors changing the algorithm.
- void window_set_experiment ()

  Function to set the experiment data in the main window.
- void window_remove_experiment ()

  Function to remove an experiment in the main window.
- void window_add_experiment ()

  Function to add an experiment in the main window.
- void window_name_experiment ()

  Function to set the experiment name in the main window.
- void window_weight_experiment ()

  Function to update the experiment weight in the main window.
- void window_inputs_experiment ()

  Function to update the experiment input templates number in the main window.
- void window_template_experiment (void ∗data)

  Function to update the experiment i-th input template in the main window.

- void window_set_variable ()
  Function to set the variable data in the main window.
- void window_remove_variable ()
  Function to remove a variable in the main window.
- void window_add_variable ()
  Function to add a variable in the main window.
- void window_label_variable ()
  Function to set the variable label in the main window.
- void window_precision_variable ()
  Function to update the variable precision in the main window.
- void window_rangemin_variable ()
  Function to update the variable rangemin in the main window.
- void window_rangemax_variable ()
  Function to update the variable rangemax in the main window.
- void window_rangeminabs_variable ()
  Function to update the variable rangeminabs in the main window.
- void window_rangemaxabs_variable ()
  Function to update the variable rangemaxabs in the main window.
- void window_update_variable ()
  Function to update the variable data in the main window.
- int window_read (char ∗filename)
  Function to read the input data of a file.
- void window_open ()
  Function to open the input data.
- void window_new ()
  Function to open the main window.

Variables

- const char ∗ logo [ ]
  Logo pixmap.
- Options options [1]
  Options struct to define the options dialog.
- Running running [1]
  Running struct to define the running dialog.
- Window window [1]
  Window struct to define the main interface window.

5.13.1 Detailed Description

Header file to define the graphical interface functions.

Authors

Javier Burguete.

Copyright

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Definition in file interface.h.

5.13.2 Function Documentation

5.13.2.1 unsigned int gtk_array_get_active (GtkRadioButton ∗ *array[ ],* unsigned int *n*)

Function to get the active GtkRadioButton.

Parameters

array	Array of GtkRadioButtons.
n	Number of GtkRadioButtons.

Returns

Active GtkRadioButton.

Definition at line 353 of file utils.c.

```
{
  unsigned int i;
  for (i = 0; i < n; ++i)
    if (gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON (array[i])))
      break;
  return i;
}
```

5.13.2.2 void input_save (char ∗ *filename*)

Function to save the input file.

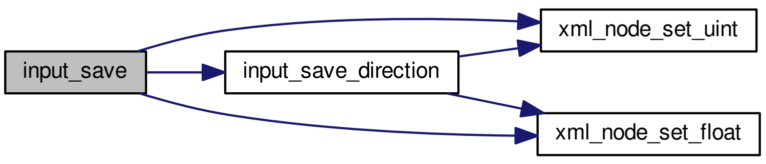
Parameters

filename	Input file name.

Definition at line 204 of file interface.c.

```
{
  unsigned int i, j;
  char *buffer;
  xmlDoc *doc;
  xmlNode *node, *child;
  GFile *file, *file2;

#if DEBUG_INTERFACE
  fprintf (stderr, "input_save: start\n");
#endif

  // Getting the input file directory
  input->name = g_path_get_basename (filename);
  input->directory = g_path_get_dirname (filename);
  file = g_file_new_for_path (input->directory);

  // Opening the input file
  doc = xmlNewDoc ((const xmlChar *) "1.0");

  // Setting root XML node
  node = xmlNewDocNode (doc, 0, XML_OPTIMIZE, 0);
  xmlDocSetRootElement (doc, node);

  // Adding properties to the root XML node
  if (xmlStrcmp ((const xmlChar *) input->result, result_name))
    xmlSetProp (node, XML_RESULT, (xmlChar *) input->result);
  if (xmlStrcmp ((const xmlChar *) input->variables, variables_name))
    xmlSetProp (node, XML_VARIABLES, (xmlChar *) input->variables);
  file2 = g_file_new_for_path (input->simulator);
  buffer = g_file_get_relative_path (file, file2);
  g_object_unref (file2);
  xmlSetProp (node, XML_SIMULATOR, (xmlChar *) buffer);
  g_free (buffer);
  if (input->evaluator)
    {
      file2 = g_file_new_for_path (input->evaluator);
      buffer = g_file_get_relative_path (file, file2);
      g_object_unref (file2);
      if (xmlStrlen ((xmlChar *) buffer))
        xmlSetProp (node, XML_EVALUATOR, (xmlChar *) buffer);
      g_free (buffer);
    }
  if (input->seed != DEFAULT_RANDOM_SEED)
    xml_node_set_uint (node, XML_SEED, input->seed);

  // Setting the algorithm
  buffer = (char *) g_slice_alloc (64);
  switch (input->algorithm)
    {
    case ALGORITHM_MONTE_CARLO:
      xmlSetProp (node, XML_ALGORITHM, XML_MONTE_CARLO);
      snprintf (buffer, 64, "%u", input->nsimulations);
      xmlSetProp (node, XML_NSIMULATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NITERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->tolerance);
      xmlSetProp (node, XML_TOLERANCE, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->nbest);
      xmlSetProp (node, XML_NBEST, (xmlChar *) buffer);
      input_save_direction (node);
      break;
    case ALGORITHM_SWEEP:
      xmlSetProp (node, XML_ALGORITHM, XML_SWEEP);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NITERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->tolerance);
      xmlSetProp (node, XML_TOLERANCE, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->nbest);
      xmlSetProp (node, XML_NBEST, (xmlChar *) buffer);
      input_save_direction (node);
      break;
    default:
      xmlSetProp (node, XML_ALGORITHM, XML_GENETIC);
      snprintf (buffer, 64, "%u", input->nsimulations);
      xmlSetProp (node, XML_NPOPULATION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%u", input->niterations);
      xmlSetProp (node, XML_NGENERATIONS, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->mutation_ratio);
      xmlSetProp (node, XML_MUTATION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->reproduction_ratio);
      xmlSetProp (node, XML_REPRODUCTION, (xmlChar *) buffer);
      snprintf (buffer, 64, "%.3lg", input->adaptation_ratio);
      xmlSetProp (node, XML_ADAPTATION, (xmlChar *) buffer);
      break;
    }
  g_slice_free1 (64, buffer);
  if (input->threshold != 0.)
    xml_node_set_float (node, XML_THRESHOLD, input->
threshold);

  // Setting the experimental data
  for (i = 0; i < input->nexperiments; ++i)
    {
      child = xmlNewChild (node, 0, XML_EXPERIMENT, 0);
      xmlSetProp (child, XML_NAME, (xmlChar *) input->experiment[i].
name);
      if (input->experiment[i].weight != 1.)
        xml_node_set_float (child, XML_WEIGHT, input->
experiment[i].weight);
      for (j = 0; j < input->experiment->ninputs; ++j)
        xmlSetProp (child, template[j],
                    (xmlChar *) input->experiment[i].template[j]);
    }

  // Setting the variables data
  for (i = 0; i < input->nvariables; ++i)
    {
      child = xmlNewChild (node, 0, XML_VARIABLE, 0);
      xmlSetProp (child, XML_NAME, (xmlChar *) input->variable[i].
name);
      xml_node_set_float (child, XML_MINIMUM, input->
variable[i].rangemin);
      if (input->variable[i].rangeminabs != -G_MAXDOUBLE)
        xml_node_set_float (child, XML_ABSOLUTE_MINIMUM,
                            input->variable[i].rangeminabs);
      xml_node_set_float (child, XML_MAXIMUM, input->
variable[i].rangemax);
      if (input->variable[i].rangemaxabs != G_MAXDOUBLE)
        xml_node_set_float (child, XML_ABSOLUTE_MAXIMUM,
                            input->variable[i].rangemaxabs);
      if (input->variable[i].precision != DEFAULT_PRECISION)
        xml_node_set_uint (child, XML_PRECISION, input->
variable[i].precision);
      if (input->algorithm == ALGORITHM_SWEEP)
        xml_node_set_uint (child, XML_NSWEEPS, input->
variable[i].nsweeps);
      else if (input->algorithm == ALGORITHM_GENETIC)
        xml_node_set_uint (child, XML_NBITS, input->
variable[i].nbits);
      if (input->nsteps)
        xml_node_set_float (child, XML_STEP, input->
variable[i].step);
    }

  // Saving the error norm
  switch (input->norm)
    {
    case ERROR_NORM_MAXIMUM:
      xmlSetProp (node, XML_NORM, XML_MAXIMUM);
      break;
    case ERROR_NORM_P:
      xmlSetProp (node, XML_NORM, XML_P);
      xml_node_set_float (node, XML_P, input->p);
      break;
    case ERROR_NORM_TAXICAB:
      xmlSetProp (node, XML_NORM, XML_TAXICAB);
    }

  // Saving the XML file
  xmlSaveFormatFile (filename, doc, 1);

  // Freeing memory
  xmlFreeDoc (doc);

#if DEBUG_INTERFACE
  fprintf (stderr, "input_save: end\n");
#endif
}
```

Here is the call graph for this function:



5.13.2.3 unsigned int window_get_algorithm ( )

Function to get the stochastic algorithm number.

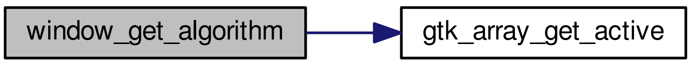
Returns

Stochastic algorithm number.

Definition at line 461 of file interface.c.

```
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_algorithm: start\n");
#endif
  i = gtk_array_get_active (window->button_algorithm,
NALGORITHMS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_algorithm: %u\n", i);
  fprintf (stderr, "window_get_algorithm: end\n");
#endif
  return i;
}
```

Here is the call graph for this function:



5.13.2.4 unsigned int window_get_direction ( )

Function to get the direction search method number.

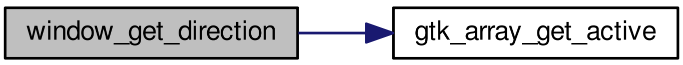
Returns

Direction search method number.

Definition at line 481 of file interface.c.

```
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_direction: start\n");
#endif
  i = gtk_array_get_active (window->button_direction,
NDIRECTIONS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_direction: %u\n", i);
  fprintf (stderr, "window_get_direction: end\n");
#endif
  return i;
}
```

Here is the call graph for this function:



5.13.2.5 unsigned int window_get_norm ( )

Function to get the norm method number.

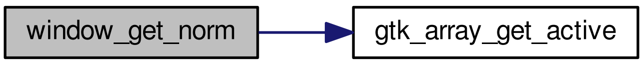
Returns

Norm method number.

Definition at line 501 of file interface.c.

```
{
  unsigned int i;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_norm: start\n");
#endif
  i = gtk_array_get_active (window->button_norm,
NNORMS);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_get_norm: %u\n", i);
  fprintf (stderr, "window_get_norm: end\n");
#endif
  return i;
}
```

Here is the call graph for this function:



5.13.2.6 int window_read (char ∗ *filename*)

Function to read the input data of a file.

Parameters

filename	File name.

Returns

1 on succes, 0 on error.

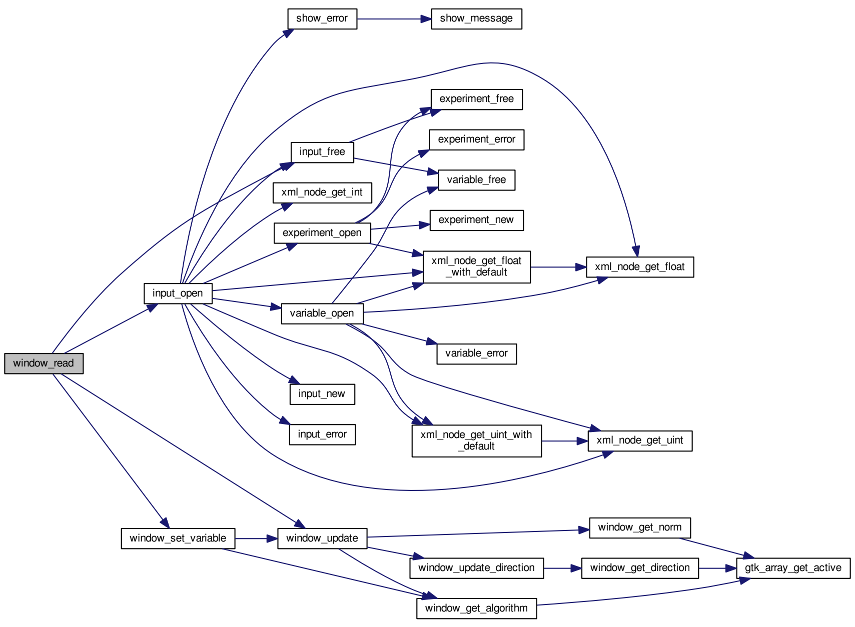
Definition at line 1560 of file interface.c.

```
{
  unsigned int i;
  char *buffer;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_read: start\n");
```

```
#endif

  // Reading new input file
  input_free ();
  if (!input_open (filename))
    {
#if DEBUG_INTERFACE
      fprintf (stderr, "window_read: end\n");
#endif
      return 0;
    }

  // Setting GTK+ widgets data
  gtk_entry_set_text (window->entry_result, input->result);
  gtk_entry_set_text (window->entry_variables, input->
variables);
  buffer = g_build_filename (input->directory, input->simulator, NULL);
  gtk_file_chooser_set_filename (GTK_FILE_CHOOSER
                                 (window->button_simulator), buffer);
  g_free (buffer);
  gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (window->check_evaluator),
                                (size_t) input->evaluator);
  if (input->evaluator)
    {
      buffer = g_build_filename (input->directory, input->evaluator, NULL);
      gtk_file_chooser_set_filename (GTK_FILE_CHOOSER
                                     (window->button_evaluator), buffer);
      g_free (buffer);
    }
  gtk_toggle_button_set_active
    (GTK_TOGGLE_BUTTON (window->button_algorithm[input->
algorithm]), TRUE);
  switch (input->algorithm)
    {
    case ALGORITHM_MONTE_CARLO:
      gtk_spin_button_set_value (window->spin_simulations,
                                 (gdouble) input->nsimulations);
    case ALGORITHM_SWEEP:
      gtk_spin_button_set_value (window->spin_iterations,
                                 (gdouble) input->niterations);
      gtk_spin_button_set_value (window->spin_bests, (gdouble) input->
nbest);
      gtk_spin_button_set_value (window->spin_tolerance, input->
tolerance);
      gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (window->
check_direction),
                                    input->nsteps);
      if (input->nsteps)
        {
          gtk_toggle_button_set_active
            (GTK_TOGGLE_BUTTON (window->button_direction
                                [input->direction]), TRUE);
          gtk_spin_button_set_value (window->spin_steps,
                                     (gdouble) input->nsteps);
          gtk_spin_button_set_value (window->spin_relaxation,
                                     (gdouble) input->relaxation);
          switch (input->direction)
            {
            case DIRECTION_METHOD_RANDOM:
              gtk_spin_button_set_value (window->spin_estimates,
                                         (gdouble) input->nestimates);
            }
        }
      break;
    default:
      gtk_spin_button_set_value (window->spin_population,
                                 (gdouble) input->nsimulations);
      gtk_spin_button_set_value (window->spin_generations,
                                 (gdouble) input->niterations);
      gtk_spin_button_set_value (window->spin_mutation, input->
mutation_ratio);
      gtk_spin_button_set_value (window->spin_reproduction,
                                 input->reproduction_ratio);
      gtk_spin_button_set_value (window->spin_adaptation,
                                 input->adaptation_ratio);
    }
  gtk_toggle_button_set_active
    (GTK_TOGGLE_BUTTON (window->button_norm[input->norm]), TRUE);
  gtk_spin_button_set_value (window->spin_p, input->p);
  gtk_spin_button_set_value (window->spin_threshold, input->
threshold);
  g_signal_handler_block (window->combo_experiment, window->
id_experiment);
  g_signal_handler_block (window->button_experiment,
                          window->id_experiment_name);
  gtk_combo_box_text_remove_all (window->combo_experiment);
  for (i = 0; i < input->nexperiments; ++i)
```

```
    gtk_combo_box_text_append_text (window->combo_experiment,
                                    input->experiment[i].name);
  g_signal_handler_unblock
    (window->button_experiment, window->
id_experiment_name);
  g_signal_handler_unblock (window->combo_experiment,
window->id_experiment);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_experiment), 0);
  g_signal_handler_block (window->combo_variable, window->
id_variable);
  g_signal_handler_block (window->entry_variable, window->
id_variable_label);
  gtk_combo_box_text_remove_all (window->combo_variable);
  for (i = 0; i < input->nvariables; ++i)
    gtk_combo_box_text_append_text (window->combo_variable,
                                    input->variable[i].name);
  g_signal_handler_unblock (window->entry_variable, window->
id_variable_label);
  g_signal_handler_unblock (window->combo_variable, window->
id_variable);
  gtk_combo_box_set_active (GTK_COMBO_BOX (window->combo_variable), 0);
  window_set_variable ();
  window_update ();

#if DEBUG_INTERFACE
  fprintf (stderr, "window_read: end\n");
#endif
  return 1;
}
```

Here is the call graph for this function:



5.13.2.7 int window_save ( )

Function to save the input file.

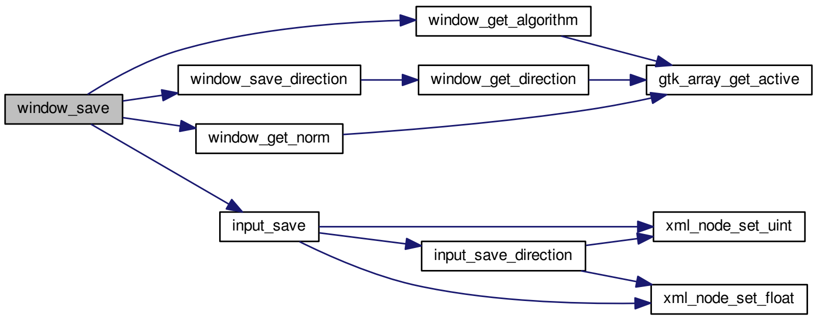
Returns

1 on OK, 0 on Cancel.

Definition at line 554 of file interface.c.

```
{
  GtkFileChooserDialog *dlg;
  GtkFileFilter *filter;
  char *buffer;

#if DEBUG_INTERFACE
  fprintf (stderr, "window_save: start\n");
#endif

  // Opening the saving dialog
  dlg = (GtkFileChooserDialog *)
    gtk_file_chooser_dialog_new (gettext ("Save file"),
                                 window->window,
                                 GTK_FILE_CHOOSER_ACTION_SAVE,
                                 gettext ("_Cancel"),
                                 GTK_RESPONSE_CANCEL,
                                 gettext ("_OK"), GTK_RESPONSE_OK, NULL);
  gtk_file_chooser_set_do_overwrite_confirmation (GTK_FILE_CHOOSER (dlg), TRUE);
  buffer = g_build_filename (input->directory, input->name, NULL);
  gtk_file_chooser_set_filename (GTK_FILE_CHOOSER (dlg), buffer);
  g_free (buffer);

  // Adding XML filter
  filter = (GtkFileFilter *) gtk_file_filter_new ();
  gtk_file_filter_set_name (filter, "XML");
  gtk_file_filter_add_pattern (filter, "*.xml");
  gtk_file_filter_add_pattern (filter, "*.XML");
  gtk_file_chooser_add_filter (GTK_FILE_CHOOSER (dlg), filter);

  // If OK response then saving
  if (gtk_dialog_run (GTK_DIALOG (dlg)) == GTK_RESPONSE_OK)
    {

      // Adding properties to the root XML node
      input->simulator = gtk_file_chooser_get_filename
        (GTK_FILE_CHOOSER (window->button_simulator));
      if (gtk_toggle_button_get_active
          (GTK_TOGGLE_BUTTON (window->check_evaluator)))
        input->evaluator = gtk_file_chooser_get_filename
          (GTK_FILE_CHOOSER (window->button_evaluator));
      else
        input->evaluator = NULL;
      input->result
        = (char *) xmlStrdup ((const xmlChar *)
                              gtk_entry_get_text (window->entry_result));
      input->variables
        = (char *) xmlStrdup ((const xmlChar *)
                              gtk_entry_get_text (window->entry_variables));

      // Setting the algorithm
      switch (window_get_algorithm ())
        {
        case ALGORITHM_MONTE_CARLO:
          input->algorithm = ALGORITHM_MONTE_CARLO;
          input->nsimulations
            = gtk_spin_button_get_value_as_int (window->spin_simulations);
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_iterations);
          input->tolerance = gtk_spin_button_get_value (window->
spin_tolerance);
          input->nbest = gtk_spin_button_get_value_as_int (window->
spin_bests);
          window_save_direction ();
          break;
        case ALGORITHM_SWEEP:
          input->algorithm = ALGORITHM_SWEEP;
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_iterations);
          input->tolerance = gtk_spin_button_get_value (window->
spin_tolerance);
          input->nbest = gtk_spin_button_get_value_as_int (window->
spin_bests);
          window_save_direction ();
          break;
        default:
          input->algorithm = ALGORITHM_GENETIC;
          input->nsimulations
            = gtk_spin_button_get_value_as_int (window->spin_population);
          input->niterations
            = gtk_spin_button_get_value_as_int (window->spin_generations);
          input->mutation_ratio
            = gtk_spin_button_get_value (window->spin_mutation);
          input->reproduction_ratio
            = gtk_spin_button_get_value (window->spin_reproduction);
          input->adaptation_ratio
            = gtk_spin_button_get_value (window->spin_adaptation);
          break;
        }
      input->norm = window_get_norm ();
      input->p = gtk_spin_button_get_value (window->spin_p);
      input->threshold = gtk_spin_button_get_value (window->
spin_threshold);

      // Saving the XML file
      buffer = gtk_file_chooser_get_filename (GTK_FILE_CHOOSER (dlg));
      input_save (buffer);

      // Closing and freeing memory
      g_free (buffer);
      gtk_widget_destroy (GTK_WIDGET (dlg));
#if DEBUG_INTERFACE
      fprintf (stderr, "window_save: end\n");
#endif
      return 1;
    }

  // Closing and freeing memory
  gtk_widget_destroy (GTK_WIDGET (dlg));
#if DEBUG_INTERFACE
  fprintf (stderr, "window_save: end\n");
#endif
  return 0;
}
```

Here is the call graph for this function:



5.13.2.8 void window_template_experiment (void * *data*)

Function to update the experiment i-th input template in the main window.

Parameters

data	Callback data (i-th input template).

Definition at line 1210 of file interface.c.

```
01211 {
  unsigned int i, j;
  char *buffer;
  GFile *file1, *file2;
#if DEBUG_INTERFACE
  fprintf (stderr, "window_template_experiment: start\n");
#endif
  i = (size_t) data;
  j = gtk_combo_box_get_active (GTK_COMBO_BOX (window->combo_experiment));
  file1
    = gtk_file_chooser_get_file (GTK_FILE_CHOOSER (window->button_template[i]));
  file2 = g_file_new_for_path (input->directory);
  buffer = g_file_get_relative_path (file2, file1);
  input->experiment[j].template[i] = (char *) xmlStrdup ((xmlChar *) buffer);
  g_free (buffer);
  g_object_unref (file2);
  g_object_unref (file1);
#if DEBUG_INTERFACE
  fprintf (stderr, "window_template_experiment: end\n");
#endif
}
```

5.14 interface.h

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO,
PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR
BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN
CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#ifndef INTERFACE__H
#define INTERFACE__H 1

#define MAX_LENGTH (DEFAULT_PRECISION + 8)

typedef struct
{
  GtkDialog *dialog;
  GtkGrid *grid;
  GtkLabel *label_seed;
  GtkSpinButton *spin_seed;
  GtkLabel *label_threads;
  GtkSpinButton *spin_threads;
  GtkLabel *label_direction;
  GtkSpinButton *spin_direction;
} Options;

typedef struct
{
  GtkDialog *dialog;
  GtkLabel *label;
  GtkSpinner *spinner;
  GtkGrid *grid;
} Running;

typedef struct
{
  GtkWindow *window;
```

```
GtkGrid *grid;
GtkToolbar *bar_buttons;
GtkToolButton *button_open;
GtkToolButton *button_save;
GtkToolButton *button_run;
GtkToolButton *button_options;
GtkToolButton *button_help;
GtkToolButton *button_about;
GtkToolButton *button_exit;
GtkGrid *grid_files;
GtkLabel *label_simulator;
GtkFileChooserButton *button_simulator;
GtkCheckButton *check_evaluator;
GtkFileChooserButton *button_evaluator;
GtkLabel *label_result;
GtkEntry *entry_result;
GtkLabel *label_variables;
GtkEntry *entry_variables;
GtkFrame *frame_norm;
GtkGrid *grid_norm;
GtkRadioButton *button_norm[NNORMS];
GtkLabel *label_p;
GtkSpinButton *spin_p;
GtkScrolledWindow *scrolled_p;
GtkFrame *frame_algorithm;
GtkGrid *grid_algorithm;
GtkRadioButton *button_algorithm[NALGORITHMS];
GtkLabel *label_simulations;
GtkSpinButton *spin_simulations;
GtkLabel *label_iterations;
GtkSpinButton *spin_iterations;
GtkLabel *label_tolerance;
GtkSpinButton *spin_tolerance;
GtkLabel *label_bests;
GtkSpinButton *spin_bests;
GtkLabel *label_population;
GtkSpinButton *spin_population;
GtkLabel *label_generations;
GtkSpinButton *spin_generations;
GtkLabel *label_mutation;
GtkSpinButton *spin_mutation;
GtkLabel *label_reproduction;
GtkSpinButton *spin_reproduction;
GtkLabel *label_adaptation;
GtkSpinButton *spin_adaptation;
GtkCheckButton *check_direction;
GtkGrid *grid_direction;
GtkRadioButton *button_direction[NDIRECTIONS];
GtkLabel *label_steps;
GtkSpinButton *spin_steps;
GtkLabel *label_estimates;
GtkSpinButton *spin_estimates;
GtkLabel *label_relaxation;
GtkSpinButton *spin_relaxation;
GtkLabel *label_threshold;
GtkSpinButton *spin_threshold;
GtkScrolledWindow *scrolled_threshold;
GtkFrame *frame_variable;
GtkGrid *grid_variable;
GtkComboBoxText *combo_variable;
GtkButton *button_add_variable;
GtkButton *button_remove_variable;
GtkLabel *label_variable;
GtkEntry *entry_variable;
GtkLabel *label_min;
GtkSpinButton *spin_min;
GtkScrolledWindow *scrolled_min;
GtkLabel *label_max;
GtkSpinButton *spin_max;
GtkScrolledWindow *scrolled_max;
GtkCheckButton *check_minabs;
GtkSpinButton *spin_minabs;
GtkScrolledWindow *scrolled_minabs;
GtkCheckButton *check_maxabs;
GtkSpinButton *spin_maxabs;
GtkScrolledWindow *scrolled_maxabs;
GtkLabel *label_precision;
GtkSpinButton *spin_precision;
GtkLabel *label_sweeps;
GtkSpinButton *spin_sweeps;
GtkLabel *label_bits;
GtkSpinButton *spin_bits;
GtkLabel *label_step;
GtkSpinButton *spin_step;
GtkScrolledWindow *scrolled_step;
GtkFrame *frame_experiment;
GtkGrid *grid_experiment;
```

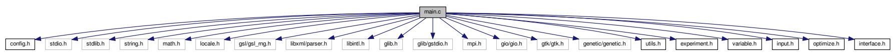
```
  GtkComboBoxText *combo_experiment;
  GtkButton *button_add_experiment;
  GtkButton *button_remove_experiment;
  GtkLabel *label_experiment;
  GtkFileChooserButton *button_experiment;
  GtkLabel *label_weight;
  GtkSpinButton *spin_weight;
  GtkCheckButton *check_template[MAX_NINPUTS];
  GtkFileChooserButton *button_template[MAX_NINPUTS];
  GdkPixbuf *logo;
  Experiment *experiment;
  Variable *variable;
  char *application_directory;
  gulong id_experiment;
  gulong id_experiment_name;
  gulong id_variable;
  gulong id_variable_label;
  gulong id_template[MAX_NINPUTS];
  gulong id_input[MAX_NINPUTS];
  unsigned int nexperiments;
  unsigned int nvariables;
} Window;

// Global variables
extern const char *logo[];
extern Options options[1];
extern Running running[1];
extern Window window[1];

// Inline functions
#if GTK_MAJOR_VERSION <= 3 && GTK_MINOR_VERSION < 10
static inline GtkButton *
gtk_button_new_from_icon_name (const char *name, GtkIconSize size)
{
  GtkButton *button;
  GtkImage *image;
  button = (GtkButton *) gtk_button_new ();
  image = (GtkImage *) gtk_image_new_from_icon_name (name, size);
  gtk_button_set_image (button, GTK_WIDGET (image));
  return button;
}
#endif

// Public functions
unsigned int gtk_array_get_active (GtkRadioButton * array[], unsigned int n);
void input_save (char *filename);
void options_new ();
void running_new ();
unsigned int window_get_algorithm ();
unsigned int window_get_direction ();
unsigned int window_get_norm ();
void window_save_direction ();
int window_save ();
void window_run ();
void window_help ();
void window_update_direction ();
void window_update ();
void window_set_algorithm ();
void window_set_experiment ();
void window_remove_experiment ();
void window_add_experiment ();
void window_name_experiment ();
void window_weight_experiment ();
void window_inputs_experiment ();
void window_template_experiment (void *data);
void window_set_variable ();
void window_remove_variable ();
void window_add_variable ();
void window_label_variable ();
void window_precision_variable ();
void window_rangemin_variable ();
void window_rangemax_variable ();
void window_rangeminabs_variable ();
void window_rangemaxabs_variable ();
void window_update_variable ();
int window_read (char *filename);
void window_open ();
void window_new ();

#endif
```

5.15 main.c File Reference

Main source file.

```
#include "config.h"
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <locale.h>
#include <gsl/gsl_rng.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include <glib/gstdio.h>
#include <mpi.h>
#include <gio/gio.h>
#include <gtk/gtk.h>
#include "genetic/genetic.h"
#include "utils.h"
#include "experiment.h"
#include "variable.h"
#include "input.h"
#include "optimize.h"
#include "interface.h"
```

Include dependency graph for main.c:



Macros

- #define **_GNU_SOURCE**
- #define DEBUG_MAIN 0

  Macro to debug main functions.

Functions

- int **main** (int argn, char ∗∗argc)

5.15.1 Detailed Description

Main source file.

Authors

Javier Burguete and Borja Latorre.

Copyright

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Definition in file main.c.

5.16 main.c

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO,
PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR
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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#define _GNU_SOURCE
#include "config.h"
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <locale.h>
#include <gsl/gsl_rng.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include <glib/gstdio.h>
#ifdef G_OS_WIN32
#include <windows.h>
#endif
#if HAVE_MPI
#include <mpi.h>
#endif
#if HAVE_GTK
#include <gio/gio.h>
#include <gtk/gtk.h>
#endif
#include "genetic/genetic.h"
#include "utils.h"
#include "experiment.h"
#include "variable.h"
#include "input.h"
#include "optimize.h"
#if HAVE_GTK
#include "interface.h"
#endif

#define DEBUG_MAIN 0


int
main (int argn, char **argc)
{
#if HAVE_GTK
  char *buffer;
#endif

  // Starting pseudo-random numbers generator
#if DEBUG_MAIN
  fprintf (stderr, "main: starting pseudo-random numbers generator\n");
#endif
  optimize->rng = gsl_rng_alloc (gsl_rng_taus2);

  // Allowing spaces in the XML data file
#if DEBUG_MAIN
  fprintf (stderr, "main: allowing spaces in the XML data file\n");
#endif
  xmlKeepBlanksDefault (0);

  // Starting MPI
#if HAVE_MPI
#if DEBUG_MAIN
  fprintf (stderr, "main: starting MPI\n");
#endif
  MPI_Init (&argn, &argc);
  MPI_Comm_size (MPI_COMM_WORLD, &ntasks);
  MPI_Comm_rank (MPI_COMM_WORLD, &optimize->mpi_rank);
  printf ("rank=%d tasks=%d\n", optimize->mpi_rank, ntasks);
#else
  ntasks = 1;
#endif

  // Resetting result and variables file names
#if DEBUG_MAIN
  fprintf (stderr, "main: resetting result and variables file names\n");
#endif
  input->result = input->variables = NULL;

#if HAVE_GTK

  // Getting threads number and pseudo-random numbers generator seed
  nthreads_direction = nthreads = cores_number ();
  optimize->seed = DEFAULT_RANDOM_SEED;

  // Setting local language and international floating point numbers notation
  setlocale (LC_ALL, "");
  setlocale (LC_NUMERIC, "C");
  window->application_directory = g_get_current_dir ();
  buffer = g_build_filename (window->application_directory,
LOCALE_DIR, NULL);
  bindtextdomain (PROGRAM_INTERFACE, buffer);
  bind_textdomain_codeset (PROGRAM_INTERFACE, "UTF-8");
  textdomain (PROGRAM_INTERFACE);

  // Initing GTK+
  gtk_disable_setlocale ();
  gtk_init (&argn, &argc);

  // Opening the main window
  window_new ();
  gtk_main ();

  // Freeing memory
  input_free ();
  g_free (buffer);
  gtk_widget_destroy (GTK_WIDGET (window->window));
  g_free (window->application_directory);

#else

  // Checking syntax
  if (argn < 2)
    {
      printf ("The syntax is:\n"
              "./mpcotoolbin [-nthreads x] [-seed s] data_file [result_file] "
              "[variables_file]\n");
      return 1;
    }

  // Getting threads number and pseudo-random numbers generator seed
#if DEBUG_MAIN
  fprintf (stderr, "main: getting threads number and pseudo-random numbers "
           "generator seed\n");
#endif
  nthreads_direction = nthreads = cores_number ();
  optimize->seed = DEFAULT_RANDOM_SEED;
  if (argn > 2 && !strcmp (argc[1], "-nthreads"))
    {
      nthreads_direction = nthreads = atoi (argc[2]);
      if (!nthreads)
        {
          printf ("Bad threads number\n");
          return 2;
        }
      argc += 2;
      argn -= 2;
      if (argn > 2 && !strcmp (argc[1], "-seed"))
        {
          optimize->seed = atoi (argc[2]);
          argc += 2;
          argn -= 2;
        }
    }
  else if (argn > 2 && !strcmp (argc[1], "-seed"))
    {
      optimize->seed = atoi (argc[2]);
      argc += 2;
      argn -= 2;
      if (argn > 2 && !strcmp (argc[1], "-nthreads"))
        {
          nthreads_direction = nthreads = atoi (argc[2]);
          if (!nthreads)
            {
              printf ("Bad threads number\n");
              return 2;
            }
          argc += 2;
          argn -= 2;
        }
    }
  printf ("nthreads=%u\n", nthreads);
  printf ("seed=%lu\n", optimize->seed);

  // Checking arguments
#if DEBUG_MAIN
  fprintf (stderr, "main: checking arguments\n");
#endif
  if (argn > 4 || argn < 2)
    {
      printf ("The syntax is:\n"
              "./mpcotoolbin [-nthreads x] [-seed s] data_file [result_file] "
              "[variables_file]\n");
      return 1;
    }
  if (argn > 2)
    input->result = (char *) xmlStrdup ((xmlChar *) argc[2]);
  if (argn == 4)
    input->variables = (char *) xmlStrdup ((xmlChar *) argc[3]);

  // Making optimization
#if DEBUG_MAIN
  fprintf (stderr, "main: making optimization\n");
#endif
  if (input_open (argc[1]))
    optimize_open ();

  // Freeing memory
#if DEBUG_MAIN
  fprintf (stderr, "main: freeing memory and closing\n");
#endif
  optimize_free ();

#endif

  // Closing MPI
#if HAVE_MPI
  MPI_Finalize ();
#endif

  // Freeing memory
  gsl_rng_free (optimize->rng);

  // Closing
  return 0;
}
```
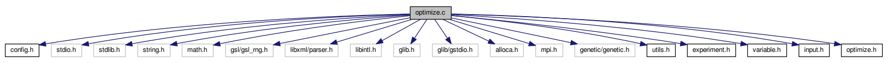

5.17 optimize.c File Reference

Source file to define the optimization functions.

```
#include "config.h"
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <gsl/gsl_rng.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include <glib/gstdio.h>
#include <alloca.h>
#include <mpi.h>
#include "genetic/genetic.h"
#include "utils.h"
#include "experiment.h"
#include "variable.h"
#include "input.h"
#include "optimize.h"
```

Include dependency graph for optimize.c:



Macros

- #define **_GNU_SOURCE**
- #define DEBUG_OPTIMIZE 0

  Macro to debug optimize functions.
- #define RM "rm"

  Macro to define the shell remove command.

Functions

- void optimize_input (unsigned int simulation, char ∗input, GMappedFile ∗template)

  Function to write the simulation input file.
- double optimize_parse (unsigned int simulation, unsigned int experiment)

  Function to parse input files, simulating and calculating the \ objective function.
- double optimize_norm_euclidian (unsigned int simulation)

  Function to calculate the Euclidian error norm.
- double optimize_norm_maximum (unsigned int simulation)

  Function to calculate the maximum error norm.
- double optimize_norm_p (unsigned int simulation)

  Function to calculate the P error norm.
- double optimize_norm_taxicab (unsigned int simulation)

  Function to calculate the taxicab error norm.
- void optimize_print ()

  Function to print the results.
- void optimize_save_variables (unsigned int simulation, double error)

  Function to save in a file the variables and the error.
- void optimize_best (unsigned int simulation, double value)

Function to save the best simulations.

- void optimize_sequential ()

  Function to optimize sequentially.
- void ∗ optimize_thread (ParallelData ∗data)

  Function to optimize on a thread.
- void optimize_merge (unsigned int nsaveds, unsigned int ∗simulation_best, double ∗error_best)

  Function to merge the 2 optimization results.
- void optimize_synchronise ()

  Function to synchronise the optimization results of MPI tasks.
- void optimize_sweep ()

  Function to optimize with the sweep algorithm.
- void optimize_MonteCarlo ()

  Function to optimize with the Monte-Carlo algorithm.
- void optimize_best_direction (unsigned int simulation, double value)

  Function to save the best simulation in a direction search method.
- void optimize_direction_sequential (unsigned int simulation)

  Function to estimate the direction search sequentially.
- void ∗ optimize_direction_thread (ParallelData ∗data)

  Function to estimate the direction search on a thread.
- double optimize_estimate_direction_random (unsigned int variable, unsigned int estimate)

  Function to estimate a component of the direction search vector.
- double optimize_estimate_direction_coordinates (unsigned int variable, unsigned int estimate)

  Function to estimate a component of the direction search vector.
- void optimize_step_direction (unsigned int simulation)

  Function to do a step of the direction search method.
- void optimize_direction ()

  Function to optimize with a direction search method.
- double optimize_genetic_objective (Entity ∗entity)

  Function to calculate the objective function of an entity.
- void optimize_genetic ()

  Function to optimize with the genetic algorithm.
- void optimize_save_old ()

  Function to save the best results on iterative methods.
- void optimize_merge_old ()

  Function to merge the best results with the previous step best results on iterative methods.
- void optimize_refine ()

  Function to refine the search ranges of the variables in iterative algorithms.
- void optimize_step ()

  Function to do a step of the iterative algorithm.
- void optimize_iterate ()

  Function to iterate the algorithm.
- void optimize_free ()

  Function to free the memory used by the Optimize struct.
- void optimize_open ()

  Function to open and perform a optimization.

Variables

- int ntasks

  Number of tasks.
- unsigned int nthreads

  Number of threads.
- unsigned int nthreads_direction

  Number of threads for the direction search method.
- GMutex mutex [1]

  Mutex struct.
- void(∗ optimize_algorithm)()

  Pointer to the function to perform a optimization algorithm step.
- double(∗ optimize_estimate_direction)(unsigned int variable, unsigned int estimate)

  Pointer to the function to estimate the direction.
- double(∗ optimize_norm)(unsigned int simulation)

  Pointer to the error norm function.
- Optimize optimize [1]

  Optimization data.

5.17.1 Detailed Description

Source file to define the optimization functions.

Authors

Javier Burguete and Borja Latorre.

Copyright

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Definition in file optimize.c.

5.17.2 Function Documentation

5.17.2.1 void optimize_best (unsigned int *simulation,* double *value*)

Function to save the best simulations.

Parameters

simulation	Simulation number.
value	Objective function value.

Definition at line 461 of file optimize.c.

```
00462 {
  unsigned int i, j;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best: start\n");
  fprintf (stderr, "optimize_best: nsaveds=%u nbest=%u\n",
           optimize->nsaveds, optimize->nbest);
#endif
  if (optimize->nsaveds < optimize->nbest
      || value < optimize->error_best[optimize->nsaveds - 1])
    {
      if (optimize->nsaveds < optimize->nbest)
        ++optimize->nsaveds;
      optimize->error_best[optimize->nsaveds - 1] = value;
      optimize->simulation_best[optimize->nsaveds - 1] = simulation;
      for (i = optimize->nsaveds; --i;)
        {
          if (optimize->error_best[i] < optimize->error_best[i - 1])
            {
              j = optimize->simulation_best[i];
              e = optimize->error_best[i];
              optimize->simulation_best[i] = optimize->simulation_best[i - 1];
              optimize->error_best[i] = optimize->error_best[i - 1];
              optimize->simulation_best[i - 1] = j;
              optimize->error_best[i - 1] = e;
            }
          else
            break;
        }
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best: end\n");
#endif
}
```

5.17.2.2 void optimize_best_direction (unsigned int *simulation*, double *value*)

Function to save the best simulation in a direction search method.

Parameters

simulation	Simulation number.
value	Objective function value.

Definition at line 786 of file optimize.c.

```
{
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best_direction: start\n");
  fprintf (stderr,
           "optimize_best_direction: simulation=%u value=%.14le best=%.14le\n",
           simulation, value, optimize->error_best[0]);
#endif
  if (value < optimize->error_best[0])
    {
      optimize->error_best[0] = value;
      optimize->simulation_best[0] = simulation;
#if DEBUG_OPTIMIZE
      fprintf (stderr,
               "optimize_best_direction: BEST simulation=%u value=%.14le\n",
               simulation, value);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best_direction: end\n");
#endif
}
```

5.17.2.3 void optimize_direction_sequential (unsigned int *simulation*)

Function to estimate the direction search sequentially.

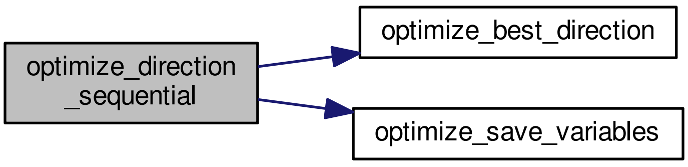
Parameters

simulation	Simulation number.

Definition at line 816 of file optimize.c.

```
{
  unsigned int i, j;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_sequential: start\n");
  fprintf (stderr, "optimize_direction_sequential: nstart_direction=%u "
           "nend_direction=%u\n",
           optimize->nstart_direction, optimize->
nend_direction);
#endif
  for (i = optimize->nstart_direction; i < optimize->nend_direction; ++i)
    {
      j = simulation + i;
      e = optimize_norm (j);
      optimize_best_direction (j, e);
      optimize_save_variables (j, e);
      if (e < optimize->threshold)
        {
          optimize->stop = 1;
          break;
        }
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_direction_sequential: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_sequential: end\n");
#endif
}
```

Here is the call graph for this function:



5.17.2.4 void ∗ optimize_direction_thread (ParallelData ∗ *data*)

Function to estimate the direction search on a thread.

Parameters

data	Function data.

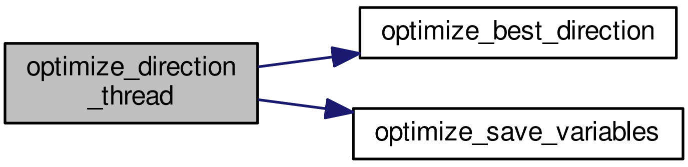
Returns

NULL

Definition at line 854 of file optimize.c.

```
{
  unsigned int i, thread;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: start\n");
#endif
  thread = data->thread;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: thread=%u start=%u end=%u\n",
           thread,
           optimize->thread_direction[thread],
           optimize->thread_direction[thread + 1]);
#endif
  for (i = optimize->thread_direction[thread];
       i < optimize->thread_direction[thread + 1]; ++i)
    {
      e = optimize_norm (i);
      g_mutex_lock (mutex);
      optimize_best_direction (i, e);
      optimize_save_variables (i, e);
      if (e < optimize->threshold)
        optimize->stop = 1;
      g_mutex_unlock (mutex);
      if (optimize->stop)
        break;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_direction_thread: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: end\n");
#endif
  g_thread_exit (NULL);
  return NULL;
}
```

Here is the call graph for this function:



5.17.2.5 double optimize_estimate_direction_coordinates (unsigned int *variable*, unsigned int *estimate*)

Function to estimate a component of the direction search vector.

Parameters

variable	Variable number.
estimate	Estimate number.

Definition at line 928 of file optimize.c.

```c
{
  double x;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_coordinates: start\n");
#endif
  x = optimize->direction[variable];
  if (estimate >= (2 * variable) && estimate < (2 * variable + 2))
    {
      if (estimate & 1)
        x += optimize->step[variable];
      else
        x -= optimize->step[variable];
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr,
           "optimize_estimate_direction_coordinates: direction%u=%lg\n",
           variable, x);
  fprintf (stderr, "optimize_estimate_direction_coordinates: end\n");
#endif
  return x;
}
```

5.17.2.6 double optimize_estimate_direction_random (unsigned int *variable,* unsigned int *estimate*)

Function to estimate a component of the direction search vector.

Parameters

variable	Variable number.
estimate	Estimate number.

Definition at line 901 of file optimize.c.

```c
{
  double x;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_random: start\n");
#endif
  x = optimize->direction[variable]
    + (1. - 2. * gsl_rng_uniform (optimize->rng)) * optimize->step[variable];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_random: direction%u=%lg\n",
           variable, x);
  fprintf (stderr, "optimize_estimate_direction_random: end\n");
#endif
  return x;
}
```

5.17.2.7 double optimize_genetic_objective (Entity ∗ *entity*)

Function to calculate the objective function of an entity.

Parameters

entity	entity data.

Returns

objective function value.

Definition at line 1095 of file optimize.c.

```
{
  unsigned int j;
  double objective;
  char buffer[64];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic_objective: start\n");
#endif
  for (j = 0; j < optimize->nvariables; ++j)
    {
      optimize->value[entity->id * optimize->nvariables + j]
        = genetic_get_variable (entity, optimize->genetic_variable + j);
    }
  objective = optimize_norm (entity->id);
  g_mutex_lock (mutex);
  for (j = 0; j < optimize->nvariables; ++j)
    {
      snprintf (buffer, 64, "%s ", format[optimize->precision[j]]);
      fprintf (optimize->file_variables, buffer,
               genetic_get_variable (entity, optimize->genetic_variable + j));
    }
  fprintf (optimize->file_variables, "%.14le\n", objective);
  g_mutex_unlock (mutex);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic_objective: end\n");
#endif
  return objective;
}
```

5.17.2.8 void optimize_input (unsigned int *simulation*, char ∗ *input*, GMappedFile ∗ *template*)

Function to write the simulation input file.

Parameters

simulation	Simulation number.
input	Input file name.
template	Template of the input file name.

Definition at line 102 of file optimize.c.

```
{
  unsigned int i;
  char buffer[32], value[32], *buffer2, *buffer3, *content;
  FILE *file;
  gsize length;
  GRegex *regex;

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: start\n");
#endif

  // Checking the file
  if (!template)
    goto optimize_input_end;

  // Opening template
  content = g_mapped_file_get_contents (template);
  length = g_mapped_file_get_length (template);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: length=%lu\ncontent:\n%s", length, content);
#endif
  file = g_fopen (input, "w");

  // Parsing template
  for (i = 0; i < optimize->nvariables; ++i)
    {
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_input: variable=%u\n", i);
#endif
      snprintf (buffer, 32, "@variable%u@", i + 1);
      regex = g_regex_new (buffer, 0, 0, NULL);
      if (i == 0)
        {
          buffer2 = g_regex_replace_literal (regex, content, length, 0,
                                             optimize->label[i], 0, NULL);
#if DEBUG_OPTIMIZE
          fprintf (stderr, "optimize_input: buffer2\n%s", buffer2);
#endif
        }
      else
        {
          length = strlen (buffer3);
          buffer2 = g_regex_replace_literal (regex, buffer3, length, 0,
                                             optimize->label[i], 0, NULL);
          g_free (buffer3);
        }
      g_regex_unref (regex);
      length = strlen (buffer2);
      snprintf (buffer, 32, "@value%u@", i + 1);
      regex = g_regex_new (buffer, 0, 0, NULL);
      snprintf (value, 32, format[optimize->precision[i]],
                optimize->value[simulation * optimize->
nvariables + i]);

#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_input: value=%s\n", value);
#endif
      buffer3 = g_regex_replace_literal (regex, buffer2, length, 0, value,
                                         0, NULL);
      g_free (buffer2);
      g_regex_unref (regex);
    }

  // Saving input file
  fwrite (buffer3, strlen (buffer3), sizeof (char), file);
  g_free (buffer3);
  fclose (file);

optimize_input_end:
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: end\n");
#endif
  return;
}
```

5.17.2.9 void optimize_merge (unsigned int *nsaveds,* unsigned int ∗ *simulation_best,* double ∗ *error_best*)

Function to merge the 2 optimization results.

Parameters

nsaveds	Number of saved results.
simulation_best	Array of best simulation numbers.
error_best	Array of best objective function values.

Definition at line 584 of file optimize.c.

```
{
  unsigned int i, j, k, s[optimize->nbest];
  double e[optimize->nbest];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_merge: start\n");
#endif
  i = j = k = 0;
  do
    {
      if (i == optimize->nsaveds)
        {
          s[k] = simulation_best[j];
          e[k] = error_best[j];
          ++j;
          ++k;
          if (j == nsaveds)
            break;
        }
      else if (j == nsaveds)
        {
          s[k] = optimize->simulation_best[i];
          e[k] = optimize->error_best[i];
          ++i;
          ++k;
          if (i == optimize->nsaveds)
            break;
        }
      else if (optimize->error_best[i] > error_best[j])
        {
          s[k] = simulation_best[j];
          e[k] = error_best[j];
          ++j;
          ++k;
        }
      else
        {
          s[k] = optimize->simulation_best[i];
          e[k] = optimize->error_best[i];
          ++i;
          ++k;
        }
    }
  while (k < optimize->nbest);
  optimize->nsaveds = k;
  memcpy (optimize->simulation_best, s, k * sizeof (unsigned int));
  memcpy (optimize->error_best, e, k * sizeof (double));
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_merge: end\n");
#endif
}
```

5.17.2.10 double optimize_norm_euclidian (unsigned int *simulation*)

Function to calculate the Euclidian error norm.

Parameters

simulation	simulation number.

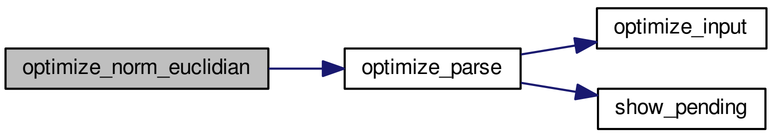
Returns

Euclidian error norm.

Definition at line 294 of file optimize.c.

```
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_euclidian: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = optimize_parse (simulation, i);
      e += ei * ei;
    }
  e = sqrt (e);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_euclidian: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_euclidian: end\n");
#endif
  return e;
}
```

Here is the call graph for this function:



5.17.2.11 double optimize_norm_maximum (unsigned int *simulation*)

Function to calculate the maximum error norm.

Parameters

simulation	simulation number.

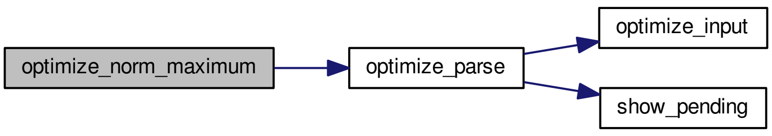
Returns

Maximum error norm.

Definition at line 323 of file optimize.c.

```
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_maximum: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = fabs (optimize_parse (simulation, i));
      e = fmax (e, ei);
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_maximum: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_maximum: end\n");
#endif
  return e;
}
```

Here is the call graph for this function:



5.17.2.12 double optimize_norm_p (unsigned int *simulation*)

Function to calculate the P error norm.

Parameters

simulation	simulation number.

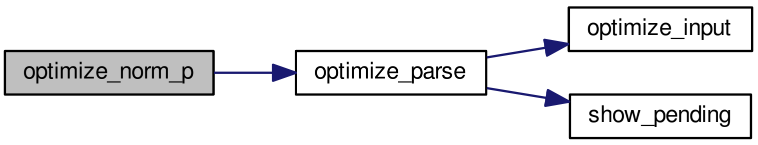
Returns

P error norm.

Definition at line 351 of file optimize.c.

```
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_p: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = fabs (optimize_parse (simulation, i));
      e += pow (ei, optimize->p);
    }
  e = pow (e, 1. / optimize->p);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_p: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_p: end\n");
#endif
  return e;
}
```

Here is the call graph for this function:



5.17.2.13 double optimize_norm_taxicab (unsigned int *simulation*)

Function to calculate the taxicab error norm.

Parameters

simulation	simulation number.

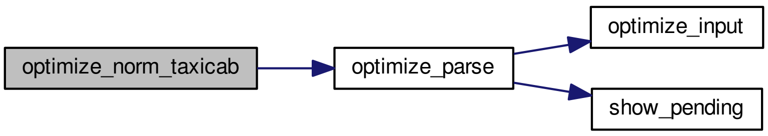
Returns

Taxicab error norm.

Definition at line 380 of file optimize.c.

```
{
  double e;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_taxicab: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    e += fabs (optimize_parse (simulation, i));
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_taxicab: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_taxicab: end\n");
#endif
  return e;
}
```

Here is the call graph for this function:



5.17.2.14 double optimize_parse (unsigned int *simulation,* unsigned int *experiment*)

Function to parse input files, simulating and calculating the \ objective function.

Parameters

simulation	Simulation number.
experiment	Experiment number.

Returns

Objective function value.

Definition at line 188 of file optimize.c.

```
{
  unsigned int i;
  double e;
  char buffer[512], input[MAX_NINPUTS][32], output[32], result[32], *buffer2,
    *buffer3, *buffer4;
  FILE *file_result;

#if DEBUG_OPTIMIZE
```

```
  fprintf (stderr, "optimize_parse: start\n");
  fprintf (stderr, "optimize_parse: simulation=%u experiment=%u\n", simulation,
           experiment);
#endif

  // Opening input files
  for (i = 0; i < optimize->ninputs; ++i)
    {
      snprintf (&input[i][0], 32, "input-%u-%u-%u", i, simulation, experiment);
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_parse: i=%u input=%s\n", i, &input[i][0]);
#endif
      optimize_input (simulation, &input[i][0], optimize->
file[i][experiment]);
    }
  for (; i < MAX_NINPUTS; ++i)
    strcpy (&input[i][0], "");
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: parsing end\n");
#endif

  // Performing the simulation
  snprintf (output, 32, "output-%u-%u", simulation, experiment);
  buffer2 = g_path_get_dirname (optimize->simulator);
  buffer3 = g_path_get_basename (optimize->simulator);
  buffer4 = g_build_filename (buffer2, buffer3, NULL);
  snprintf (buffer, 512, "\"%s\" %s %s %s %s %s %s %s %s %s",
            buffer4, input[0], input[1], input[2], input[3], input[4], input[5],
            input[6], input[7], output);
  g_free (buffer4);
  g_free (buffer3);
  g_free (buffer2);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: %s\n", buffer);
#endif
  system (buffer);

  // Checking the objective value function
  if (optimize->evaluator)
    {
      snprintf (result, 32, "result-%u-%u", simulation, experiment);
      buffer2 = g_path_get_dirname (optimize->evaluator);
      buffer3 = g_path_get_basename (optimize->evaluator);
      buffer4 = g_build_filename (buffer2, buffer3, NULL);
      snprintf (buffer, 512, "\"%s\" %s %s %s",
                buffer4, output, optimize->experiment[experiment], result);
      g_free (buffer4);
      g_free (buffer3);
      g_free (buffer2);
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_parse: %s\n", buffer);
#endif
      system (buffer);
      file_result = g_fopen (result, "r");
      e = atof (fgets (buffer, 512, file_result));
      fclose (file_result);
    }
  else
    {
      strcpy (result, "");
      file_result = g_fopen (output, "r");
      e = atof (fgets (buffer, 512, file_result));
      fclose (file_result);
    }

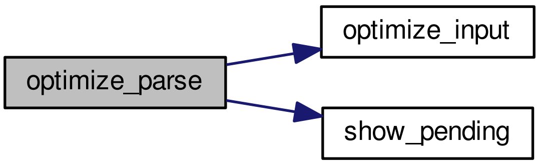
  // Removing files
#if !DEBUG_OPTIMIZE
  for (i = 0; i < optimize->ninputs; ++i)
    {
      if (optimize->file[i][0])
        {
          snprintf (buffer, 512, RM " %s", &input[i][0]);
          system (buffer);
        }
    }
  snprintf (buffer, 512, RM " %s %s", output, result);
  system (buffer);
#endif

  // Processing pending events
  show_pending ();

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: end\n");
#endif

  // Returning the objective function
  return e * optimize->weight[experiment];
}
```

Here is the call graph for this function:



5.17.2.15 void optimize_save_variables (unsigned int *simulation*, double *error*)

Function to save in a file the variables and the error.

Parameters

simulation	Simulation number.
error	Error value.

Definition at line 433 of file optimize.c.

```
{
  unsigned int i;
  char buffer[64];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_save_variables: start\n");
#endif
  for (i = 0; i < optimize->nvariables; ++i)
    {
      snprintf (buffer, 64, "%s ", format[optimize->precision[i]]);
      fprintf (optimize->file_variables, buffer,
               optimize->value[simulation * optimize->
nvariables + i]);
    }
  fprintf (optimize->file_variables, "%.14le\n", error);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_save_variables: end\n");
#endif
}
```

5.17.2.16 void optimize_step_direction (unsigned int *simulation*)

Function to do a step of the direction search method.

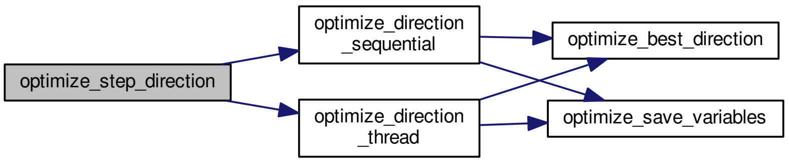
Parameters

simulation	Simulation number.

Definition at line 959 of file optimize.c.

```
{
  GThread *thread[nthreads_direction];
  ParallelData data[nthreads_direction];
  unsigned int i, j, k, b;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_step_direction: start\n");
#endif
  for (i = 0; i < optimize->nestimates; ++i)
    {
      k = (simulation + i) * optimize->nvariables;
      b = optimize->simulation_best[0] * optimize->
nvariables;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_step_direction: simulation=%u best=%u\n",
               simulation + i, optimize->simulation_best[0]);
#endif
      for (j = 0; j < optimize->nvariables; ++j, ++k, ++b)
        {
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: estimate=%u best%u=%.14le\n",
                   i, j, optimize->value[b]);
#endif
          optimize->value[k]
            = optimize->value[b] + optimize_estimate_direction (j,
i);
          optimize->value[k] = fmin (fmax (optimize->value[k],
                                           optimize->rangeminabs[j]),
                                     optimize->rangemaxabs[j]);
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: estimate=%u variable%u=%.14le\n",
                   i, j, optimize->value[k]);
#endif
        }
    }
  if (nthreads_direction == 1)
    optimize_direction_sequential (simulation);
  else
    {
      for (i = 0; i <= nthreads_direction; ++i)
        {
          optimize->thread_direction[i]
            = simulation + optimize->nstart_direction
            + i * (optimize->nend_direction - optimize->
nstart_direction)
            / nthreads_direction;
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: i=%u thread_direction=%u\n",
                   i, optimize->thread_direction[i]);
#endif
        }
      for (i = 0; i < nthreads_direction; ++i)
        {
          data[i].thread = i;
          thread[i] = g_thread_new
            (NULL, (void (*)) optimize_direction_thread, &data[i]);
        }
      for (i = 0; i < nthreads_direction; ++i)
        g_thread_join (thread[i]);
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_step_direction: end\n");
#endif
}
```

Here is the call graph for this function:



5.17.2.17 void * optimize_thread (ParallelData * *data*)

Function to optimize on a thread.

Parameters

data	Function data.

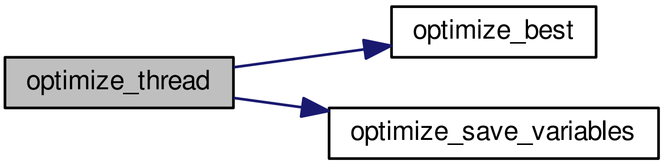
Returns

NULL

Definition at line 538 of file optimize.c.

```
{
  unsigned int i, thread;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: start\n");
#endif
  thread = data->thread;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: thread=%u start=%u end=%u\n", thread,
           optimize->thread[thread], optimize->thread[thread + 1]);
#endif
  for (i = optimize->thread[thread]; i < optimize->thread[thread + 1]; ++i)
    {
      e = optimize_norm (i);
      g_mutex_lock (mutex);
      optimize_best (i, e);
      optimize_save_variables (i, e);
      if (e < optimize->threshold)
        optimize->stop = 1;
      g_mutex_unlock (mutex);
      if (optimize->stop)
        break;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_thread: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: end\n");
#endif
  g_thread_exit (NULL);
  return NULL;
}
```

Here is the call graph for this function:



5.18 optimize.c

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO,
PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR
BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN
CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#define _GNU_SOURCE
#include "config.h"
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <gsl/gsl_rng.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include <glib/gstdio.h>
#ifdef G_OS_WIN32
#include <windows.h>
#elif !defined(__BSD_VISIBLE)
#include <alloca.h>
#endif
#if HAVE_MPI
#include <mpi.h>
#endif
#include "genetic/genetic.h"
#include "utils.h"
#include "experiment.h"
#include "variable.h"
#include "input.h"
#include "optimize.h"

```

```
#define DEBUG_OPTIMIZE 0


#ifdef G_OS_WIN32
#define RM "del"
#else
#define RM "rm"
#endif

int ntasks;
unsigned int nthreads;
unsigned int nthreads_direction;
GMutex mutex[1];
void (*optimize_algorithm) ();
double (*optimize_estimate_direction) (unsigned int variable,
                                       unsigned int estimate);
double (*optimize_norm) (unsigned int simulation);
Optimize optimize[1];

void
optimize_input (unsigned int simulation, char *input, GMappedFile * template)
{
  unsigned int i;
  char buffer[32], value[32], *buffer2, *buffer3, *content;
  FILE *file;
  gsize length;
  GRegex *regex;

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: start\n");
#endif

  // Checking the file
  if (!template)
    goto optimize_input_end;

  // Opening template
  content = g_mapped_file_get_contents (template);
  length = g_mapped_file_get_length (template);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: length=%lu\ncontent:\n%s", length, content);
#endif
  file = g_fopen (input, "w");

  // Parsing template
  for (i = 0; i < optimize->nvariables; ++i)
    {
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_input: variable=%u\n", i);
#endif
      snprintf (buffer, 32, "@variable%u@", i + 1);
      regex = g_regex_new (buffer, 0, 0, NULL);
      if (i == 0)
        {
          buffer2 = g_regex_replace_literal (regex, content, length, 0,
                                             optimize->label[i], 0, NULL);
#if DEBUG_OPTIMIZE
          fprintf (stderr, "optimize_input: buffer2\n%s", buffer2);
#endif
        }
      else
        {
          length = strlen (buffer3);
          buffer2 = g_regex_replace_literal (regex, buffer3, length, 0,
                                             optimize->label[i], 0, NULL);
          g_free (buffer3);
        }
      g_regex_unref (regex);
      length = strlen (buffer2);
      snprintf (buffer, 32, "@value%u@", i + 1);
      regex = g_regex_new (buffer, 0, 0, NULL);
      snprintf (value, 32, format[optimize->precision[i]],
                optimize->value[simulation * optimize->nvariables + i]);

#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_input: value=%s\n", value);
#endif
      buffer3 = g_regex_replace_literal (regex, buffer2, length, 0, value,
                                         0, NULL);
      g_free (buffer2);
      g_regex_unref (regex);
    }

  // Saving input file
  fwrite (buffer3, strlen (buffer3), sizeof (char), file);
  g_free (buffer3);
  fclose (file);
```

```

optimize_input_end:
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: end\n");
#endif
  return;
}

double
optimize_parse (unsigned int simulation, unsigned int experiment)
{
  unsigned int i;
  double e;
  char buffer[512], input[MAX_NINPUTS][32], output[32], result[32], *buffer2,
    *buffer3, *buffer4;
  FILE *file_result;

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: start\n");
  fprintf (stderr, "optimize_parse: simulation=%u experiment=%u\n", simulation,
           experiment);
#endif

  // Opening input files
  for (i = 0; i < optimize->ninputs; ++i)
    {
      snprintf (&input[i][0], 32, "input-%u-%u-%u", i, simulation, experiment);
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_parse: i=%u input=%s\n", i, &input[i][0]);
#endif
      optimize_input (simulation, &input[i][0], optimize->file[i][experiment]);
    }
  for (; i < MAX_NINPUTS; ++i)
    strcpy (&input[i][0], "");
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: parsing end\n");
#endif

  // Performing the simulation
  snprintf (output, 32, "output-%u-%u", simulation, experiment);
  buffer2 = g_path_get_dirname (optimize->simulator);
  buffer3 = g_path_get_basename (optimize->simulator);
  buffer4 = g_build_filename (buffer2, buffer3, NULL);
  snprintf (buffer, 512, "\"%s\" %s %s %s %s %s %s %s %s %s",
            buffer4, input[0], input[1], input[2], input[3], input[4], input[5],
            input[6], input[7], output);
  g_free (buffer4);
  g_free (buffer3);
  g_free (buffer2);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: %s\n", buffer);
#endif
  system (buffer);

  // Checking the objective value function
  if (optimize->evaluator)
    {
      snprintf (result, 32, "result-%u-%u", simulation, experiment);
      buffer2 = g_path_get_dirname (optimize->evaluator);
      buffer3 = g_path_get_basename (optimize->evaluator);
      buffer4 = g_build_filename (buffer2, buffer3, NULL);
      snprintf (buffer, 512, "\"%s\" %s %s %s",
                buffer4, output, optimize->experiment[experiment], result);
      g_free (buffer4);
      g_free (buffer3);
      g_free (buffer2);
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_parse: %s\n", buffer);
#endif
      system (buffer);
      file_result = g_fopen (result, "r");
      e = atof (fgets (buffer, 512, file_result));
      fclose (file_result);
    }
  else
    {
      strcpy (result, "");
      file_result = g_fopen (output, "r");
      e = atof (fgets (buffer, 512, file_result));
      fclose (file_result);
    }

  // Removing files
#if !DEBUG_OPTIMIZE
  for (i = 0; i < optimize->ninputs; ++i)
    {
      if (optimize->file[i][0])
```

```
        {
          snprintf (buffer, 512, RM " %s", &input[i][0]);
          system (buffer);
        }
    }
  snprintf (buffer, 512, RM " %s %s", output, result);
  system (buffer);
#endif

  // Processing pending events
  show_pending ();

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: end\n");
#endif

  // Returning the objective function
  return e * optimize->weight[experiment];
}

double
optimize_norm_euclidian (unsigned int simulation)
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_euclidian: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = optimize_parse (simulation, i);
      e += ei * ei;
    }
  e = sqrt (e);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_euclidian: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_euclidian: end\n");
#endif
  return e;
}

double
optimize_norm_maximum (unsigned int simulation)
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_maximum: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = fabs (optimize_parse (simulation, i));
      e = fmax (e, ei);
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_maximum: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_maximum: end\n");
#endif
  return e;
}

double
optimize_norm_p (unsigned int simulation)
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_p: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = fabs (optimize_parse (simulation, i));
      e += pow (ei, optimize->p);
    }
  e = pow (e, 1. / optimize->p);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_p: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_p: end\n");
#endif
  return e;
}

double
optimize_norm_taxicab (unsigned int simulation)
```

```
{
  double e;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_taxicab: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    e += fabs (optimize_parse (simulation, i));
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_taxicab: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_taxicab: end\n");
#endif
  return e;
}

void
optimize_print ()
{
  unsigned int i;
  char buffer[512];
#if HAVE_MPI
  if (optimize->mpi_rank)
    return;
#endif
  printf ("%s\n", gettext ("Best result"));
  fprintf (optimize->file_result, "%s\n", gettext ("Best result"));
  printf ("error = %.15le\n", optimize->error_old[0]);
  fprintf (optimize->file_result, "error = %.15le\n", optimize->
error_old[0]);
  for (i = 0; i < optimize->nvariables; ++i)
    {
      snprintf (buffer, 512, "%s = %s\n",
                optimize->label[i], format[optimize->precision[i]]);
      printf (buffer, optimize->value_old[i]);
      fprintf (optimize->file_result, buffer, optimize->value_old[i]);
    }
  fflush (optimize->file_result);
}

void
optimize_save_variables (unsigned int simulation, double error)
{
  unsigned int i;
  char buffer[64];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_save_variables: start\n");
#endif
  for (i = 0; i < optimize->nvariables; ++i)
    {
      snprintf (buffer, 64, "%s ", format[optimize->precision[i]]);
      fprintf (optimize->file_variables, buffer,
               optimize->value[simulation * optimize->nvariables + i]);
    }
  fprintf (optimize->file_variables, "%.14le\n", error);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_save_variables: end\n");
#endif
}

void
optimize_best (unsigned int simulation, double value)
{
  unsigned int i, j;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best: start\n");
  fprintf (stderr, "optimize_best: nsaveds=%u nbest=%u\n",
           optimize->nsaveds, optimize->nbest);
#endif
  if (optimize->nsaveds < optimize->nbest
      || value < optimize->error_best[optimize->nsaveds - 1])
    {
      if (optimize->nsaveds < optimize->nbest)
        ++optimize->nsaveds;
      optimize->error_best[optimize->nsaveds - 1] = value;
      optimize->simulation_best[optimize->nsaveds - 1] = simulation;
      for (i = optimize->nsaveds; --i;)
        {
          if (optimize->error_best[i] < optimize->error_best[i - 1])
            {
              j = optimize->simulation_best[i];
              e = optimize->error_best[i];
              optimize->simulation_best[i] = optimize->
simulation_best[i - 1];
              optimize->error_best[i] = optimize->error_best[i - 1];
              optimize->simulation_best[i - 1] = j;
              optimize->error_best[i - 1] = e;
            }
          else
            break;
        }
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best: end\n");
#endif
}

void
optimize_sequential ()
{
  unsigned int i;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_sequential: start\n");
  fprintf (stderr, "optimize_sequential: nstart=%u nend=%u\n",
           optimize->nstart, optimize->nend);
#endif
  for (i = optimize->nstart; i < optimize->nend; ++i)
    {
      e = optimize_norm (i);
      optimize_best (i, e);
      optimize_save_variables (i, e);
      if (e < optimize->threshold)
        {
          optimize->stop = 1;
          break;
        }
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_sequential: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_sequential: end\n");
#endif
}

void *
optimize_thread (ParallelData * data)
{
  unsigned int i, thread;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: start\n");
#endif
  thread = data->thread;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: thread=%u start=%u end=%u\n", thread,
           optimize->thread[thread], optimize->thread[thread + 1]);
#endif
  for (i = optimize->thread[thread]; i < optimize->thread[thread + 1]; ++i)
    {
      e = optimize_norm (i);
      g_mutex_lock (mutex);
      optimize_best (i, e);
      optimize_save_variables (i, e);
      if (e < optimize->threshold)
        optimize->stop = 1;
      g_mutex_unlock (mutex);
      if (optimize->stop)
        break;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_thread: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: end\n");
#endif
  g_thread_exit (NULL);
  return NULL;
}

void
optimize_merge (unsigned int nsaveds, unsigned int *simulation_best,
                double *error_best)
{
  unsigned int i, j, k, s[optimize->nbest];
  double e[optimize->nbest];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_merge: start\n");
#endif
  i = j = k = 0;
  do
    {
      if (i == optimize->nsaveds)
        {
          s[k] = simulation_best[j];
          e[k] = error_best[j];
          ++j;
          ++k;
          if (j == nsaveds)
            break;
        }
      else if (j == nsaveds)
        {
          s[k] = optimize->simulation_best[i];
          e[k] = optimize->error_best[i];
          ++i;
          ++k;
          if (i == optimize->nsaveds)
            break;
        }
      else if (optimize->error_best[i] > error_best[j])
        {
          s[k] = simulation_best[j];
          e[k] = error_best[j];
          ++j;
          ++k;
        }
      else
        {
          s[k] = optimize->simulation_best[i];
          e[k] = optimize->error_best[i];
          ++i;
          ++k;
        }
    }
  while (k < optimize->nbest);
  optimize->nsaveds = k;
  memcpy (optimize->simulation_best, s, k * sizeof (unsigned int));
  memcpy (optimize->error_best, e, k * sizeof (double));
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_merge: end\n");
#endif
}

#if HAVE_MPI
void
optimize_synchronise ()
{
  unsigned int i, nsaveds, simulation_best[optimize->nbest], stop;
  double error_best[optimize->nbest];
  MPI_Status mpi_stat;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_synchronise: start\n");
#endif
  if (optimize->mpi_rank == 0)
    {
      for (i = 1; i < ntasks; ++i)
        {
          MPI_Recv (&nsaveds, 1, MPI_INT, i, 1, MPI_COMM_WORLD, &mpi_stat);
          MPI_Recv (simulation_best, nsaveds, MPI_INT, i, 1,
                    MPI_COMM_WORLD, &mpi_stat);
          MPI_Recv (error_best, nsaveds, MPI_DOUBLE, i, 1,
                    MPI_COMM_WORLD, &mpi_stat);
          optimize_merge (nsaveds, simulation_best, error_best);
          MPI_Recv (&stop, 1, MPI_UNSIGNED, i, 1, MPI_COMM_WORLD, &mpi_stat);
          if (stop)
            optimize->stop = 1;
        }
      for (i = 1; i < ntasks; ++i)
        MPI_Send (&optimize->stop, 1, MPI_UNSIGNED, i, 1, MPI_COMM_WORLD);
    }
  else
    {
      MPI_Send (&optimize->nsaveds, 1, MPI_INT, 0, 1, MPI_COMM_WORLD);
      MPI_Send (optimize->simulation_best, optimize->nsaveds, MPI_INT, 0, 1,
                MPI_COMM_WORLD);
      MPI_Send (optimize->error_best, optimize->nsaveds, MPI_DOUBLE, 0, 1,
                MPI_COMM_WORLD);
      MPI_Send (&optimize->stop, 1, MPI_UNSIGNED, 0, 1, MPI_COMM_WORLD);
      MPI_Recv (&stop, 1, MPI_UNSIGNED, 0, 1, MPI_COMM_WORLD, &mpi_stat);
      if (stop)
        optimize->stop = 1;
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_synchronise: end\n");
#endif
}
#endif
```

```
void
optimize_sweep ()
{
  unsigned int i, j, k, l;
  double e;
  GThread *thread[nthreads];
  ParallelData data[nthreads];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_sweep: start\n");
#endif
  for (i = 0; i < optimize->nsimulations; ++i)
    {
      k = i;
      for (j = 0; j < optimize->nvariables; ++j)
        {
          l = k % optimize->nsweeps[j];
          k /= optimize->nsweeps[j];
          e = optimize->rangemin[j];
          if (optimize->nsweeps[j] > 1)
            e += l * (optimize->rangemax[j] - optimize->rangemin[j])
              / (optimize->nsweeps[j] - 1);
          optimize->value[i * optimize->nvariables + j] = e;
        }
    }
  optimize->nsaveds = 0;
  if (nthreads <= 1)
    optimize_sequential ();
  else
    {
      for (i = 0; i < nthreads; ++i)
        {
          data[i].thread = i;
          thread[i] = g_thread_new (NULL, (void (*)) optimize_thread, &data[i]);
        }
      for (i = 0; i < nthreads; ++i)
        g_thread_join (thread[i]);
    }
#if HAVE_MPI
  // Communicating tasks results
  optimize_synchronise ();
#endif
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_sweep: end\n");
#endif
}

void
optimize_MonteCarlo ()
{
  unsigned int i, j;
  GThread *thread[nthreads];
  ParallelData data[nthreads];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_MonteCarlo: start\n");
#endif
  for (i = 0; i < optimize->nsimulations; ++i)
    for (j = 0; j < optimize->nvariables; ++j)
      optimize->value[i * optimize->nvariables + j]
        = optimize->rangemin[j] + gsl_rng_uniform (optimize->rng)
        * (optimize->rangemax[j] - optimize->rangemin[j]);
  optimize->nsaveds = 0;
  if (nthreads <= 1)
    optimize_sequential ();
  else
    {
      for (i = 0; i < nthreads; ++i)
        {
          data[i].thread = i;
          thread[i] = g_thread_new (NULL, (void (*)) optimize_thread, &data[i]);
        }
      for (i = 0; i < nthreads; ++i)
        g_thread_join (thread[i]);
    }
#if HAVE_MPI
  // Communicating tasks results
  optimize_synchronise ();
#endif
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_MonteCarlo: end\n");
#endif
}

void
optimize_best_direction (unsigned int simulation, double value)
{
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best_direction: start\n");
  fprintf (stderr,
           "optimize_best_direction: simulation=%u value=%.14le best=%.14le\n",
           simulation, value, optimize->error_best[0]);
#endif
  if (value < optimize->error_best[0])
    {
      optimize->error_best[0] = value;
      optimize->simulation_best[0] = simulation;
#if DEBUG_OPTIMIZE
      fprintf (stderr,
               "optimize_best_direction: BEST simulation=%u value=%.14le\n",
               simulation, value);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best_direction: end\n");
#endif
}

void
optimize_direction_sequential (unsigned int simulation)
{
  unsigned int i, j;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_sequential: start\n");
  fprintf (stderr, "optimize_direction_sequential: nstart_direction=%u "
           "nend_direction=%u\n",
           optimize->nstart_direction, optimize->nend_direction);
#endif
  for (i = optimize->nstart_direction; i < optimize->nend_direction; ++i)
    {
      j = simulation + i;
      e = optimize_norm (j);
      optimize_best_direction (j, e);
      optimize_save_variables (j, e);
      if (e < optimize->threshold)
        {
          optimize->stop = 1;
          break;
        }
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_direction_sequential: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_sequential: end\n");
#endif
}

void *
optimize_direction_thread (ParallelData * data)
{
  unsigned int i, thread;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: start\n");
#endif
  thread = data->thread;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: thread=%u start=%u end=%u\n",
           thread,
           optimize->thread_direction[thread],
           optimize->thread_direction[thread + 1]);
#endif
  for (i = optimize->thread_direction[thread];
       i < optimize->thread_direction[thread + 1]; ++i)
    {
      e = optimize_norm (i);
      g_mutex_lock (mutex);
      optimize_best_direction (i, e);
      optimize_save_variables (i, e);
      if (e < optimize->threshold)
        optimize->stop = 1;
      g_mutex_unlock (mutex);
      if (optimize->stop)
        break;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_direction_thread: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: end\n");
#endif
  g_thread_exit (NULL);
  return NULL;
}
```

```

double
optimize_estimate_direction_random (unsigned int variable,
                                    unsigned int estimate)
{
  double x;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_random: start\n");
#endif
  x = optimize->direction[variable]
    + (1. - 2. * gsl_rng_uniform (optimize->rng)) * optimize->step[variable];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_random: direction%u=%lg\n",
           variable, x);
  fprintf (stderr, "optimize_estimate_direction_random: end\n");
#endif
  return x;
}

double
optimize_estimate_direction_coordinates (unsigned int variable,
                                         unsigned int estimate)
{
  double x;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_coordinates: start\n");
#endif
  x = optimize->direction[variable];
  if (estimate >= (2 * variable) && estimate < (2 * variable + 2))
    {
      if (estimate & 1)
        x += optimize->step[variable];
      else
        x -= optimize->step[variable];
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr,
           "optimize_estimate_direction_coordinates: direction%u=%lg\n",
           variable, x);
  fprintf (stderr, "optimize_estimate_direction_coordinates: end\n");
#endif
  return x;
}

void
optimize_step_direction (unsigned int simulation)
{
  GThread *thread[nthreads_direction];
  ParallelData data[nthreads_direction];
  unsigned int i, j, k, b;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_step_direction: start\n");
#endif
  for (i = 0; i < optimize->nestimates; ++i)
    {
      k = (simulation + i) * optimize->nvariables;
      b = optimize->simulation_best[0] * optimize->nvariables;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_step_direction: simulation=%u best=%u\n",
               simulation + i, optimize->simulation_best[0]);
#endif
      for (j = 0; j < optimize->nvariables; ++j, ++k, ++b)
        {
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: estimate=%u best%u=%.14le\n",
                   i, j, optimize->value[b]);
#endif
          optimize->value[k]
            = optimize->value[b] + optimize_estimate_direction (j, i);
          optimize->value[k] = fmin (fmax (optimize->value[k],
                                           optimize->rangeminabs[j]),
                                     optimize->rangemaxabs[j]);
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: estimate=%u variable%u=%.14le\n",
                   i, j, optimize->value[k]);
#endif
        }
    }
  if (nthreads_direction == 1)
    optimize_direction_sequential (simulation);
  else
    {
      for (i = 0; i <= nthreads_direction; ++i)
        {
          optimize->thread_direction[i]
```

```
            = simulation + optimize->nstart_direction
            + i * (optimize->nend_direction - optimize->
nstart_direction)
            / nthreads_direction;
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: i=%u thread_direction=%u\n",
                   i, optimize->thread_direction[i]);
#endif
        }
      for (i = 0; i < nthreads_direction; ++i)
        {
          data[i].thread = i;
          thread[i] = g_thread_new
            (NULL, (void (*)) optimize_direction_thread, &data[i]);
        }
      for (i = 0; i < nthreads_direction; ++i)
        g_thread_join (thread[i]);
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_step_direction: end\n");
#endif
}

void
optimize_direction ()
{
  unsigned int i, j, k, b, s, adjust;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction: start\n");
#endif
  for (i = 0; i < optimize->nvariables; ++i)
    optimize->direction[i] = 0.;
  b = optimize->simulation_best[0] * optimize->nvariables;
  s = optimize->nsimulations;
  adjust = 1;
  for (i = 0; i < optimize->nsteps; ++i, s += optimize->nestimates, b = k)
    {
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_direction: step=%u old_best=%u\n",
               i, optimize->simulation_best[0]);
#endif
      optimize_step_direction (s);
      k = optimize->simulation_best[0] * optimize->nvariables;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_direction: step=%u best=%u\n",
               i, optimize->simulation_best[0]);
#endif
      if (k == b)
        {
          if (adjust)
            for (j = 0; j < optimize->nvariables; ++j)
              optimize->step[j] *= 0.5;
          for (j = 0; j < optimize->nvariables; ++j)
            optimize->direction[j] = 0.;
          adjust = 1;
        }
      else
        {
          for (j = 0; j < optimize->nvariables; ++j)
            {
#if DEBUG_OPTIMIZE
              fprintf (stderr,
                       "optimize_direction: best%u=%.14le old%u=%.14le\n",
                       j, optimize->value[k + j], j, optimize->value[b + j]);
#endif
              optimize->direction[j]
                = (1. - optimize->relaxation) * optimize->direction[j]
                + optimize->relaxation
                * (optimize->value[k + j] - optimize->value[b + j]);
#if DEBUG_OPTIMIZE
              fprintf (stderr, "optimize_direction: direction%u=%.14le\n",
                       j, optimize->direction[j]);
#endif
            }
          adjust = 0;
        }
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction: end\n");
#endif
}

double
optimize_genetic_objective (Entity * entity)
{
  unsigned int j;
  double objective;
  char buffer[64];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic_objective: start\n");
#endif
  for (j = 0; j < optimize->nvariables; ++j)
    {
      optimize->value[entity->id * optimize->nvariables + j]
        = genetic_get_variable (entity, optimize->genetic_variable + j);
    }
  objective = optimize_norm (entity->id);
  g_mutex_lock (mutex);
  for (j = 0; j < optimize->nvariables; ++j)
    {
      snprintf (buffer, 64, "%s ", format[optimize->precision[j]]);
      fprintf (optimize->file_variables, buffer,
               genetic_get_variable (entity, optimize->genetic_variable + j));
    }
  fprintf (optimize->file_variables, "%.14le\n", objective);
  g_mutex_unlock (mutex);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic_objective: end\n");
#endif
  return objective;
}

void
optimize_genetic ()
{
  char *best_genome;
  double best_objective, *best_variable;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic: start\n");
  fprintf (stderr, "optimize_genetic: ntasks=%u nthreads=%u\n", ntasks,
           nthreads);
  fprintf (stderr,
           "optimize_genetic: nvariables=%u population=%u generations=%u\n",
           optimize->nvariables, optimize->nsimulations, optimize->
niterations);
  fprintf (stderr,
           "optimize_genetic: mutation=%lg reproduction=%lg adaptation=%lg\n",
           optimize->mutation_ratio, optimize->reproduction_ratio,
           optimize->adaptation_ratio);
#endif
  genetic_algorithm_default (optimize->nvariables,
                             optimize->genetic_variable,
                             optimize->nsimulations,
                             optimize->niterations,
                             optimize->mutation_ratio,
                             optimize->reproduction_ratio,
                             optimize->adaptation_ratio,
                             optimize->seed,
                             optimize->threshold,
                             &optimize_genetic_objective,
                             &best_genome, &best_variable, &best_objective);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic: the best\n");
#endif
  optimize->error_old = (double *) g_malloc (sizeof (double));
  optimize->value_old
    = (double *) g_malloc (optimize->nvariables * sizeof (double));
  optimize->error_old[0] = best_objective;
  memcpy (optimize->value_old, best_variable,
          optimize->nvariables * sizeof (double));
  g_free (best_genome);
  g_free (best_variable);
  optimize_print ();
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic: end\n");
#endif
}

void
optimize_save_old ()
{
  unsigned int i, j;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_save_old: start\n");
  fprintf (stderr, "optimize_save_old: nsaveds=%u\n", optimize->nsaveds);
#endif
  memcpy (optimize->error_old, optimize->error_best,
          optimize->nbest * sizeof (double));
  for (i = 0; i < optimize->nbest; ++i)
    {
      j = optimize->simulation_best[i];
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_save_old: i=%u j=%u\n", i, j);
```

```
#endif
      memcpy (optimize->value_old + i * optimize->nvariables,
              optimize->value + j * optimize->nvariables,
              optimize->nvariables * sizeof (double));
    }
#if DEBUG_OPTIMIZE
  for (i = 0; i < optimize->nvariables; ++i)
    fprintf (stderr, "optimize_save_old: best variable %u=%lg\n",
             i, optimize->value_old[i]);
  fprintf (stderr, "optimize_save_old: end\n");
#endif
}

void
optimize_merge_old ()
{
  unsigned int i, j, k;
  double v[optimize->nbest * optimize->nvariables], e[optimize->
nbest],
    *enew, *eold;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_merge_old: start\n");
#endif
  enew = optimize->error_best;
  eold = optimize->error_old;
  i = j = k = 0;
  do
    {
      if (*enew < *eold)
        {
          memcpy (v + k * optimize->nvariables,
                  optimize->value
                  + optimize->simulation_best[i] * optimize->
nvariables,
                  optimize->nvariables * sizeof (double));
          e[k] = *enew;
          ++k;
          ++enew;
          ++i;
        }
      else
        {
          memcpy (v + k * optimize->nvariables,
                  optimize->value_old + j * optimize->nvariables,
                  optimize->nvariables * sizeof (double));
          e[k] = *eold;
          ++k;
          ++eold;
          ++j;
        }
    }
  while (k < optimize->nbest);
  memcpy (optimize->value_old, v, k * optimize->nvariables * sizeof (double));
  memcpy (optimize->error_old, e, k * sizeof (double));
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_merge_old: end\n");
#endif
}

void
optimize_refine ()
{
  unsigned int i, j;
  double d;
#if HAVE_MPI
  MPI_Status mpi_stat;
#endif
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_refine: start\n");
#endif
#if HAVE_MPI
  if (!optimize->mpi_rank)
    {
#endif
      for (j = 0; j < optimize->nvariables; ++j)
        {
          optimize->rangemin[j] = optimize->rangemax[j]
            = optimize->value_old[j];
        }
      for (i = 0; ++i < optimize->nbest;)
        {
          for (j = 0; j < optimize->nvariables; ++j)
            {
              optimize->rangemin[j]
                = fmin (optimize->rangemin[j],
                        optimize->value_old[i * optimize->nvariables + j]);
              optimize->rangemax[j]
```

```
                = fmax (optimize->rangemax[j],
                        optimize->value_old[i * optimize->nvariables + j]);
            }
        }
      for (j = 0; j < optimize->nvariables; ++j)
        {
          d = optimize->tolerance
            * (optimize->rangemax[j] - optimize->rangemin[j]);
          switch (optimize->algorithm)
            {
            case ALGORITHM_MONTE_CARLO:
              d *= 0.5;
              break;
            default:
              if (optimize->nsweeps[j] > 1)
                d /= optimize->nsweeps[j] - 1;
              else
                d = 0.;
            }
          optimize->rangemin[j] -= d;
          optimize->rangemin[j]
            = fmax (optimize->rangemin[j], optimize->rangeminabs[j]);
          optimize->rangemax[j] += d;
          optimize->rangemax[j]
            = fmin (optimize->rangemax[j], optimize->rangemaxabs[j]);
          printf ("%s min=%lg max=%lg\n", optimize->label[j],
                  optimize->rangemin[j], optimize->rangemax[j]);
          fprintf (optimize->file_result, "%s min=%lg max=%lg\n",
                   optimize->label[j], optimize->rangemin[j],
                   optimize->rangemax[j]);
        }
#if HAVE_MPI
      for (i = 1; i < ntasks; ++i)
        {
          MPI_Send (optimize->rangemin, optimize->nvariables, MPI_DOUBLE, i,
                    1, MPI_COMM_WORLD);
          MPI_Send (optimize->rangemax, optimize->nvariables, MPI_DOUBLE, i,
                    1, MPI_COMM_WORLD);
        }
    }
  else
    {
      MPI_Recv (optimize->rangemin, optimize->nvariables, MPI_DOUBLE, 0, 1,
                MPI_COMM_WORLD, &mpi_stat);
      MPI_Recv (optimize->rangemax, optimize->nvariables, MPI_DOUBLE, 0, 1,
                MPI_COMM_WORLD, &mpi_stat);
    }
#endif
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_refine: end\n");
#endif
}

void
optimize_step ()
{
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_step: start\n");
#endif
  optimize_algorithm ();
  if (optimize->nsteps)
    optimize_direction ();
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_step: end\n");
#endif
}

void
optimize_iterate ()
{
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_iterate: start\n");
#endif
  optimize->error_old = (double *) g_malloc (optimize->nbest * sizeof (double));
  optimize->value_old = (double *)
    g_malloc (optimize->nbest * optimize->nvariables * sizeof (double));
  optimize_step ();
  optimize_save_old ();
  optimize_refine ();
  optimize_print ();
  for (i = 1; i < optimize->niterations && !optimize->stop; ++i)
    {
      optimize_step ();
      optimize_merge_old ();
      optimize_refine ();
      optimize_print ();
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_iterate: end\n");
#endif
}

void
optimize_free ()
{
  unsigned int i, j;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_free: start\n");
#endif
  for (j = 0; j < optimize->ninputs; ++j)
    {
      for (i = 0; i < optimize->nexperiments; ++i)
        g_mapped_file_unref (optimize->file[j][i]);
      g_free (optimize->file[j]);
    }
  g_free (optimize->error_old);
  g_free (optimize->value_old);
  g_free (optimize->value);
  g_free (optimize->genetic_variable);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_free: end\n");
#endif
}

void
optimize_open ()
{
  GTimeZone *tz;
  GDateTime *t0, *t;
  unsigned int i, j;

#if DEBUG_OPTIMIZE
  char *buffer;
  fprintf (stderr, "optimize_open: start\n");
#endif

  // Getting initial time
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: getting initial time\n");
#endif
  tz = g_time_zone_new_utc ();
  t0 = g_date_time_new_now (tz);

  // Obtaining and initing the pseudo-random numbers generator seed
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: getting initial seed\n");
#endif
  if (optimize->seed == DEFAULT_RANDOM_SEED)
    optimize->seed = input->seed;
  gsl_rng_set (optimize->rng, optimize->seed);

  // Replacing the working directory
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: replacing the working directory\n");
#endif
  g_chdir (input->directory);

  // Getting results file names
  optimize->result = input->result;
  optimize->variables = input->variables;

  // Obtaining the simulator file
  optimize->simulator = input->simulator;

  // Obtaining the evaluator file
  optimize->evaluator = input->evaluator;

  // Reading the algorithm
  optimize->algorithm = input->algorithm;
  switch (optimize->algorithm)
    {
    case ALGORITHM_MONTE_CARLO:
      optimize_algorithm = optimize_MonteCarlo;
      break;
    case ALGORITHM_SWEEP:
      optimize_algorithm = optimize_sweep;
      break;
    default:
      optimize_algorithm = optimize_genetic;
      optimize->mutation_ratio = input->mutation_ratio;
      optimize->reproduction_ratio = input->reproduction_ratio;
      optimize->adaptation_ratio = input->adaptation_ratio;
    }
  optimize->nvariables = input->nvariables;
  optimize->nsimulations = input->nsimulations;
  optimize->niterations = input->niterations;
  optimize->nbest = input->nbest;
  optimize->tolerance = input->tolerance;
  optimize->nsteps = input->nsteps;
  optimize->nestimates = 0;
  optimize->threshold = input->threshold;
  optimize->stop = 0;
  if (input->nsteps)
    {
      optimize->relaxation = input->relaxation;
      switch (input->direction)
        {
        case DIRECTION_METHOD_COORDINATES:
          optimize->nestimates = 2 * optimize->nvariables;
          optimize_estimate_direction =
optimize_estimate_direction_coordinates;
          break;
        default:
          optimize->nestimates = input->nestimates;
          optimize_estimate_direction =
optimize_estimate_direction_random;
        }
    }

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: nbest=%u\n", optimize->nbest);
#endif
  optimize->simulation_best
    = (unsigned int *) alloca (optimize->nbest * sizeof (unsigned int));
  optimize->error_best = (double *) alloca (optimize->nbest * sizeof (double));

  // Reading the experimental data
#if DEBUG_OPTIMIZE
  buffer = g_get_current_dir ();
  fprintf (stderr, "optimize_open: current directory=%s\n", buffer);
  g_free (buffer);
#endif
  optimize->nexperiments = input->nexperiments;
  optimize->ninputs = input->experiment->ninputs;
  optimize->experiment
    = (char **) alloca (input->nexperiments * sizeof (char *));
  optimize->weight = (double *) alloca (input->nexperiments * sizeof (double));
  for (i = 0; i < input->experiment->ninputs; ++i)
    optimize->file[i] = (GMappedFile **)
      g_malloc (input->nexperiments * sizeof (GMappedFile *));
  for (i = 0; i < input->nexperiments; ++i)
    {
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_open: i=%u\n", i);
#endif
      optimize->experiment[i] = input->experiment[i].name;
      optimize->weight[i] = input->experiment[i].weight;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_open: experiment=%s weight=%lg\n",
               optimize->experiment[i], optimize->weight[i]);
#endif
      for (j = 0; j < input->experiment->ninputs; ++j)
        {
#if DEBUG_OPTIMIZE
          fprintf (stderr, "optimize_open: template%u\n", j + 1);
#endif
          optimize->file[j][i]
            = g_mapped_file_new (input->experiment[i].template[j], 0, NULL);
        }
    }

  // Reading the variables data
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: reading variables\n");
#endif
  optimize->label = (char **) alloca (input->nvariables * sizeof (char *));
  j = input->nvariables * sizeof (double);
  optimize->rangemin = (double *) alloca (j);
  optimize->rangeminabs = (double *) alloca (j);
  optimize->rangemax = (double *) alloca (j);
  optimize->rangemaxabs = (double *) alloca (j);
  optimize->step = (double *) alloca (j);
  j = input->nvariables * sizeof (unsigned int);
  optimize->precision = (unsigned int *) alloca (j);
  optimize->nsweeps = (unsigned int *) alloca (j);
  optimize->nbits = (unsigned int *) alloca (j);
  for (i = 0; i < input->nvariables; ++i)
    {
      optimize->label[i] = input->variable[i].name;
      optimize->rangemin[i] = input->variable[i].rangemin;
      optimize->rangeminabs[i] = input->variable[i].rangeminabs;
      optimize->rangemax[i] = input->variable[i].rangemax;
      optimize->rangemaxabs[i] = input->variable[i].rangemaxabs;
      optimize->precision[i] = input->variable[i].precision;
      optimize->step[i] = input->variable[i].step;
      optimize->nsweeps[i] = input->variable[i].nsweeps;
      optimize->nbits[i] = input->variable[i].nbits;
    }
  if (input->algorithm == ALGORITHM_SWEEP)
    {
      optimize->nsimulations = 1;
      for (i = 0; i < input->nvariables; ++i)
        {
          if (input->algorithm == ALGORITHM_SWEEP)
            {
              optimize->nsimulations *= optimize->nsweeps[i];
#if DEBUG_OPTIMIZE
              fprintf (stderr, "optimize_open: nsweeps=%u nsimulations=%u\n",
                       optimize->nsweeps[i], optimize->nsimulations);
#endif
            }
        }
    }
  if (optimize->nsteps)
    optimize->direction
      = (double *) alloca (optimize->nvariables * sizeof (double));

  // Setting error norm
  switch (input->norm)
    {
    case ERROR_NORM_EUCLIDIAN:
      optimize_norm = optimize_norm_euclidian;
      break;
    case ERROR_NORM_MAXIMUM:
      optimize_norm = optimize_norm_maximum;
      break;
    case ERROR_NORM_P:
      optimize_norm = optimize_norm_p;
      optimize->p = input->p;
      break;
    default:
      optimize_norm = optimize_norm_taxicab;
    }

  // Allocating values
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: allocating variables\n");
  fprintf (stderr, "optimize_open: nvariables=%u algorithm=%u\n",
           optimize->nvariables, optimize->algorithm);
#endif
  optimize->genetic_variable = NULL;
  if (optimize->algorithm == ALGORITHM_GENETIC)
    {
      optimize->genetic_variable = (GeneticVariable *)
        g_malloc (optimize->nvariables * sizeof (GeneticVariable));
      for (i = 0; i < optimize->nvariables; ++i)
        {
#if DEBUG_OPTIMIZE
          fprintf (stderr, "optimize_open: i=%u min=%lg max=%lg nbits=%u\n",
                   i, optimize->rangemin[i], optimize->rangemax[i],
                   optimize->nbits[i]);
#endif
          optimize->genetic_variable[i].minimum = optimize->rangemin[i];
          optimize->genetic_variable[i].maximum = optimize->rangemax[i];
          optimize->genetic_variable[i].nbits = optimize->nbits[i];
        }
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: nvariables=%u nsimulations=%u\n",
           optimize->nvariables, optimize->nsimulations);
#endif
  optimize->value = (double *)
    g_malloc ((optimize->nsimulations
               + optimize->nestimates * optimize->nsteps)
              * optimize->nvariables * sizeof (double));

  // Calculating simulations to perform for each task
#if HAVE_MPI
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: rank=%u ntasks=%u\n",
           optimize->mpi_rank, ntasks);
#endif
  optimize->nstart = optimize->mpi_rank * optimize->nsimulations /
```

```
ntasks;
  optimize->nend = (1 + optimize->mpi_rank) * optimize->nsimulations /
ntasks;
  if (optimize->nsteps)
    {
      optimize->nstart_direction
        = optimize->mpi_rank * optimize->nestimates / ntasks;
      optimize->nend_direction
        = (1 + optimize->mpi_rank) * optimize->nestimates /
ntasks;
    }
#else
  optimize->nstart = 0;
  optimize->nend = optimize->nsimulations;
  if (optimize->nsteps)
    {
      optimize->nstart_direction = 0;
      optimize->nend_direction = optimize->nestimates;
    }
#endif
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: nstart=%u nend=%u\n", optimize->nstart,
           optimize->nend);
#endif

  // Calculating simulations to perform for each thread
  optimize->thread
    = (unsigned int *) alloca ((1 + nthreads) * sizeof (unsigned int));
  for (i = 0; i <= nthreads; ++i)
    {
      optimize->thread[i] = optimize->nstart
        + i * (optimize->nend - optimize->nstart) / nthreads;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_open: i=%u thread=%u\n", i,
               optimize->thread[i]);
#endif
    }
  if (optimize->nsteps)
    optimize->thread_direction = (unsigned int *)
      alloca ((1 + nthreads_direction) * sizeof (unsigned int));

  // Opening result files
  optimize->file_result = g_fopen (optimize->result, "w");
  optimize->file_variables = g_fopen (optimize->variables, "w");

  // Performing the algorithm
  switch (optimize->algorithm)
    {
      // Genetic algorithm
    case ALGORITHM_GENETIC:
      optimize_genetic ();
      break;

      // Iterative algorithm
    default:
      optimize_iterate ();
    }

  // Getting calculation time
  t = g_date_time_new_now (tz);
  optimize->calculation_time = 0.000001 * g_date_time_difference (t, t0);
  g_date_time_unref (t);
  g_date_time_unref (t0);
  g_time_zone_unref (tz);
  printf ("%s = %.6lg s\n",
          gettext ("Calculation time"), optimize->calculation_time);
  fprintf (optimize->file_result, "%s = %.6lg s\n",
           gettext ("Calculation time"), optimize->calculation_time);

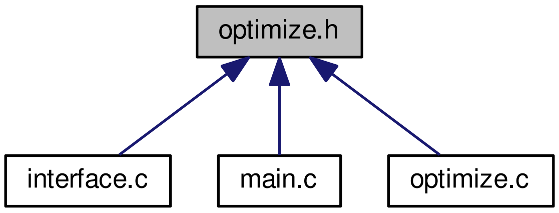
  // Closing result files
  fclose (optimize->file_variables);
  fclose (optimize->file_result);

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_open: end\n");
#endif
}
```

5.19 optimize.h File Reference

Header file to define the optimization functions.

This graph shows which files directly or indirectly include this file:



Data Structures

- struct Optimize

  Struct to define the optimization ation data.
- struct ParallelData

  Struct to pass to the GThreads parallelized function.

Functions

- void optimize_input (unsigned int simulation, char ∗input, GMappedFile ∗template)

  Function to write the simulation input file.
- double optimize_parse (unsigned int simulation, unsigned int experiment)

  Function to parse input files, simulating and calculating the \ objective function.
- double optimize_norm_euclidian (unsigned int simulation)

  Function to calculate the Euclidian error norm.
- double optimize_norm_maximum (unsigned int simulation)

  Function to calculate the maximum error norm.
- double optimize_norm_p (unsigned int simulation)

  Function to calculate the P error norm.
- double optimize_norm_taxicab (unsigned int simulation)

  Function to calculate the taxicab error norm.
- void optimize_print ()

  Function to print the results.
- void optimize_save_variables (unsigned int simulation, double error)

  Function to save in a file the variables and the error.
- void optimize_best (unsigned int simulation, double value)

  Function to save the best simulations.
- void optimize_sequential ()

  Function to optimize sequentially.
- void ∗ optimize_thread (ParallelData ∗data)

  Function to optimize on a thread.
- void optimize_merge (unsigned int nsaveds, unsigned int ∗simulation_best, double ∗error_best)

  Function to merge the 2 optimization results.
- void optimize_synchronise ()

Function to synchronise the optimization results of MPI tasks.
- void optimize_sweep ()

  Function to optimize with the sweep algorithm.
- void optimize_MonteCarlo ()

  Function to optimize with the Monte-Carlo algorithm.
- void optimize_best_direction (unsigned int simulation, double value)

  Function to save the best simulation in a direction search method.
- void **optimize_direction_sequential** ()
- void ∗ optimize_direction_thread (ParallelData ∗data)

  Function to estimate the direction search on a thread.
- double optimize_estimate_direction_random (unsigned int variable, unsigned int estimate)

  Function to estimate a component of the direction search vector.
- double optimize_estimate_direction_coordinates (unsigned int variable, unsigned int estimate)

  Function to estimate a component of the direction search vector.
- void optimize_step_direction (unsigned int simulation)

  Function to do a step of the direction search method.
- void optimize_direction ()

  Function to optimize with a direction search method.
- double optimize_genetic_objective (Entity ∗entity)

  Function to calculate the objective function of an entity.
- void optimize_genetic ()

  Function to optimize with the genetic algorithm.
- void optimize_save_old ()

  Function to save the best results on iterative methods.
- void optimize_merge_old ()

  Function to merge the best results with the previous step best results on iterative methods.
- void optimize_refine ()

  Function to refine the search ranges of the variables in iterative algorithms.
- void optimize_step ()

  Function to do a step of the iterative algorithm.
- void optimize_iterate ()

  Function to iterate the algorithm.
- void optimize_free ()

  Function to free the memory used by the Optimize struct.
- void optimize_open ()

  Function to open and perform a optimization.

Variables

- int ntasks

  Number of tasks.
- unsigned int nthreads

  Number of threads.
- unsigned int nthreads_direction

  Number of threads for the direction search method.
- GMutex mutex [1]

  Mutex struct.
- void(∗ optimize_algorithm)()

  Pointer to the function to perform a optimization algorithm step.
- double(∗ optimize_estimate_direction)(unsigned int variable, unsigned int estimate)

Pointer to the function to estimate the direction.

- double(∗ optimize_norm)(unsigned int simulation)

  Pointer to the error norm function.

- Optimize optimize [1]

  Optimization data.

- const xmlChar ∗ result_name

  Name of the result file.

- const xmlChar ∗ variables_name

  Name of the variables file.

5.19.1 Detailed Description

Header file to define the optimization functions.

Authors

Javier Burguete.

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Definition in file optimize.h.

5.19.2 Function Documentation

5.19.2.1 void optimize_best (unsigned int *simulation,* double *value*)

Function to save the best simulations.

Parameters

simulation	Simulation number.
value	Objective function value.

Definition at line 461 of file optimize.c.

```
{
  unsigned int i, j;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best: start\n");
  fprintf (stderr, "optimize_best: nsaveds=%u nbest=%u\n",
           optimize->nsaveds, optimize->nbest);
#endif
  if (optimize->nsaveds < optimize->nbest
      || value < optimize->error_best[optimize->nsaveds - 1])
    {
      if (optimize->nsaveds < optimize->nbest)
        ++optimize->nsaveds;
      optimize->error_best[optimize->nsaveds - 1] = value;
      optimize->simulation_best[optimize->nsaveds - 1] = simulation;
      for (i = optimize->nsaveds; --i;)
```

```
        {
          if (optimize->error_best[i] < optimize->
error_best[i - 1])
            {
              j = optimize->simulation_best[i];
              e = optimize->error_best[i];
              optimize->simulation_best[i] = optimize->
simulation_best[i - 1];
              optimize->error_best[i] = optimize->
error_best[i - 1];
              optimize->simulation_best[i - 1] = j;
              optimize->error_best[i - 1] = e;
            }
          else
            break;
        }
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best: end\n");
#endif
}
```

5.19.2.2 void optimize_best_direction (unsigned int *simulation,* double *value*)

Function to save the best simulation in a direction search method.

Parameters

simulation	Simulation number.
value	Objective function value.

Definition at line 786 of file optimize.c.

```
{
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best_direction: start\n");
  fprintf (stderr,
           "optimize_best_direction: simulation=%u value=%.14le best=%.14le\n",
           simulation, value, optimize->error_best[0]);
#endif
  if (value < optimize->error_best[0])
    {
      optimize->error_best[0] = value;
      optimize->simulation_best[0] = simulation;
#if DEBUG_OPTIMIZE
      fprintf (stderr,
               "optimize_best_direction: BEST simulation=%u value=%.14le\n",
               simulation, value);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_best_direction: end\n");
#endif
}
```

5.19.2.3 void∗ optimize_direction_thread (ParallelData ∗ *data*)

Function to estimate the direction search on a thread.

Parameters

data	Function data.

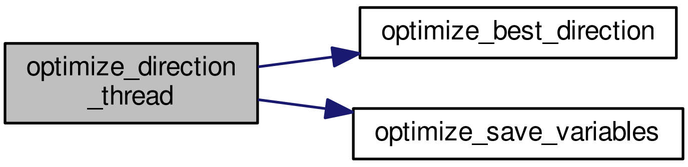
Returns

NULL

Definition at line 854 of file optimize.c.

```
{
  unsigned int i, thread;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: start\n");
#endif
  thread = data->thread;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: thread=%u start=%u end=%u\n",
           thread,
           optimize->thread_direction[thread],
           optimize->thread_direction[thread + 1]);
#endif
  for (i = optimize->thread_direction[thread];
       i < optimize->thread_direction[thread + 1]; ++i)
    {
      e = optimize_norm (i);
      g_mutex_lock (mutex);
      optimize_best_direction (i, e);
      optimize_save_variables (i, e);
      if (e < optimize->threshold)
        optimize->stop = 1;
      g_mutex_unlock (mutex);
      if (optimize->stop)
        break;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_direction_thread: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_direction_thread: end\n");
#endif
  g_thread_exit (NULL);
  return NULL;
}
```

Here is the call graph for this function:



5.19.2.4 double optimize_estimate_direction_coordinates (unsigned int *variable*, unsigned int *estimate*)

Function to estimate a component of the direction search vector.

Parameters

variable	Variable number.
estimate	Estimate number.

Definition at line 928 of file optimize.c.

```
{
  double x;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_coordinates: start\n");
#endif
  x = optimize->direction[variable];
  if (estimate >= (2 * variable) && estimate < (2 * variable + 2))
    {
      if (estimate & 1)
        x += optimize->step[variable];
      else
        x -= optimize->step[variable];
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr,
           "optimize_estimate_direction_coordinates: direction%u=%lg\n",
           variable, x);
  fprintf (stderr, "optimize_estimate_direction_coordinates: end\n");
#endif
  return x;
}
```

5.19.2.5 double optimize_estimate_direction_random (unsigned int *variable,* unsigned int *estimate*)

Function to estimate a component of the direction search vector.

Parameters

variable	Variable number.
estimate	Estimate number.

Definition at line 901 of file optimize.c.

```
{
  double x;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_random: start\n");
#endif
  x = optimize->direction[variable]
    + (1. - 2. * gsl_rng_uniform (optimize->rng)) * optimize->
step[variable];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_estimate_direction_random: direction%u=%lg\n",
           variable, x);
  fprintf (stderr, "optimize_estimate_direction_random: end\n");
#endif
  return x;
}
```

5.19.2.6 double optimize_genetic_objective (Entity ∗ *entity*)

Function to calculate the objective function of an entity.

Parameters

entity	entity data.

Returns

objective function value.

Definition at line 1095 of file optimize.c.

```
{
  unsigned int j;
  double objective;
  char buffer[64];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic_objective: start\n");
#endif
  for (j = 0; j < optimize->nvariables; ++j)
    {
      optimize->value[entity->id * optimize->nvariables + j]
        = genetic_get_variable (entity, optimize->genetic_variable + j);
    }
  objective = optimize_norm (entity->id);
  g_mutex_lock (mutex);
  for (j = 0; j < optimize->nvariables; ++j)
    {
      snprintf (buffer, 64, "%s ", format[optimize->precision[j]]);
      fprintf (optimize->file_variables, buffer,
               genetic_get_variable (entity, optimize->genetic_variable + j));
    }
  fprintf (optimize->file_variables, "%.14le\n", objective);
  g_mutex_unlock (mutex);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_genetic_objective: end\n");
#endif
  return objective;
}
```

5.19.2.7 void optimize_input (unsigned int *simulation*, char ∗ *input*, GMappedFile ∗ *template*)

Function to write the simulation input file.

Parameters

simulation	Simulation number.
input	Input file name.
template	Template of the input file name.

Definition at line 102 of file optimize.c.

```
{
  unsigned int i;
  char buffer[32], value[32], *buffer2, *buffer3, *content;
  FILE *file;
  gsize length;
  GRegex *regex;

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: start\n");
#endif

  // Checking the file
  if (!template)
    goto optimize_input_end;

  // Opening template
  content = g_mapped_file_get_contents (template);
  length = g_mapped_file_get_length (template);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: length=%lu\ncontent:\n%s", length, content);
#endif
  file = g_fopen (input, "w");

  // Parsing template
  for (i = 0; i < optimize->nvariables; ++i)
    {
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_input: variable=%u\n", i);
#endif
      snprintf (buffer, 32, "@variable%u@", i + 1);
      regex = g_regex_new (buffer, 0, 0, NULL);
      if (i == 0)
        {
          buffer2 = g_regex_replace_literal (regex, content, length, 0,
                                             optimize->label[i], 0, NULL);
#if DEBUG_OPTIMIZE
          fprintf (stderr, "optimize_input: buffer2\n%s", buffer2);
#endif
        }
      else
        {
          length = strlen (buffer3);
          buffer2 = g_regex_replace_literal (regex, buffer3, length, 0,
                                             optimize->label[i], 0, NULL);
          g_free (buffer3);
        }
      g_regex_unref (regex);
      length = strlen (buffer2);
      snprintf (buffer, 32, "@value%u@", i + 1);
      regex = g_regex_new (buffer, 0, 0, NULL);
      snprintf (value, 32, format[optimize->precision[i]],
                optimize->value[simulation * optimize->
nvariables + i]);

#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_input: value=%s\n", value);
#endif
      buffer3 = g_regex_replace_literal (regex, buffer2, length, 0, value,
                                         0, NULL);
      g_free (buffer2);
      g_regex_unref (regex);
    }

  // Saving input file
  fwrite (buffer3, strlen (buffer3), sizeof (char), file);
  g_free (buffer3);
  fclose (file);

optimize_input_end:
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_input: end\n");
#endif
  return;
}
```

5.19.2.8 void optimize_merge (unsigned int *nsaveds*, unsigned int ∗ *simulation_best*, double ∗ *error_best*)

Function to merge the 2 optimization results.

Parameters

nsaveds	Number of saved results.
simulation_best	Array of best simulation numbers.
error_best	Array of best objective function values.

Definition at line 584 of file optimize.c.

```
{
  unsigned int i, j, k, s[optimize->nbest];
  double e[optimize->nbest];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_merge: start\n");
#endif
  i = j = k = 0;
  do
    {
      if (i == optimize->nsaveds)
        {
          s[k] = simulation_best[j];
          e[k] = error_best[j];
          ++j;
          ++k;
          if (j == nsaveds)
            break;
        }
      else if (j == nsaveds)
        {
          s[k] = optimize->simulation_best[i];
          e[k] = optimize->error_best[i];
          ++i;
          ++k;
          if (i == optimize->nsaveds)
            break;
        }
      else if (optimize->error_best[i] > error_best[j])
        {
          s[k] = simulation_best[j];
          e[k] = error_best[j];
          ++j;
          ++k;
        }
      else
        {
          s[k] = optimize->simulation_best[i];
          e[k] = optimize->error_best[i];
          ++i;
          ++k;
        }
    }
  while (k < optimize->nbest);
  optimize->nsaveds = k;
  memcpy (optimize->simulation_best, s, k * sizeof (unsigned int));
  memcpy (optimize->error_best, e, k * sizeof (double));
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_merge: end\n");
#endif
}
```

5.19.2.9 double optimize_norm_euclidian (unsigned int *simulation*)

Function to calculate the Euclidian error norm.

Parameters

simulation	simulation number.

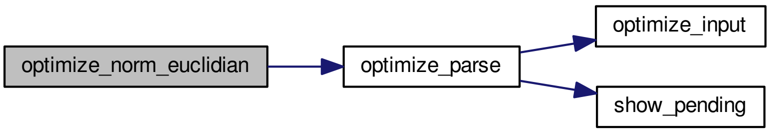
Returns

Euclidian error norm.

Definition at line 294 of file optimize.c.

```
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_euclidian: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = optimize_parse (simulation, i);
      e += ei * ei;
    }
  e = sqrt (e);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_euclidian: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_euclidian: end\n");
#endif
  return e;
}
```

Here is the call graph for this function:



5.19.2.10 double optimize_norm_maximum (unsigned int *simulation*)

Function to calculate the maximum error norm.

Parameters

simulation	simulation number.

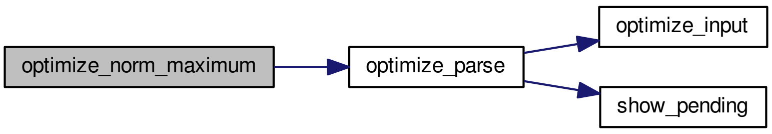
Returns

Maximum error norm.

Definition at line 323 of file optimize.c.

```
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_maximum: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = fabs (optimize_parse (simulation, i));
      e = fmax (e, ei);
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_maximum: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_maximum: end\n");
#endif
  return e;
}
```

Here is the call graph for this function:



5.19.2.11 double optimize_norm_p (unsigned int *simulation*)

Function to calculate the P error norm.

Parameters

simulation	simulation number.

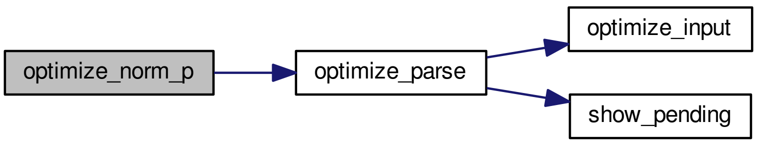
Returns

P error norm.

Definition at line 351 of file optimize.c.

```
{
  double e, ei;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_p: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    {
      ei = fabs (optimize_parse (simulation, i));
      e += pow (ei, optimize->p);
    }
  e = pow (e, 1. / optimize->p);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_p: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_p: end\n");
#endif
  return e;
}
```

Here is the call graph for this function:



5.19.2.12 double optimize_norm_taxicab (unsigned int *simulation*)

Function to calculate the taxicab error norm.

Parameters

simulation	simulation number.

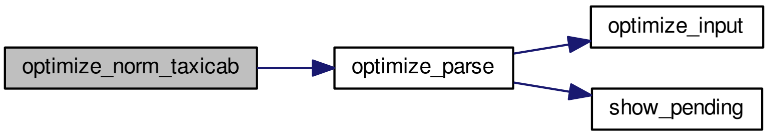
Returns

Taxicab error norm.

Definition at line 380 of file optimize.c.

```
{
  double e;
  unsigned int i;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_taxicab: start\n");
#endif
  e = 0.;
  for (i = 0; i < optimize->nexperiments; ++i)
    e += fabs (optimize_parse (simulation, i));
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_norm_taxicab: error=%lg\n", e);
  fprintf (stderr, "optimize_norm_taxicab: end\n");
#endif
  return e;
}
```

Here is the call graph for this function:



5.19.2.13 double optimize_parse (unsigned int *simulation,* unsigned int *experiment*)

Function to parse input files, simulating and calculating the \ objective function.

Parameters

simulation	Simulation number.
experiment	Experiment number.

Returns

Objective function value.

Definition at line 188 of file optimize.c.

```
{
  unsigned int i;
  double e;
  char buffer[512], input[MAX_NINPUTS][32], output[32], result[32], *buffer2,
    *buffer3, *buffer4;
  FILE *file_result;

#if DEBUG_OPTIMIZE
```

```
  fprintf (stderr, "optimize_parse: start\n");
  fprintf (stderr, "optimize_parse: simulation=%u experiment=%u\n", simulation,
           experiment);
#endif

  // Opening input files
  for (i = 0; i < optimize->ninputs; ++i)
    {
      snprintf (&input[i][0], 32, "input-%u-%u-%u", i, simulation, experiment);
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_parse: i=%u input=%s\n", i, &input[i][0]);
#endif
      optimize_input (simulation, &input[i][0], optimize->
file[i][experiment]);
    }
  for (; i < MAX_NINPUTS; ++i)
    strcpy (&input[i][0], "");
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: parsing end\n");
#endif

  // Performing the simulation
  snprintf (output, 32, "output-%u-%u", simulation, experiment);
  buffer2 = g_path_get_dirname (optimize->simulator);
  buffer3 = g_path_get_basename (optimize->simulator);
  buffer4 = g_build_filename (buffer2, buffer3, NULL);
  snprintf (buffer, 512, "\"%s\" %s %s %s %s %s %s %s %s %s",
            buffer4, input[0], input[1], input[2], input[3], input[4], input[5],
            input[6], input[7], output);
  g_free (buffer4);
  g_free (buffer3);
  g_free (buffer2);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: %s\n", buffer);
#endif
  system (buffer);

  // Checking the objective value function
  if (optimize->evaluator)
    {
      snprintf (result, 32, "result-%u-%u", simulation, experiment);
      buffer2 = g_path_get_dirname (optimize->evaluator);
      buffer3 = g_path_get_basename (optimize->evaluator);
      buffer4 = g_build_filename (buffer2, buffer3, NULL);
      snprintf (buffer, 512, "\"%s\" %s %s %s",
                buffer4, output, optimize->experiment[experiment], result);
      g_free (buffer4);
      g_free (buffer3);
      g_free (buffer2);
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_parse: %s\n", buffer);
#endif
      system (buffer);
      file_result = g_fopen (result, "r");
      e = atof (fgets (buffer, 512, file_result));
      fclose (file_result);
    }
  else
    {
      strcpy (result, "");
      file_result = g_fopen (output, "r");
      e = atof (fgets (buffer, 512, file_result));
      fclose (file_result);
    }

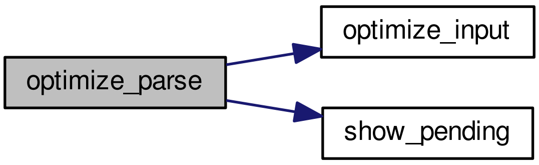
  // Removing files
#if !DEBUG_OPTIMIZE
  for (i = 0; i < optimize->ninputs; ++i)
    {
      if (optimize->file[i][0])
        {
          snprintf (buffer, 512, RM " %s", &input[i][0]);
          system (buffer);
        }
    }
  snprintf (buffer, 512, RM " %s %s", output, result);
  system (buffer);
#endif

  // Processing pending events
  show_pending ();

#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_parse: end\n");
#endif

  // Returning the objective function
  return e * optimize->weight[experiment];
}
```

Here is the call graph for this function:



5.19.2.14 void optimize_save_variables (unsigned int *simulation,* double *error*)

Function to save in a file the variables and the error.

Parameters

simulation	Simulation number.
error	Error value.

Definition at line 433 of file optimize.c.

```
{
  unsigned int i;
  char buffer[64];
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_save_variables: start\n");
#endif
  for (i = 0; i < optimize->nvariables; ++i)
    {
      snprintf (buffer, 64, "%s ", format[optimize->precision[i]]);
      fprintf (optimize->file_variables, buffer,
               optimize->value[simulation * optimize->
nvariables + i]);
    }
  fprintf (optimize->file_variables, "%.14le\n", error);
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_save_variables: end\n");
#endif
}
```

5.19.2.15 void optimize_step_direction (unsigned int *simulation*)

Function to do a step of the direction search method.

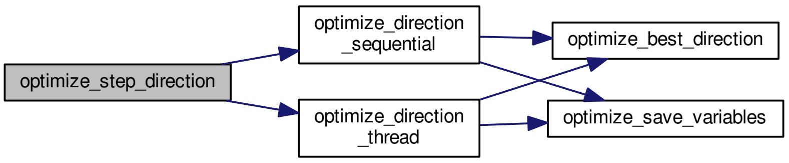
Parameters

simulation	Simulation number.

Definition at line 959 of file optimize.c.

```
{
  GThread *thread[nthreads_direction];
  ParallelData data[nthreads_direction];
  unsigned int i, j, k, b;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_step_direction: start\n");
#endif
  for (i = 0; i < optimize->nestimates; ++i)
    {
      k = (simulation + i) * optimize->nvariables;
      b = optimize->simulation_best[0] * optimize->nvariables;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_step_direction: simulation=%u best=%u\n",
               simulation + i, optimize->simulation_best[0]);
#endif
      for (j = 0; j < optimize->nvariables; ++j, ++k, ++b)
        {
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: estimate=%u best%u=%.14le\n",
                   i, j, optimize->value[b]);
#endif
          optimize->value[k]
            = optimize->value[b] + optimize_estimate_direction (j, i);
          optimize->value[k] = fmin (fmax (optimize->value[k],
                                           optimize->rangeminabs[j]),
                                     optimize->rangemaxabs[j]);
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: estimate=%u variable%u=%.14le\n",
                   i, j, optimize->value[k]);
#endif
        }
    }
  if (nthreads_direction == 1)
    optimize_direction_sequential (simulation);
  else
    {
      for (i = 0; i <= nthreads_direction; ++i)
        {
          optimize->thread_direction[i]
            = simulation + optimize->nstart_direction
            + i * (optimize->nend_direction - optimize->nstart_direction)
            / nthreads_direction;
#if DEBUG_OPTIMIZE
          fprintf (stderr,
                   "optimize_step_direction: i=%u thread_direction=%u\n",
                   i, optimize->thread_direction[i]);
#endif
        }
      for (i = 0; i < nthreads_direction; ++i)
        {
          data[i].thread = i;
          thread[i] = g_thread_new
            (NULL, (void (*)) optimize_direction_thread, &data[i]);
        }
      for (i = 0; i < nthreads_direction; ++i)
        g_thread_join (thread[i]);
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_step_direction: end\n");
#endif
}
```

Here is the call graph for this function:



5.19.2.16 void∗ optimize_thread (ParallelData ∗ *data*)

Function to optimize on a thread.

Parameters

data	Function data.

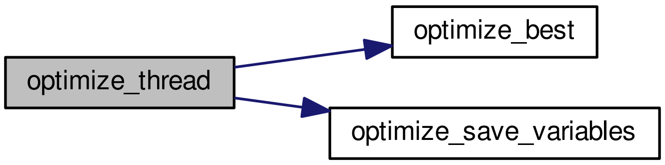
Returns

NULL

Definition at line 538 of file optimize.c.

```
{
  unsigned int i, thread;
  double e;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: start\n");
#endif
  thread = data->thread;
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: thread=%u start=%u end=%u\n", thread,
           optimize->thread[thread], optimize->thread[thread + 1]);
#endif
  for (i = optimize->thread[thread]; i < optimize->thread[thread + 1]; ++i)
    {
      e = optimize_norm (i);
      g_mutex_lock (mutex);
      optimize_best (i, e);
      optimize_save_variables (i, e);
      if (e < optimize->threshold)
        optimize->stop = 1;
      g_mutex_unlock (mutex);
      if (optimize->stop)
        break;
#if DEBUG_OPTIMIZE
      fprintf (stderr, "optimize_thread: i=%u e=%lg\n", i, e);
#endif
    }
#if DEBUG_OPTIMIZE
  fprintf (stderr, "optimize_thread: end\n");
#endif
  g_thread_exit (NULL);
  return NULL;
}
```

Here is the call graph for this function:



5.20 optimize.h

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN
CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#ifndef OPTIMIZE__H
#define OPTIMIZE__H 1

typedef struct
{
  GMappedFile **file[MAX_NINPUTS];
  char **experiment;
  char **label;
  gsl_rng *rng;
  GeneticVariable *genetic_variable;
  FILE *file_result;
  FILE *file_variables;
  char *result;
  char *variables;
  char *simulator;
  char *evaluator;
  double *value;
  double *rangemin;
  double *rangemax;
  double *rangeminabs;
  double *rangemaxabs;
  double *error_best;
  double *weight;
  double *step;
  double *direction;
  double *value_old;
  double *error_old;
  unsigned int *precision;
  unsigned int *nsweeps;
  unsigned int *nbits;
  unsigned int *thread;
  unsigned int *thread_direction;
  unsigned int *simulation_best;
  double tolerance;
  double mutation_ratio;
  double reproduction_ratio;
  double adaptation_ratio;
  double relaxation;
  double calculation_time;
  double p;
  double threshold;
  unsigned long int seed;
  unsigned int nvariables;
  unsigned int nexperiments;
  unsigned int ninputs;
  unsigned int nsimulations;
  unsigned int nsteps;
  unsigned int nestimates;
  unsigned int algorithm;
  unsigned int nstart;
  unsigned int nend;
  unsigned int nstart_direction;
  unsigned int nend_direction;
  unsigned int niterations;
  unsigned int nbest;
  unsigned int nsaveds;
  unsigned int stop;
#if HAVE_MPI
  int mpi_rank;
#endif
} Optimize;

typedef struct
{
  unsigned int thread;
} ParallelData;

// Global variables
extern int ntasks;
extern unsigned int nthreads;
extern unsigned int nthreads_direction;
extern GMutex mutex[1];
extern void (*optimize_algorithm) ();
extern double (*optimize_estimate_direction) (unsigned int variable,
                                               unsigned int estimate);
extern double (*optimize_norm) (unsigned int simulation);
extern Optimize optimize[1];
extern const xmlChar *result_name;
extern const xmlChar *variables_name;

// Public functions
void optimize_input (unsigned int simulation, char *input,
                     GMappedFile * template);
double optimize_parse (unsigned int simulation, unsigned int experiment);
double optimize_norm_euclidian (unsigned int simulation);
double optimize_norm_maximum (unsigned int simulation);
double optimize_norm_p (unsigned int simulation);
double optimize_norm_taxicab (unsigned int simulation);
void optimize_print ();
void optimize_save_variables (unsigned int simulation, double error);
void optimize_best (unsigned int simulation, double value);
void optimize_sequential ();
void *optimize_thread (ParallelData * data);
void optimize_merge (unsigned int nsaveds, unsigned int *simulation_best,
                     double *error_best);
#if HAVE_MPI
void optimize_synchronise ();
#endif
void optimize_sweep ();
void optimize_MonteCarlo ();
void optimize_best_direction (unsigned int simulation, double value);
void optimize_direction_sequential ();
void *optimize_direction_thread (ParallelData * data);
double optimize_estimate_direction_random (unsigned int variable,
                                           unsigned int estimate);
double optimize_estimate_direction_coordinates (unsigned int variable,
                                                unsigned int estimate);
void optimize_step_direction (unsigned int simulation);
void optimize_direction ();
double optimize_genetic_objective (Entity * entity);
void optimize_genetic ();
void optimize_save_old ();
void optimize_merge_old ();
void optimize_refine ();
void optimize_step ();
void optimize_iterate ();
void optimize_free ();
void optimize_open ();

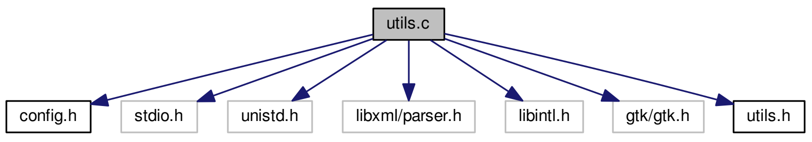
#endif
```

5.21 utils.c File Reference

Source file to define some useful functions.

```
#include "config.h"
#include <stdio.h>
#include <unistd.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <gtk/gtk.h>
#include "utils.h"
```

Include dependency graph for utils.c:



Functions

- void show_pending ()

  Function to show events on long computation.
- void show_message (char ∗title, char ∗msg, int type)

  Function to show a dialog with a message.
- void show_error (char ∗msg)

  Function to show a dialog with an error message.
- int xml_node_get_int (xmlNode ∗node, const xmlChar ∗prop, int ∗error_code)

  Function to get an integer number of a XML node property.
- unsigned int xml_node_get_uint (xmlNode ∗node, const xmlChar ∗prop, int ∗error_code)

  Function to get an unsigned integer number of a XML node property.
- unsigned int xml_node_get_uint_with_default (xmlNode ∗node, const xmlChar ∗prop, unsigned int default↩ _value, int ∗error_code)

  Function to get an unsigned integer number of a XML node property with a default value.
- double xml_node_get_float (xmlNode ∗node, const xmlChar ∗prop, int ∗error_code)

  Function to get a floating point number of a XML node property.
- double xml_node_get_float_with_default (xmlNode ∗node, const xmlChar ∗prop, double default_value, int ∗error_code)

  Function to get a floating point number of a XML node property with a default value.
- void xml_node_set_int (xmlNode ∗node, const xmlChar ∗prop, int value)

  Function to set an integer number in a XML node property.

- void xml_node_set_uint (xmlNode ∗node, const xmlChar ∗prop, unsigned int value)

    Function to set an unsigned integer number in a XML node property.
- void xml_node_set_float (xmlNode ∗node, const xmlChar ∗prop, double value)

    Function to set a floating point number in a XML node property.
- int cores_number ()

    Function to obtain the cores number.
- unsigned int gtk_array_get_active (GtkRadioButton ∗array[ ], unsigned int n)

    Function to get the active GtkRadioButton.

Variables

- GtkWindow ∗ main_window

    Main GtkWindow.
- char ∗ error_message

    Error message.

5.21.1 Detailed Description

Source file to define some useful functions.

Authors

Javier Burguete and Borja Latorre.

Copyright

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Definition in file utils.c.

5.21.2 Function Documentation

5.21.2.1 int cores_number ( )

Function to obtain the cores number.

Returns

Cores number.

Definition at line 329 of file utils.c.

```
00330 {
00331 #ifdef G_OS_WIN32
00332   SYSTEM_INFO sysinfo;
00333   GetSystemInfo (&sysinfo);
00334   return sysinfo.dwNumberOfProcessors;
00335 #else
00336   return (int) sysconf (_SC_NPROCESSORS_ONLN);
00337 #endif
00338 }
```

5.21.2.2 unsigned int gtk_array_get_active (GtkRadioButton ∗ *array[ ],* unsigned int *n*)

Function to get the active GtkRadioButton.

Parameters

array	Array of GtkRadioButtons.
n	Number of GtkRadioButtons.

Returns

Active GtkRadioButton.

Definition at line 353 of file utils.c.

```
{
  unsigned int i;
  for (i = 0; i < n; ++i)
    if (gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON (array[i])))
      break;
  return i;
}
```

5.21.2.3 void show_error (char ∗ *msg*)

Function to show a dialog with an error message.

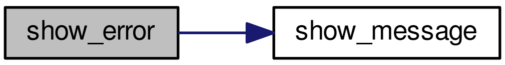
Parameters

msg	Error message.

Definition at line 109 of file utils.c.

```
{
  show_message (gettext ("ERROR!"), msg, ERROR_TYPE);
}
```

Here is the call graph for this function:



5.21.2.4 void show_message (char ∗ *title,* char ∗ *msg,* int *type*)

Function to show a dialog with a message.

Parameters

title	Title.
msg	Message.
type	Message type.

Definition at line 79 of file utils.c.

```
{
#if HAVE_GTK
  GtkMessageDialog *dlg;

  // Creating the dialog
  dlg = (GtkMessageDialog *) gtk_message_dialog_new
    (main_window, GTK_DIALOG_MODAL, type, GTK_BUTTONS_OK, "%s", msg);

  // Setting the dialog title
  gtk_window_set_title (GTK_WINDOW (dlg), title);

  // Showing the dialog and waiting response
  gtk_dialog_run (GTK_DIALOG (dlg));

  // Closing and freeing memory
  gtk_widget_destroy (GTK_WIDGET (dlg));

#else
  printf ("%s: %s\n", title, msg);
#endif
}
```

5.21.2.5 double xml_node_get_float (xmlNode * *node*, const xmlChar * *prop*, int * *error_code*)

Function to get a floating point number of a XML node property.

Parameters

node	XML node.
prop	XML property.
error_code	Error code.

Returns

Floating point number value.

Definition at line 219 of file utils.c.

```
{
  double x = 0.;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%lf", &x) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return x;
}
```

5.21.2.6 double xml_node_get_float_with_default (xmlNode ∗ *node*, const xmlChar ∗ *prop*, double *default_value*, int ∗ *error_code*)

Function to get a floating point number of a XML node property with a default value.

Parameters

node	XML node.
prop	XML property.
default_value	default value.
error_code	Error code.

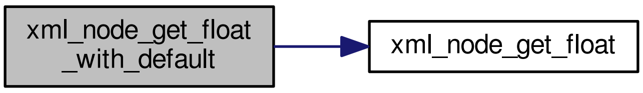
Returns

Floating point number value.

Definition at line 253 of file utils.c.

```
{
  double x;
  if (xmlHasProp (node, prop))
    x = xml_node_get_float (node, prop, error_code);
  else
    {
      x = default_value;
      *error_code = 0;
    }
  return x;
}
```

Here is the call graph for this function:



5.21.2.7 int xml_node_get_int (xmlNode ∗ *node*, const xmlChar ∗ *prop*, int ∗ *error_code*)

Function to get an integer number of a XML node property.

Parameters

node	XML node.
prop	XML property.
error_code	Error code.

Returns

Integer number value.

Definition at line 127 of file utils.c.

```
{
  int i = 0;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%d", &i) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return i;
}
```

5.21.2.8 int xml_node_get_uint (xmlNode * *node,* const xmlChar * *prop,* int * *error_code*)

Function to get an unsigned integer number of a XML node property.

Parameters

node	XML node.
prop	XML property.
error_code	Error code.

Returns

Unsigned integer number value.

Definition at line 158 of file utils.c.

```
{
  unsigned int i = 0;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%u", &i) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return i;
}
```

5.21.2.9 int xml_node_get_uint_with_default (xmlNode * *node,* const xmlChar * *prop,* unsigned int *default_value,* int * *error_code*)

Function to get an unsigned integer number of a XML node property with a default value.

Parameters

node	XML node.
prop	XML property.
default_value	default value.
error_code	Error code.

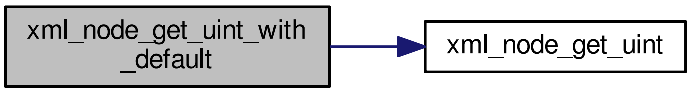
Returns

Unsigned integer number value.

Definition at line 192 of file utils.c.

```
{
  unsigned int i;
  if (xmlHasProp (node, prop))
    i = xml_node_get_uint (node, prop, error_code);
  else
    {
      i = default_value;
      *error_code = 0;
    }
  return i;
}
```

Here is the call graph for this function:



5.21.2.10 void xml_node_set_float (xmlNode ∗ *node*, const xmlChar ∗ *prop*, double *value*)

Function to set a floating point number in a XML node property.

Parameters

node	XML node.
prop	XML property.
value	Floating point number value.

Definition at line 316 of file utils.c.

```
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%.14lg", value);
  xmlSetProp (node, prop, buffer);
}
```

5.21.2.11 void xml_node_set_int (xmlNode ∗ *node*, const xmlChar ∗ *prop*, int *value*)

Function to set an integer number in a XML node property.

Parameters

node	XML node.
prop	XML property.
value	Integer number value.

Definition at line 278 of file utils.c.

```
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%d", value);
  xmlSetProp (node, prop, buffer);
}
```

5.21.2.12 void xml_node_set_uint (xmlNode ∗ *node*, const xmlChar ∗ *prop*, unsigned int *value*)

Function to set an unsigned integer number in a XML node property.

Parameters

node	XML node.
prop	XML property.
value	Unsigned integer number value.

Definition at line 297 of file utils.c.

```
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%u", value);
  xmlSetProp (node, prop, buffer);
}
```

5.22 utils.c

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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```

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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#define _GNU_SOURCE
#include "config.h"
#include <stdio.h>
#include <unistd.h>
#include <libxml/parser.h>
#include <libintl.h>
#if HAVE_GTK
#include <gtk/gtk.h>
#endif
#include "utils.h"

#if HAVE_GTK
GtkWindow *main_window;
#endif

char *error_message;

void
show_pending ()
{
#if HAVE_GTK
  while (gtk_events_pending ())
    gtk_main_iteration ();
#endif
}

void
show_message (char *title, char *msg, int type)
{
#if HAVE_GTK
  GtkMessageDialog *dlg;

  // Creating the dialog
  dlg = (GtkMessageDialog *) gtk_message_dialog_new
    (main_window, GTK_DIALOG_MODAL, type, GTK_BUTTONS_OK, "%s", msg);

  // Setting the dialog title
  gtk_window_set_title (GTK_WINDOW (dlg), title);

  // Showing the dialog and waiting response
  gtk_dialog_run (GTK_DIALOG (dlg));

  // Closing and freeing memory
  gtk_widget_destroy (GTK_WIDGET (dlg));

#else
  printf ("%s: %s\n", title, msg);
#endif
}

void
show_error (char *msg)
{
  show_message (gettext ("ERROR!"), msg, ERROR_TYPE);
}

int
xml_node_get_int (xmlNode * node, const xmlChar * prop, int *error_code)
{
  int i = 0;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%d", &i) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return i;
}

```

```
unsigned int
xml_node_get_uint (xmlNode * node, const xmlChar * prop, int *error_code)
{
  unsigned int i = 0;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%u", &i) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return i;
}

unsigned int
xml_node_get_uint_with_default (xmlNode * node, const xmlChar * prop,
                                unsigned int default_value, int *error_code)
{
  unsigned int i;
  if (xmlHasProp (node, prop))
    i = xml_node_get_uint (node, prop, error_code);
  else
    {
      i = default_value;
      *error_code = 0;
    }
  return i;
}

double
xml_node_get_float (xmlNode * node, const xmlChar * prop, int *error_code)
{
  double x = 0.;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%lf", &x) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return x;
}

double
xml_node_get_float_with_default (xmlNode * node, const xmlChar * prop,
                                 double default_value, int *error_code)
{
  double x;
  if (xmlHasProp (node, prop))
    x = xml_node_get_float (node, prop, error_code);
  else
    {
      x = default_value;
      *error_code = 0;
    }
  return x;
}

void
xml_node_set_int (xmlNode * node, const xmlChar * prop, int value)
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%d", value);
  xmlSetProp (node, prop, buffer);
}

void
xml_node_set_uint (xmlNode * node, const xmlChar * prop, unsigned int value)
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%u", value);
  xmlSetProp (node, prop, buffer);
}

void
xml_node_set_float (xmlNode * node, const xmlChar * prop, double value)
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%.141g", value);
  xmlSetProp (node, prop, buffer);
}

int
cores_number ()
{
#ifdef G_OS_WIN32
  SYSTEM_INFO sysinfo;
  GetSystemInfo (&sysinfo);
  return sysinfo.dwNumberOfProcessors;
#else
  return (int) sysconf (_SC_NPROCESSORS_ONLN);
#endif
}

#if HAVE_GTK

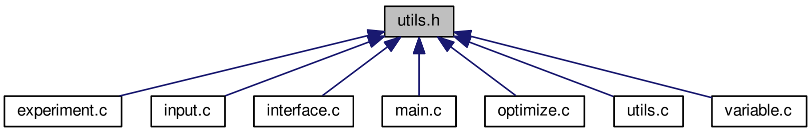
unsigned int
gtk_array_get_active (GtkRadioButton * array[], unsigned int n)
{
  unsigned int i;
  for (i = 0; i < n; ++i)
    if (gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON (array[i])))
      break;
  return i;
}

#endif
```

5.23 utils.h File Reference

Header file to define some useful functions.

This graph shows which files directly or indirectly include this file:



Macros

- #define ERROR_TYPE GTK_MESSAGE_ERROR

    Macro to define the error message type.
- #define INFO_TYPE GTK_MESSAGE_INFO

    Macro to define the information message type.

Functions

- void show_pending ()

    Function to show events on long computation.
- void show_message (char ∗title, char ∗msg, int type)

    Function to show a dialog with a message.
- void show_error (char ∗msg)

Function to show a dialog with an error message.
- int xml_node_get_int (xmlNode ∗node, const xmlChar ∗prop, int ∗error_code)

  Function to get an integer number of a XML node property.
- unsigned int xml_node_get_uint (xmlNode ∗node, const xmlChar ∗prop, int ∗error_code)

  Function to get an unsigned integer number of a XML node property.
- unsigned int xml_node_get_uint_with_default (xmlNode ∗node, const xmlChar ∗prop, unsigned int default←_value, int ∗error_code)

  Function to get an unsigned integer number of a XML node property with a default value.
- double xml_node_get_float (xmlNode ∗node, const xmlChar ∗prop, int ∗error_code)

  Function to get a floating point number of a XML node property.
- double xml_node_get_float_with_default (xmlNode ∗node, const xmlChar ∗prop, double default_value, int ∗error_code)

  Function to get a floating point number of a XML node property with a default value.
- void xml_node_set_int (xmlNode ∗node, const xmlChar ∗prop, int value)

  Function to set an integer number in a XML node property.
- void xml_node_set_uint (xmlNode ∗node, const xmlChar ∗prop, unsigned int value)

  Function to set an unsigned integer number in a XML node property.
- void xml_node_set_float (xmlNode ∗node, const xmlChar ∗prop, double value)

  Function to set a floating point number in a XML node property.
- int cores_number ()

  Function to obtain the cores number.
- unsigned int gtk_array_get_active (GtkRadioButton ∗array[ ], unsigned int n)

  Function to get the active GtkRadioButton.

Variables

- GtkWindow ∗ main_window

  Main GtkWindow.
- char ∗ error_message

  Error message.

5.23.1 Detailed Description

Header file to define some useful functions.

Authors

Javier Burguete.

Copyright

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Definition in file utils.h.

5.23.2 Function Documentation

5.23.2.1 int cores_number ( )

Function to obtain the cores number.

Returns

Cores number.

Definition at line 329 of file utils.c.

```
{
#ifdef G_OS_WIN32
  SYSTEM_INFO sysinfo;
  GetSystemInfo (&sysinfo);
  return sysinfo.dwNumberOfProcessors;
#else
  return (int) sysconf (_SC_NPROCESSORS_ONLN);
#endif
}
```

5.23.2.2 unsigned int gtk_array_get_active (GtkRadioButton ∗ *array[ ]*, unsigned int *n*)

Function to get the active GtkRadioButton.

Parameters

array	Array of GtkRadioButtons.
n	Number of GtkRadioButtons.

Returns

Active GtkRadioButton.

Definition at line 353 of file utils.c.

```
{
  unsigned int i;
  for (i = 0; i < n; ++i)
    if (gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON (array[i])))
      break;
  return i;
}
```

5.23.2.3 void show_error (char ∗ *msg*)

Function to show a dialog with an error message.

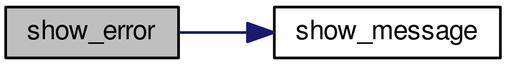
Parameters

msg	Error message.

Definition at line 109 of file utils.c.

```
{
  show_message (gettext ("ERROR!"), msg, ERROR_TYPE);
}
```

Here is the call graph for this function:



5.23.2.4 void show_message (char ∗ *title,* char ∗ *msg,* int *type*)

Function to show a dialog with a message.

Parameters

title	Title.
msg	Message.
type	Message type.

Definition at line 79 of file utils.c.

```
{
#if HAVE_GTK
  GtkMessageDialog *dlg;

  // Creating the dialog
  dlg = (GtkMessageDialog *) gtk_message_dialog_new
    (main_window, GTK_DIALOG_MODAL, type, GTK_BUTTONS_OK, "%s", msg);

  // Setting the dialog title
  gtk_window_set_title (GTK_WINDOW (dlg), title);

  // Showing the dialog and waiting response
  gtk_dialog_run (GTK_DIALOG (dlg));

  // Closing and freeing memory
  gtk_widget_destroy (GTK_WIDGET (dlg));

#else
  printf ("%s: %s\n", title, msg);
#endif
}
```

5.23.2.5 double xml_node_get_float (xmlNode ∗ *node,* const xmlChar ∗ *prop,* int ∗ *error_code*)

Function to get a floating point number of a XML node property.

Parameters

node	XML node.
prop	XML property.
error_code	Error code.

Returns

Floating point number value.

Definition at line 219 of file utils.c.

```
{
  double x = 0.;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%lf", &x) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return x;
}
```

5.23.2.6 double xml_node_get_float_with_default (xmlNode * *node*, const xmlChar * *prop*, double *default_value*, int * *error_code*)

Function to get a floating point number of a XML node property with a default value.

Parameters

node	XML node.
prop	XML property.
default_value	default value.
error_code	Error code.

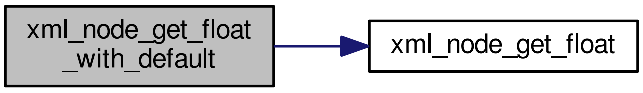
Returns

Floating point number value.

Definition at line 253 of file utils.c.

```
{
  double x;
  if (xmlHasProp (node, prop))
    x = xml_node_get_float (node, prop, error_code);
  else
    {
      x = default_value;
      *error_code = 0;
    }
  return x;
}
```

Here is the call graph for this function:



5.23.2.7 int xml_node_get_int (xmlNode ∗ *node,* const xmlChar ∗ *prop,* int ∗ *error_code*)

Function to get an integer number of a XML node property.

Parameters

node	XML node.
prop	XML property.
error_code	Error code.

Returns

Integer number value.

Definition at line 127 of file utils.c.

```
{
  int i = 0;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%d", &i) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return i;
}
```

5.23.2.8 unsigned int xml_node_get_uint (xmlNode ∗ *node,* const xmlChar ∗ *prop,* int ∗ *error_code*)

Function to get an unsigned integer number of a XML node property.

Parameters

node	XML node.
prop	XML property.
error_code	Error code.

Returns

Unsigned integer number value.

Definition at line 158 of file utils.c.

```
{
  unsigned int i = 0;
  xmlChar *buffer;
  buffer = xmlGetProp (node, prop);
  if (!buffer)
    *error_code = 1;
  else
    {
      if (sscanf ((char *) buffer, "%u", &i) != 1)
        *error_code = 2;
      else
        *error_code = 0;
      xmlFree (buffer);
    }
  return i;
}
```

5.23.2.9 unsigned int xml_node_get_uint_with_default (xmlNode * *node*, const xmlChar * *prop*, unsigned int *default_value*, int * *error_code*)

Function to get an unsigned integer number of a XML node property with a default value.

Parameters

node	XML node.
prop	XML property.
default_value	default value.
error_code	Error code.

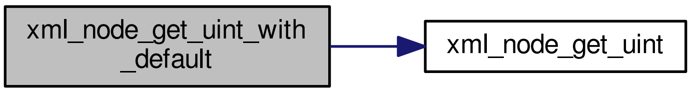
Returns

Unsigned integer number value.

Definition at line 192 of file utils.c.

```
{
  unsigned int i;
  if (xmlHasProp (node, prop))
    i = xml_node_get_uint (node, prop, error_code);
  else
    {
      i = default_value;
      *error_code = 0;
    }
  return i;
}
```

Here is the call graph for this function:



5.23.2.10 void xml_node_set_float (xmlNode ∗ *node,* const xmlChar ∗ *prop,* double *value*)

Function to set a floating point number in a XML node property.

Parameters

node	XML node.
prop	XML property.
value	Floating point number value.

Definition at line 316 of file utils.c.

```
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%.14lg", value);
  xmlSetProp (node, prop, buffer);
}
```

5.23.2.11 void xml_node_set_int (xmlNode ∗ *node,* const xmlChar ∗ *prop,* int *value*)

Function to set an integer number in a XML node property.

Parameters

node	XML node.
prop	XML property.
value	Integer number value.

Definition at line 278 of file utils.c.

```
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%d", value);
  xmlSetProp (node, prop, buffer);
}
```

5.23.2.12 void xml_node_set_uint (xmlNode ∗ *node*, const xmlChar ∗ *prop*, unsigned int *value*)

Function to set an unsigned integer number in a XML node property.

Parameters

node	XML node.
prop	XML property.
value	Unsigned integer number value.

Definition at line 297 of file utils.c.

```
{
  xmlChar buffer[64];
  snprintf ((char *) buffer, 64, "%u", value);
  xmlSetProp (node, prop, buffer);
}
```

5.24 utils.h

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO,
PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR
BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN
CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#ifndef UTILS__H
#define UTILS__H 1

#if HAVE_GTK
#define ERROR_TYPE GTK_MESSAGE_ERROR
#define INFO_TYPE GTK_MESSAGE_INFO
extern GtkWindow *main_window;
#else
#define ERROR_TYPE 0
#define INFO_TYPE 0
#endif

extern char *error_message;

// Public functions
void show_pending ();
void show_message (char *title, char *msg, int type);
void show_error (char *msg);
int xml_node_get_int (xmlNode * node, const xmlChar * prop, int *error_code);
unsigned int xml_node_get_uint (xmlNode * node, const xmlChar * prop,
                                int *error_code);
```

```
unsigned int xml_node_get_uint_with_default (xmlNode * node,
                                             const xmlChar * prop,
                                             unsigned int default_value,
                                             int *error_code);
double xml_node_get_float (xmlNode * node, const xmlChar * prop,
                           int *error_code);
double xml_node_get_float_with_default (xmlNode * node, const xmlChar * prop
,
                                        double default_value, int *error_code);
void xml_node_set_int (xmlNode * node, const xmlChar * prop, int value);
void xml_node_set_uint (xmlNode * node, const xmlChar * prop,
                        unsigned int value);
void xml_node_set_float (xmlNode * node, const xmlChar * prop, double value);
int cores_number ();
#if HAVE_GTK
unsigned int gtk_array_get_active (GtkRadioButton * array[], unsigned int n);
#endif

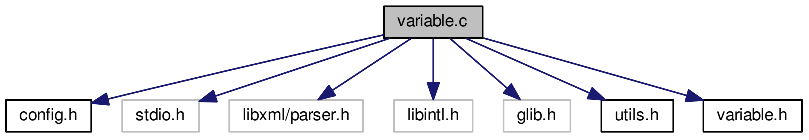
#endif
```

5.25 variable.c File Reference

Source file to define the variable data.

```
#include "config.h"
#include <stdio.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include "utils.h"
#include "variable.h"
```

Include dependency graph for variable.c:



Macros

- #define **_GNU_SOURCE**
- #define DEBUG_VARIABLE 0

  Macro to debug variable functions.

Functions

- void variable_new (Variable ∗variable)

  Function to create a new Variable struct.
- void variable_free (Variable ∗variable)

  Function to free the memory of a Variable struct.
- void variable_error (Variable ∗variable, char ∗message)

  Function to print a message error opening an Variable struct.
- int variable_open (Variable ∗variable, xmlNode ∗node, unsigned int algorithm, unsigned int nsteps)

  Function to open the variable file.

Variables

- const char ∗ format [NPRECISIONS]

  Array of C-strings with variable formats.
- const double precision [NPRECISIONS]

  Array of variable precisions.

5.25.1 Detailed Description

Source file to define the variable data.

Authors

Javier Burguete and Borja Latorre.

Copyright

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Definition in file variable.c.

5.25.2 Function Documentation

5.25.2.1 void variable_error (Variable ∗ *variable,* char ∗ *message*)

Function to print a message error opening an Variable struct.

Parameters

variable	Variable struct.
message	Error message.

Definition at line 104 of file variable.c.

```
{
  char buffer[64];
  if (!variable->name)
    snprintf (buffer, 64, "%s: %s", gettext ("Variable"), message);
  else
    snprintf (buffer, 64, "%s %s: %s", gettext ("Variable"), variable->name,
              message);
  error_message = g_strdup (buffer);
}
```

5.25.2.2 void variable_free (Variable ∗ *variable*)

Function to free the memory of a Variable struct.

Parameters

variable	Variable struct.

Definition at line 84 of file variable.c.

```
{
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_free: start\n");
#endif
  xmlFree (variable->name);
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_free: end\n");
#endif
}
```

5.25.2.3 void variable_new (Variable ∗ *variable*)

Function to create a new Variable struct.

Parameters

variable	Variable struct.

Definition at line 66 of file variable.c.

```
{
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_new: start\n");
#endif
  variable->name = NULL;
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_new: end\n");
#endif
}
```

5.25.2.4 int variable_open (Variable ∗ *variable,* xmlNode ∗ *node,* unsigned int *algorithm,* unsigned int *nsteps*)

Function to open the variable file.

Parameters

variable	Variable struct.
node	XML node.
algorithm	Algorithm type.
nsteps	Number of steps to do the direction search method.

Returns

1 on success, 0 on error.

Definition at line 130 of file variable.c.

```
{
  int error_code;

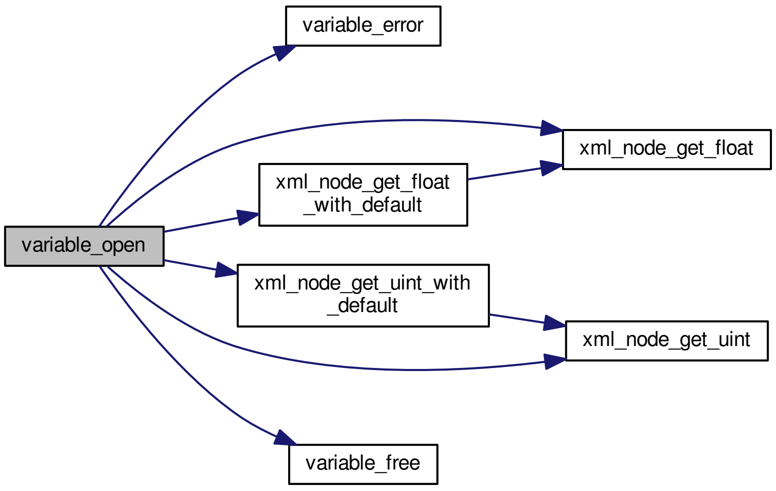
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: start\n");
#endif

  variable->name = (char *) xmlGetProp (node, XML_NAME);
  if (!variable->name)
    {
      variable_error (variable, gettext ("no name"));
      goto exit_on_error;
    }
  if (xmlHasProp (node, XML_MINIMUM))
    {
      variable->rangemin = xml_node_get_float (node,
XML_MINIMUM, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad minimum"));
          goto exit_on_error;
        }
      variable->rangeminabs
        = xml_node_get_float_with_default (node,
XML_ABSOLUTE_MINIMUM,
                                           -G_MAXDOUBLE, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad absolute minimum"));
          goto exit_on_error;
        }
      if (variable->rangemin < variable->rangeminabs)
        {
          variable_error (variable, gettext ("minimum range not allowed"));
          goto exit_on_error;
        }
    }
  else
    {
      variable_error (variable, gettext ("no minimum range"));
      goto exit_on_error;
    }
  if (xmlHasProp (node, XML_MAXIMUM))
    {
      variable->rangemax = xml_node_get_float (node,
XML_MAXIMUM, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad maximum"));
          goto exit_on_error;
        }
      variable->rangemaxabs
        = xml_node_get_float_with_default (node,
XML_ABSOLUTE_MAXIMUM,
                                           G_MAXDOUBLE, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad absolute maximum"));
          goto exit_on_error;
        }
      if (variable->rangemax > variable->rangemaxabs)
        {
          variable_error (variable, gettext ("maximum range not allowed"));
          goto exit_on_error;
        }
      if (variable->rangemax < variable->rangemin)
        {
          variable_error (variable, gettext ("bad range"));
          goto exit_on_error;
        }
    }
  else
    {
      variable_error (variable, gettext ("no maximum range"));
      goto exit_on_error;
    }
  variable->precision
    = xml_node_get_uint_with_default (node,
XML_PRECISION,
                                      DEFAULT_PRECISION, &error_code);
  if (error_code || variable->precision >= NPRECISIONS)
    {
      variable_error (variable, gettext ("bad precision"));
      goto exit_on_error;
    }
  if (algorithm == ALGORITHM_SWEEP)
    {
      if (xmlHasProp (node, XML_NSWEEPS))
        {
          variable->nsweeps
            = xml_node_get_uint (node, XML_NSWEEPS, &error_code);
          if (error_code || !variable->nsweeps)
            {
              variable_error (variable, gettext ("bad sweeps"));
              goto exit_on_error;
            }
        }
      else
        {
          variable_error (variable, gettext ("no sweeps number"));
          goto exit_on_error;
        }
#if DEBUG_VARIABLE
      fprintf (stderr, "variable_open: nsweeps=%u\n", variable->nsweeps);
#endif
    }
  if (algorithm == ALGORITHM_GENETIC)
    {
      // Obtaining bits representing each variable
      if (xmlHasProp (node, XML_NBITS))
        {
          variable->nbits = xml_node_get_uint (node, XML_NBITS, &error_code);
          if (error_code || !variable->nbits)
            {
              variable_error (variable, gettext ("invalid bits number"));
              goto exit_on_error;
            }
        }
      else
        {
          variable_error (variable, gettext ("no bits number"));
          goto exit_on_error;
        }
    }
  else if (nsteps)
    {
      variable->step = xml_node_get_float (node, XML_STEP, &error_code);
      if (error_code || variable->step < 0.)
        {
          variable_error (variable, gettext ("bad step size"));
          goto exit_on_error;
        }
    }

#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: end\n");
#endif
  return 1;

exit_on_error:
  variable_free (variable);
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: end\n");
#endif
  return 0;
}
```

Here is the call graph for this function:



5.25.3 Variable Documentation

5.25.3.1 const char* format[NPRECISIONS]

Initial value:

```
= {
  "%.0lf", "%.1lf", "%.2lf", "%.3lf", "%.4lf", "%.5lf", "%.6lf", "%.7lf",
  "%.8lf", "%.9lf", "%.10lf", "%.11lf", "%.12lf", "%.13lf", "%.14lf"
}
```

Array of C-strings with variable formats.

Definition at line 49 of file variable.c.

5.25.3.2 const double precision[NPRECISIONS]

Initial value:

```
= {
  1., 0.1, 0.01, 1e-3, 1e-4, 1e-5, 1e-6, 1e-7, 1e-8, 1e-9, 1e-10, 1e-11, 1e-12,
  1e-13, 1e-14
}
```

Array of variable precisions.

Definition at line 54 of file variable.c.

5.26 variable.c

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING
IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#define _GNU_SOURCE
#include "config.h"
#include <stdio.h>
#include <libxml/parser.h>
#include <libintl.h>
#include <glib.h>
#include "utils.h"
#include "variable.h"

#define DEBUG_VARIABLE 0

const char *format[NPRECISIONS] = {
  "%.0lf", "%.1lf", "%.2lf", "%.3lf", "%.4lf", "%.5lf", "%.6lf", "%.7lf",
  "%.8lf", "%.9lf", "%.10lf", "%.11lf", "%.12lf", "%.13lf", "%.14lf"
};

const double precision[NPRECISIONS] = {
  1., 0.1, 0.01, 1e-3, 1e-4, 1e-5, 1e-6, 1e-7, 1e-8, 1e-9, 1e-10, 1e-11, 1e-12,
  1e-13, 1e-14
};

void
variable_new (Variable * variable)
{
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_new: start\n");
#endif
  variable->name = NULL;
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_new: end\n");
#endif
}

void
variable_free (Variable * variable)
{
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_free: start\n");
#endif
  xmlFree (variable->name);
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_free: end\n");
#endif
}

void
variable_error (Variable * variable, char *message)
{
  char buffer[64];
  if (!variable->name)
    snprintf (buffer, 64, "%s: %s", gettext ("Variable"), message);
  else
    snprintf (buffer, 64, "%s %s: %s", gettext ("Variable"), variable->name,
               message);
  error_message = g_strdup (buffer);
}

int
variable_open (Variable * variable, xmlNode * node, unsigned int algorithm,
               unsigned int nsteps)
{
  int error_code;

#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: start\n");
#endif

  variable->name = (char *) xmlGetProp (node, XML_NAME);
  if (!variable->name)
    {
      variable_error (variable, gettext ("no name"));
      goto exit_on_error;
    }
  if (xmlHasProp (node, XML_MINIMUM))
    {
      variable->rangemin = xml_node_get_float (node,
XML_MINIMUM, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad minimum"));
          goto exit_on_error;
        }
      variable->rangeminabs
        = xml_node_get_float_with_default (node,
XML_ABSOLUTE_MINIMUM,
                                           -G_MAXDOUBLE, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad absolute minimum"));
          goto exit_on_error;
        }
      if (variable->rangemin < variable->rangeminabs)
        {
          variable_error (variable, gettext ("minimum range not allowed"));
          goto exit_on_error;
        }
    }
  else
    {
      variable_error (variable, gettext ("no minimum range"));
      goto exit_on_error;
    }
  if (xmlHasProp (node, XML_MAXIMUM))
    {
      variable->rangemax = xml_node_get_float (node,
XML_MAXIMUM, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad maximum"));
          goto exit_on_error;
        }
      variable->rangemaxabs
        = xml_node_get_float_with_default (node,
XML_ABSOLUTE_MAXIMUM,
                                           G_MAXDOUBLE, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad absolute maximum"));
          goto exit_on_error;
        }
      if (variable->rangemax > variable->rangemaxabs)
        {
          variable_error (variable, gettext ("maximum range not allowed"));
          goto exit_on_error;
        }
      if (variable->rangemax < variable->rangemin)
        {
          variable_error (variable, gettext ("bad range"));
          goto exit_on_error;
        }
    }
  else
    {
      variable_error (variable, gettext ("no maximum range"));
      goto exit_on_error;
    }
  variable->precision
    = xml_node_get_uint_with_default (node,
XML_PRECISION,
                                      DEFAULT_PRECISION, &error_code);
  if (error_code || variable->precision >= NPRECISIONS)
    {
      variable_error (variable, gettext ("bad precision"));
      goto exit_on_error;
    }
  if (algorithm == ALGORITHM_SWEEP)
    {
      if (xmlHasProp (node, XML_NSWEEPS))
        {
          variable->nsweeps
            = xml_node_get_uint (node, XML_NSWEEPS, &error_code);
          if (error_code || !variable->nsweeps)
            {
              variable_error (variable, gettext ("bad sweeps"));
              goto exit_on_error;
            }
        }
      else
        {
          variable_error (variable, gettext ("no sweeps number"));
          goto exit_on_error;
        }
#if DEBUG_VARIABLE
      fprintf (stderr, "variable_open: nsweeps=%u\n", variable->nsweeps);
#endif
    }
  if (algorithm == ALGORITHM_GENETIC)
    {
      // Obtaining bits representing each variable
      if (xmlHasProp (node, XML_NBITS))
        {
          variable->nbits = xml_node_get_uint (node, XML_NBITS, &error_code);
          if (error_code || !variable->nbits)
            {
              variable_error (variable, gettext ("invalid bits number"));
              goto exit_on_error;
            }
        }
      else
        {
          variable_error (variable, gettext ("no bits number"));
          goto exit_on_error;
        }
    }
  else if (nsteps)
    {
      variable->step = xml_node_get_float (node, XML_STEP, &error_code);
      if (error_code || variable->step < 0.)
        {
          variable_error (variable, gettext ("bad step size"));
          goto exit_on_error;
        }
    }

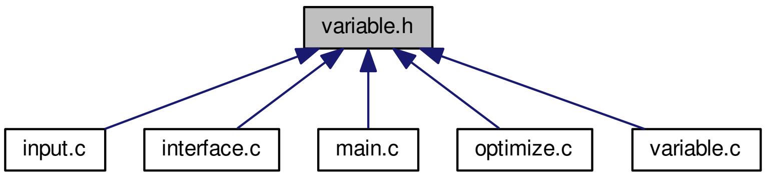
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: end\n");
#endif
  return 1;

exit_on_error:
  variable_free (variable);
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: end\n");
#endif
  return 0;
}
```

5.27 variable.h File Reference

Header file to define the variable data.

This graph shows which files directly or indirectly include this file:



Data Structures

- struct Variable

  Struct to define the variable data.

Enumerations

- enum Algorithm { ALGORITHM_MONTE_CARLO = 0, ALGORITHM_SWEEP = 1, ALGORITHM_GENETIC = 2 }

  Enum to define the algorithms.

Functions

- void variable_new (Variable ∗variable)

  Function to create a new Variable struct.
- void variable_free (Variable ∗variable)

  Function to free the memory of a Variable struct.
- void variable_error (Variable ∗variable, char ∗message)

  Function to print a message error opening an Variable struct.
- int variable_open (Variable ∗variable, xmlNode ∗node, unsigned int algorithm, unsigned int nsteps)

  Function to open the variable file.

Variables

- const char ∗ format [NPRECISIONS]

  Array of C-strings with variable formats.
- const double precision [NPRECISIONS]

  Array of variable precisions.

5.27.1 Detailed Description

Header file to define the variable data.

Authors

Javier Burguete.

Copyright

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Definition in file variable.h.

5.27.2 Enumeration Type Documentation

5.27.2.1 enum Algorithm

Enum to define the algorithms.

Enumerator

ALGORITHM_MONTE_CARLO	Monte-Carlo algorithm.
ALGORITHM_SWEEP	Sweep algorithm.
ALGORITHM_GENETIC	Genetic algorithm.

Definition at line 45 of file variable.h.

```
00046 {
00047   ALGORITHM_MONTE_CARLO = 0,
00048   ALGORITHM_SWEEP = 1,
00049   ALGORITHM_GENETIC = 2
00050 };
```

5.27.3 Function Documentation

5.27.3.1 void variable_error (Variable ∗ *variable*, char ∗ *message*)

Function to print a message error opening an Variable struct.

Parameters

variable	Variable struct.
message	Error message.

Definition at line 104 of file variable.c.

```
00105 {
  char buffer[64];
  if (!variable->name)
    snprintf (buffer, 64, "%s: %s", gettext ("Variable"), message);
  else
    snprintf (buffer, 64, "%s %s: %s", gettext ("Variable"), variable->name,
              message);
  error_message = g_strdup (buffer);
}
```

5.27.3.2 void variable_free (Variable * *variable*)

Function to free the memory of a Variable struct.

Parameters

variable	Variable struct.

Definition at line 84 of file variable.c.

```
{
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_free: start\n");
#endif
  xmlFree (variable->name);
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_free: end\n");
#endif
}
```

5.27.3.3 void variable_new (Variable * *variable*)

Function to create a new Variable struct.

Parameters

variable	Variable struct.

Definition at line 66 of file variable.c.

```
{
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_new: start\n");
#endif
  variable->name = NULL;
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_new: end\n");
#endif
}
```

5.27.3.4 int variable_open (Variable * *variable,* xmlNode * *node,* unsigned int *algorithm,* unsigned int *nsteps*)

Function to open the variable file.

Parameters

variable	Variable struct.
node	XML node.
algorithm	Algorithm type.
nsteps	Number of steps to do the direction search method.

Returns

1 on success, 0 on error.

Definition at line 130 of file variable.c.

```
{
  int error_code;

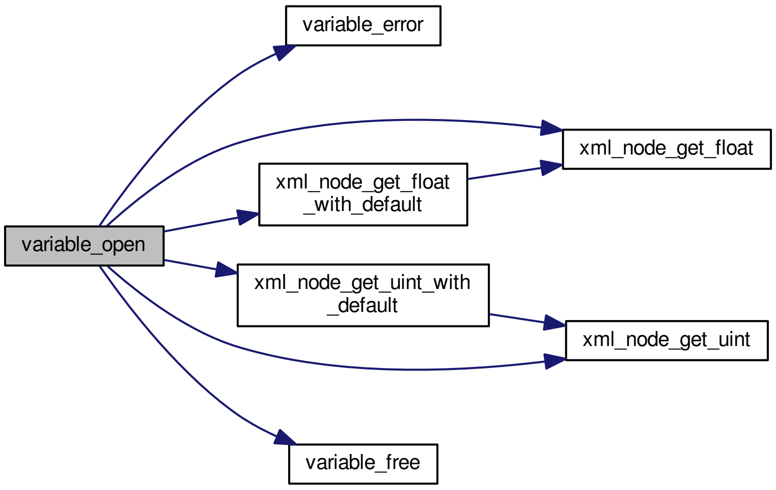
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: start\n");
#endif

  variable->name = (char *) xmlGetProp (node, XML_NAME);
  if (!variable->name)
    {
      variable_error (variable, gettext ("no name"));
      goto exit_on_error;
    }
  if (xmlHasProp (node, XML_MINIMUM))
    {
      variable->rangemin = xml_node_get_float (node,
XML_MINIMUM, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad minimum"));
          goto exit_on_error;
        }
      variable->rangeminabs
        = xml_node_get_float_with_default (node,
XML_ABSOLUTE_MINIMUM,
                                           -G_MAXDOUBLE, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad absolute minimum"));
          goto exit_on_error;
        }
      if (variable->rangemin < variable->rangeminabs)
        {
          variable_error (variable, gettext ("minimum range not allowed"));
          goto exit_on_error;
        }
    }
  else
    {
      variable_error (variable, gettext ("no minimum range"));
      goto exit_on_error;
    }
  if (xmlHasProp (node, XML_MAXIMUM))
    {
      variable->rangemax = xml_node_get_float (node,
XML_MAXIMUM, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad maximum"));
          goto exit_on_error;
        }
      variable->rangemaxabs
        = xml_node_get_float_with_default (node,
XML_ABSOLUTE_MAXIMUM,
                                           G_MAXDOUBLE, &error_code);
      if (error_code)
        {
          variable_error (variable, gettext ("bad absolute maximum"));
          goto exit_on_error;
        }
      if (variable->rangemax > variable->rangemaxabs)
        {
          variable_error (variable, gettext ("maximum range not allowed"));
          goto exit_on_error;
        }
      if (variable->rangemax < variable->rangemin)
        {
          variable_error (variable, gettext ("bad range"));
          goto exit_on_error;
        }
    }
  else
    {
      variable_error (variable, gettext ("no maximum range"));
      goto exit_on_error;
    }
  variable->precision
    = xml_node_get_uint_with_default (node,
XML_PRECISION,
                                      DEFAULT_PRECISION, &error_code);
  if (error_code || variable->precision >= NPRECISIONS)
    {
      variable_error (variable, gettext ("bad precision"));
      goto exit_on_error;
    }
  if (algorithm == ALGORITHM_SWEEP)
    {
      if (xmlHasProp (node, XML_NSWEEPS))
        {
          variable->nsweeps
            = xml_node_get_uint (node, XML_NSWEEPS, &error_code);
          if (error_code || !variable->nsweeps)
            {
              variable_error (variable, gettext ("bad sweeps"));
              goto exit_on_error;
            }
        }
      else
        {
          variable_error (variable, gettext ("no sweeps number"));
          goto exit_on_error;
        }
#if DEBUG_VARIABLE
      fprintf (stderr, "variable_open: nsweeps=%u\n", variable->nsweeps);
#endif
    }
  if (algorithm == ALGORITHM_GENETIC)
    {
      // Obtaining bits representing each variable
      if (xmlHasProp (node, XML_NBITS))
        {
          variable->nbits = xml_node_get_uint (node,
XML_NBITS, &error_code);
          if (error_code || !variable->nbits)
            {
              variable_error (variable, gettext ("invalid bits number"));
              goto exit_on_error;
            }
        }
      else
        {
          variable_error (variable, gettext ("no bits number"));
          goto exit_on_error;
        }
    }
  else if (nsteps)
    {
      variable->step = xml_node_get_float (node, XML_STEP, &error_code);
      if (error_code || variable->step < 0.)
        {
          variable_error (variable, gettext ("bad step size"));
          goto exit_on_error;
        }
    }

#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: end\n");
#endif
  return 1;

exit_on_error:
  variable_free (variable);
#if DEBUG_VARIABLE
  fprintf (stderr, "variable_open: end\n");
#endif
  return 0;
}
```

Here is the call graph for this function:



5.28 variable.h

```
/*
MPCOTool:
The Multi-Purposes Calibration and Optimization Tool. A software to perform
calibrations or optimizations of empirical parameters.

AUTHORS: Javier Burguete and Borja Latorre.

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IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY
OF SUCH DAMAGE.
*/

#ifndef VARIABLE__H
#define VARIABLE__H 1

enum Algorithm
{
  ALGORITHM_MONTE_CARLO = 0,
  ALGORITHM_SWEEP = 1,
  ALGORITHM_GENETIC = 2
};

typedef struct
{
  char *name;
  double rangemin;
  double rangemax;
  double rangeminabs;
  double rangemaxabs;
  double step;
  unsigned int precision;
  unsigned int nsweeps;
  unsigned int nbits;
} Variable;

extern const char *format[NPRECISIONS];
extern const double precision[NPRECISIONS];

// Public functions
void variable_new (Variable * variable);
void variable_free (Variable * variable);
void variable_error (Variable * variable, char *message);
int variable_open (Variable * variable, xmlNode * node, unsigned int algorithm,
                   unsigned int nsteps);

#endif
```

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