Package 'irace'

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Type Package

Title Iterated Racing for Automatic Algorithm Configuration

Description Iterated race is an extension of the Iterated F-race method for the automatic configuration of optimization algorithms, that is, (offline) tuning their parameters by finding the most appropriate settings given a set of instances of an optimization problem. M. López-Ibáñez, J. Dubois-Lacoste, L. Pérez Cáceres, T. Stützle, and M. Birattari (2016) <doi:10.1016/j.orp.2016.09.002>.

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VignetteBuilder knitr

License GPL (>= 2)

URL https://mlopez-ibanez.github.io/irace/, https://github.com/MLopez-Ibanez/irace

BugReports https://github.com/MLopez-Ibanez/irace/issues

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Contents

`irace-package` *The irace package: Iterated Racing for Automatic Algorithm Configuration*

Description

Iterated race is an extension of the Iterated F-race method for the automatic configuration of optimization algorithms, that is, (offline) tuning their parameters by finding the most appropriate settings given a set of instances of an optimization problem. M. López-Ibáñez, J. Dubois-Lacoste, L. Pérez Cáceres, T. Stützle, and M. Birattari (2016) <doi:10.1016/j.orp.2016.09.002>.

Details

License: GPL (>= 2)

Author(s)

Maintainers: Manuel López-Ibáñez and Leslie Pérez Cáceres <`irace-package@googlegroups.com`>

References

Manuel López-Ibáñez, Jérémie Dubois-Lacoste, Leslie Pérez Cáceres, Thomas Stützle, and Mauro Birattari. The irace package: Iterated Racing for Automatic Algorithm Configuration. *Operations Research Perspectives*, 2016. doi:10.1016/j.orp.2016.09.002

Manuel López-Ibáñez, Jérémie Dubois-Lacoste, Thomas Stützle, and Mauro Birattari. *The irace package, Iterated Race for Automatic Algorithm Configuration*. Technical Report TR/IRIDIA/2011-004, IRIDIA, Université Libre de Bruxelles, Belgium, 2011.

Manuel López-Ibáñez and Thomas Stützle. The Automatic Design of Multi-Objective Ant Colony Optimization Algorithms. *IEEE Transactions on Evolutionary Computation*, 2012.

See Also

`irace()` for examples and `vignette(package = "irace")` for the user-guide.

`ablation` *Performs ablation between two configurations (from source to target).*

Description

Ablation is a method for analyzing the differences between two configurations.

Usage

```
ablation(
  iraceResults,
  src = 1L,
  target = NULL,
  ab_params = NULL,
  type = c("full", "racing"),
  nrep = 1L,
  seed = 1234567L,
  ablationLogFile = "log-ablation.Rdata",
  instancesFile = "train",
  ...
)
```

Arguments

`iraceResults`	`list()|character(1)` Object created by **irace** and typically saved in the log file `irace.Rdata`. If a character string is given, then it is interpreted as the path to the log file from which the `iraceResults` object will be loaded.
`src, target`	`integer(1)|character(1)` Source and target configuration IDs. By default, the first configuration ever evaluated (ID 1) is used as `src` and the best configuration found by irace is used as target. If the argument is a string, it is interpreted as the path to a file, with the format specified by `readConfigurationsFile()`, that contains the configuration.
`ab_params`	`character()` Specific parameter names to be used for the ablation. They must be in `parameters$names`. By default, use all parameters.
`type`	`"full"|"racing"` Type of ablation to perform: `"full"` will execute each configuration on all `n_instances` to determine the best-performing one; `"racing"` will apply racing to find the best configurations.
`nrep`	`integer(1)` Number of replications per instance used in `"full"` ablation. When `nrep` > 1, each configuration will be executed `nrep` times on each instance with different random seeds.

`seed` `integer(1)`
Integer value to use as seed for the random number generation.

`ablationLogFile` `character(1)`
Log file to save the ablation log. If `NULL`, the results are not saved to a file.

`instancesFile` `character(1)`
Instances file used for ablation: `'train'`, `'test'` or a filename containing the list of instances.

`...` Further arguments to override scenario settings, e.g., `debugLevel`, `parallel`, etc.

Value

A list containing the following elements:

allConfigurations Configurations tested in the ablation.

state State of the ablation process.

experiments A matrix with the results of the experiments (columns are configurations, rows are instances).

scenario Scenario object with the settings used for the experiments.

trajectory IDs of the best configurations at each step of the ablation.

best Best configuration found in the experiments.

complete `TRUE` if the ablation process was completed.

Author(s)

Leslie Pérez Cáceres and Manuel López-Ibáñez

References

C. Fawcett and H. H. Hoos. Analysing differences between algorithm configurations through ablation. Journal of Heuristics, 22(4):431–458, 2016.

See Also

`plotAblation()` `ablation_cmdline()`

Examples

```
logfile <- system.file(package="irace", "exdata", "sann.rda")
# Execute ablation between the first and the best configuration found by irace.
ablog <- ablation(logfile, ablationLogFile = NULL)
plotAblation(ablog)
# Execute ablation between two selected configurations, and selecting only a
# subset of parameters, directly reading the setup from the irace log file.
ablog <- ablation(logfile, src = 1, target = 10,
                  ab_params = c("temp"), ablationLogFile = NULL)
plotAblation(ablog, type = "mean")
```

ablation_cmdline *Launch ablation with command-line options.*

Description

Launch ablation() with the same command-line options as the command-line executable (ablation.exe in Windows).

Usage

```
ablation_cmdline(argv = commandArgs(trailingOnly = TRUE))
```

Arguments

argv	character() The arguments provided on the R command line as a character vector, e.g., c("-i", "irace.Rdata", "--src", 1).

Details

The function reads the parameters given on the command line used to invoke R, launches ablation() and possibly plotAblation().

List of command-line options:

```
-l,--log-file           Path to the (.Rdata) file created by irace from which
                        the "iraceResults" object will be loaded.
-S,--src                Source configuration ID or the path to a file
                        containing the configuration. Default: 1.
-T,--target             Target configuration ID (by default the best
                        configuration found by irace) or the path to a file
                        containing the configuration.
-P,--params             Specific parameter names to be used for the ablation
                        (separated with commas). By default use all
-t,--type               Type of ablation to perform: "full" will execute each
                        configuration on all "--n-instances" to determine the
                        best-performing one; "racing" will apply racing to
                        find the best configurations. Default: full.
-n,--nrep               Number of replications per instance used in "full"
                        ablation. Default: 1.
   --seed               Integer value to use as seed for the random number
                        generation. Default: 1234567.
-o,--output-file        Log file to save the ablation log. If "", the results
                        are not saved to a file. Default: log-ablation.Rdata.
   --instances-file     Instances file used for ablation: "train", "test" or a
```

```
                          filename containing the list of instances. Default:
                          train.
   -p,--plot              Output filename (.pdf) for the plot. If not given, no
                          plot is created.
   -O,--plot-type         Type of plot. Supported values are "mean", "boxplot",
                          "rank" or "rank,boxplot". Default: mean.
      --old-path          Old path found in the log-file (.Rdata) given as input
                          to be replaced by --new-path.
      --new-path          New path to replace the path found in the log-file
                          (.Rdata) given as input.
   -e,--exec-dir          Directory where the target runner will be run.
   -s,--scenario          Scenario file to override the scenario given in the
                          log-file (.Rdata)
      --parallel          Number of calls to targetRunner to execute in
                          parallel. Values 0 or 1 mean no parallelization.
```

Value

A list containing the following elements:

allConfigurations Configurations tested in the ablation.

state State of the ablation process.

experiments A matrix with the results of the experiments (columns are configurations, rows are instances).

scenario Scenario object with the settings used for the experiments.

trajectory IDs of the best configurations at each step of the ablation.

best Best configuration found in the experiments.

complete `TRUE` if the ablation process was completed.

Author(s)

Manuel López-Ibáñez

See Also

`plotAblation()` `ablation()`

Examples

```
ablation_cmdline("--help")
# Find the ablation command-line executable:
Sys.glob(file.path(system.file(package="irace", "bin"), "ablation*"))
```

buildCommandLine *Generate a command-line representation of a configuration*

Description

buildCommandLine receives two vectors, one containing the values of the parameters, the other containing the switches of the parameters. It builds a string with the switches and the values that can be used as a command line to call the program to be tuned, thus generating one candidate configuration.

Usage

```
buildCommandLine(values, switches)
```

Arguments

values	A vector containing the value of each parameter for the candidate configuration.
switches	A vector containing the switches of each paramter (in an order that corresponds to the values vector).

Value

A string concatenating each element of switches and values for all parameters with a space between each pair of parameters (but none between the switches and the corresponding values).

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

Examples

```
switches <- c("--switch1 ", "--switch2-", "--switch3=")
values <- list("value_1", 1L, sqrt(2))
buildCommandLine (values, switches)
## Build a command-line from the results produced by a previous run of irace.
# First, load the data produced by irace.
logfile <- file.path(system.file(package="irace"), "exdata", "irace-acotsp.Rdata")
iraceResults <- read_logfile(logfile)
allConfigurations <- iraceResults$allConfigurations
parameters <- iraceResults$scenario$parameters
apply(allConfigurations[1:10, unlist(parameters$names)], 1, buildCommandLine,
      unlist(parameters$switches))
```

checkIraceScenario *Test that the given irace scenario can be run.*

Description

Test that the given irace scenario can be run by checking the scenario settings provided and trying to run the target-algorithm.

Usage

```
checkIraceScenario(scenario)
```

Arguments

scenario	list() Data structure containing **irace** settings. The data structure has to be the one returned by the function defaultScenario() or readScenario().

Details

If the parameters argument is missing, then the parameters will be read from the file parameterFile given by scenario. If parameters is provided, then parameterFile will not be read. This function will try to execute the target-algorithm.

Value

returns TRUE if successful and gives an error and returns FALSE otherwise.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

readScenario for reading a configuration scenario from a file.

printScenario prints the given scenario.

defaultScenario returns the default scenario settings of **irace**.

checkScenario to check that the scenario is valid.

checkParameters *checkParameters*

Description

FIXME: This is incomplete, for now we only repair inputs from previous irace versions.

Usage

```
checkParameters(parameters)
```

Arguments

parameters	ParameterSpace Data structure containing the parameter space definition. The data structure has to similar to the one returned by the function readParameters.

checkScenario *Check and correct the given scenario*

Description

Checks for errors a (possibly incomplete) scenario setup of **irace** and transforms it into a valid scenario.

Usage

```
checkScenario(scenario = defaultScenario())
```

Arguments

scenario	list() Data structure containing **irace** settings. The data structure has to be the one returned by the function defaultScenario() or readScenario().

Details

This function checks that the directories and the file names provided and required by the **irace** exist. It also checks that the settings are of the proper type, e.g. that settings expected to be integers are really integers. Finally, it also checks that there is no inconsistency between settings. If an error is found that prevents **irace** from running properly, it will stop with an error.

Value

The scenario received as a parameter, possibly corrected. Unset scenario settings are set to their default values.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

`readScenario()` for reading a configuration scenario from a file.

`printScenario()` prints the given scenario.

`defaultScenario()` returns the default scenario settings of **irace**.

`checkScenario()` to check that the scenario is valid.

`check_output_target_runner`
Check the output of the target runner and repair it if possible. If the output is incorrect, this function will throw an error.

Description

Check the output of the target runner and repair it if possible. If the output is incorrect, this function will throw an error.

Usage

```
check_output_target_runner(output, scenario, bound = NULL)
```

Arguments

`output`	The output from target runner.
`scenario`	`list()` Data structure containing **irace** settings. The data structure has to be the one returned by the function `defaultScenario()` or `readScenario()`.
`bound`	Optional time bound that the target runner should have respected.

Value

The output with its contents repaired.

configurations_print *Print configurations as a data frame*

Description

Print configurations as a data frame

Usage

```
configurations_print(configurations, metadata = FALSE)
```

Arguments

configurations	data.frame Parameter configurations of the target algorithm (one per row).
metadata	logical(1) whether to print the metadata or not. The metadata are data for the configurations (additionally to the value of each parameter) used by **irace**.

Value

None.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

configurations_print_command() to print the configurations as command-line strings.

configurations_print_command
Print configurations as command-line strings.

Description

Prints configurations after converting them into a representation for the command-line.

Usage

```
configurations_print_command(configurations, parameters)
```

Arguments

configurations	`data.frame` Parameter configurations of the target algorithm (one per row).
parameters	`ParameterSpace` Data structure containing the parameter space definition. The data structure has to similar to the one returned by the function `readParameters`.

Value

None.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

`configurations_print()` to print the configurations as a data frame.

`defaultScenario` *Default scenario settings*

Description

Return scenario object with default values.

Usage

```
defaultScenario(scenario = list(), params_def = .irace.params.def)
```

Arguments

scenario	`list()` Data structure containing **irace** settings. The data structure has to be the one returned by the function `defaultScenario()` or `readScenario()`.
params_def	`data.frame()` Definition of the options accepted by the scenario. This should only be modified by packages that wish to extend **irace**.

Value

A list indexed by the **irace** parameter names, containing the default values for each parameter, except for those already present in the scenario passed as argument. The scenario list contains the following elements:

- General options:

`scenarioFile` Path of the file that describes the configuration scenario setup and other irace settings. (Default: `"./scenario.txt"`)

`execDir` Directory where the programs will be run. (Default: `"./"`)

`logFile` File to save tuning results as an R dataset, either absolute path or relative to execDir. (Default: `"./irace.Rdata"`)

`quiet` Reduce the output generated by irace to a minimum. (Default: `0`)

`debugLevel` Debug level of the output of `irace`. Set this to 0 to silence all debug messages. Higher values (1, 2 or 3) provide more verbose debug messages. (Default: `0`)

`seed` Seed of the random number generator (by default, generate a random seed). (Default: `NA`)

`repairConfiguration` User-defined R function that takes a configuration generated by irace and repairs it. (Default: `""`)

`postselection` Perform a postselection race after the execution of irace to consume all remaining budget. Value 0 disables the postselection race. (Default: `1`)

`aclib` Enable/disable AClib mode. This option enables compatibility with GenericWrapper4AC as targetRunner script. (Default: `0`)

- Elitist `irace`:

  `elitist` Enable/disable elitist irace. (Default: `1`)

  `elitistNewInstances` Number of instances added to the execution list before previous instances in elitist irace. (Default: `1`)

  `elitistLimit` In elitist irace, maximum number per race of elimination tests that do not eliminate a configuration. Use 0 for no limit. (Default: `2`)

- Internal `irace` options:

  `sampleInstances` Randomly sample the training instances or use them in the order given. (Default: `1`)

  `softRestart` Enable/disable the soft restart strategy that avoids premature convergence of the probabilistic model. (Default: `1`)

  `softRestartThreshold` Soft restart threshold value for numerical parameters. (Default: `1e-04`)

  `nbIterations` Maximum number of iterations. (Default: `0`)

  `nbExperimentsPerIteration` Number of runs of the target algorithm per iteration. (Default: `0`)

  `minNbSurvival` Minimum number of configurations needed to continue the execution of each race (iteration). (Default: `0`)

  `nbConfigurations` Number of configurations to be sampled and evaluated at each iteration. (Default: `0`)

  `mu` Parameter used to define the number of configurations sampled and evaluated at each iteration. (Default: `5`)

- Target algorithm parameters:

  `parameterFile` File that contains the description of the parameters of the target algorithm. (Default: `"./parameters.txt"`)

  `parameters` Parameters space object (usually read from a file using `readParameters`). (Default: `""`)

- Target algorithm execution:

`targetRunner` Executable called for each configuration that executes the target algorithm to be tuned. See the templates and examples provided. (Default: `"./target-runner"`)

`targetRunnerLauncher` Executable that will be used to launch the target runner, when `targetRunner` cannot be executed directly (e.g., a Python script in Windows). (Default: `""`)

`targetCmdline` Command-line arguments provided to `targetRunner` (or `targetRunnerLauncher` if defined). The substrings `\{configurationID\}`, `\{instanceID\}`, `\{seed\}`, `\{instance\}`, and `\{bound\}` will be replaced by their corresponding values. The substring `\{targetRunnerArgs\}` will be replaced by the concatenation of the switch and value of all active parameters of the particular configuration being evaluated. The substring `\{targetRunner\}`, if present, will be replaced by the value of `targetRunner` (useful when using `targetRunnerLauncher`). (Default: `"{configurationID} {instanceID} {seed} {instance} {bound} {targetRunnerArgs}"`)

`targetRunnerRetries` Number of times to retry a call to `targetRunner` if the call failed. (Default: `0`)

`targetRunnerTimeout` Timeout in seconds of any `targetRunner` call (only applies to `target-runner` executables not to R functions), ignored if 0. (Default: `0`)

`targetRunnerData` Optional data passed to `targetRunner`. This is ignored by the default `targetRunner` function, but it may be used by custom `targetRunner` functions to pass persistent data around. (Default: `""`)

`targetRunnerParallel` Optional R function to provide custom parallelization of `targetRunner`. (Default: `""`)

`targetEvaluator` Optional script or R function that provides a numeric value for each configuration. See templates/target-evaluator.tmpl (Default: `""`)

`deterministic` If the target algorithm is deterministic, configurations will be evaluated only once per instance. (Default: `0`)

`parallel` Number of calls to `targetRunner` to execute in parallel. Values `0` or `1` mean no parallelization. (Default: `0`)

`loadBalancing` Enable/disable load-balancing when executing experiments in parallel. Load-balancing makes better use of computing resources, but increases communication overhead. If this overhead is large, disabling load-balancing may be faster. (Default: `1`)

`mpi` Enable/disable MPI. Use `Rmpi` to execute `targetRunner` in parallel (parameter `parallel` is the number of slaves). (Default: `0`)

`batchmode` Specify how irace waits for jobs to finish when `targetRunner` submits jobs to a batch cluster: sge, pbs, torque, slurm or htcondor. `targetRunner` must submit jobs to the cluster using, for example, `qsub`. (Default: `0`)

- Initial configurations:

`initConfigurations` Data frame describing initial configurations (usually read from a file using `readConfigurations`). (Default: `""`)

`configurationsFile` File that contains a table of initial configurations. If empty or `NULL`, all initial configurations are randomly generated. (Default: `""`)

- Training instances:

`instances` Character vector of the instances to be used in the `targetRunner`. (Default: `""`)

`trainInstancesDir` Directory where training instances are located; either absolute path or relative to current directory. If no `trainInstancesFiles` is provided, all the files in `trainInstancesDir` will be listed as instances. (Default: `""`)

`trainInstancesFile` File that contains a list of training instances and optionally additional parameters for them. If `trainInstancesDir` is provided, `irace` will search for the files in this folder. (Default: `""`)

`blockSize` Number of training instances, that make up a 'block' in `trainInstancesFile`. Elimination of configurations will only be performed after evaluating a complete block and never in the middle of a block. Each block typically contains one instance from each instance class (type or family) and the block size is the number of classes. The value of `blockSize` will multiply `firstTest`, `eachTest` and `elitistNewInstances`. (Default: `1`)

- Tuning budget:

  `maxExperiments` Maximum number of runs (invocations of `targetRunner`) that will be performed. It determines the maximum budget of experiments for the tuning. (Default: `0`)

  `minExperiments` Minimum number of runs (invocations of `targetRunner`) that will be performed. It determines the minimum budget of experiments for the tuning. The actual budget depends on the number of parameters and `minNbSurvival`. (Default: `NA`)

  `maxTime` Maximum total execution time for the executions of `targetRunner`. `targetRunner` must return two values: cost and time. This value and the one returned by `targetRunner` must use the same units (seconds, minutes, iterations, evaluations, ...). (Default: `0`)

  `budgetEstimation` Fraction (smaller than 1) of the budget used to estimate the mean computation time of a configuration. Only used when `maxTime` > 0 (Default: `0.05`)

  `minMeasurableTime` Minimum time unit that is still (significantly) measureable. (Default: `0.01`)

- Statistical test:

  `testType` Statistical test used for elimination. The default value selects `t-test` if `capping` is enabled or `F-test`, otherwise. Valid values are: F-test (Friedman test), t-test (pairwise t-tests with no correction), t-test-bonferroni (t-test with Bonferroni's correction for multiple comparisons), t-test-holm (t-test with Holm's correction for multiple comparisons). (Default: `""`)

  `firstTest` Number of instances evaluated before the first elimination test. It must be a multiple of `eachTest`. (Default: `5`)

  `eachTest` Number of instances evaluated between elimination tests. (Default: `1`)

  `confidence` Confidence level for the elimination test. (Default: `0.95`)

- Adaptive capping:

  `capping` Enable the use of adaptive capping, a technique designed for minimizing the computation time of configurations. Capping is enabled by default if `elitist` is active, `maxTime` > `0` and `boundMax` > `0`. (Default: `NA`)

  `cappingAfterFirstTest` If set to 1, elimination due to capping only happens after `firstTest` instances are seen. (Default: `0`)

  `cappingType` Measure used to obtain the execution bound from the performance of the elite configurations.

  - median: Median performance of the elite configurations.
  - mean: Mean performance of the elite configurations.
  - best: Best performance of the elite configurations.
  - worst: Worst performance of the elite configurations.

(Default: "median")

boundType Method to calculate the mean performance of elite configurations.

- candidate: Mean execution times across the executed instances and the current one.
- instance: Execution time of the current instance.

(Default: "candidate")

boundMax Maximum execution bound for targetRunner. It must be specified when capping is enabled. (Default: 0)

boundDigits Precision used for calculating the execution time. It must be specified when capping is enabled. (Default: 0)

boundPar Penalization multiplication constant (PARX) for timed out executions (executions that reach boundMax execution time). (Default: 1)

boundAsTimeout Replace the configuration cost of bounded executions with boundMax. (Default: 1)

- Recovery:

recoveryFile Previously saved log file to recover the execution of irace, either absolute path or relative to the current directory. If empty or NULL, recovery is not performed. (Default: "")

- Testing:

testInstancesDir Directory where testing instances are located, either absolute or relative to current directory. (Default: "")

testInstancesFile File containing a list of test instances and optionally additional parameters for them. (Default: "")

testInstances Character vector of the instances to be used in the targetRunner when executing the testing. (Default: "")

testNbElites Number of elite configurations returned by irace that will be tested if test instances are provided. (Default: 1)

testIterationElites Enable/disable testing the elite configurations found at each iteration. (Default: 0)

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

readScenario() for reading a configuration scenario from a file.

printScenario() prints the given scenario.

defaultScenario() returns the default scenario settings of **irace**.

checkScenario() to check that the scenario is valid.

getConfigurationById *Returns the configurations selected by ID.*

Description

Returns the configurations selected by ID.

Usage

```
getConfigurationById(iraceResults, ids, drop.metadata = FALSE)
```

Arguments

iraceResults	list()|character(1) Object created by **irace** and typically saved in the log file irace.Rdata. If a character string is given, then it is interpreted as the path to the log file from which the iraceResults object will be loaded.
ids	integer() The id or a vector of ids of the candidates configurations to obtain.
drop.metadata	logical(1) Remove metadata, such as the configuration ID and the ID of the parent, from the returned configurations. See removeConfigurationsMetaData().

Value

A data frame containing the elite configurations required, in the order and with the repetitions given by ids.

Author(s)

Manuel López-Ibáñez and Leslie Pérez Cáceres

Examples

```
log_file <- system.file("exdata/irace-acotsp.Rdata", package="irace", mustWork=TRUE)
getConfigurationById(log_file, ids = c(2,1), drop.metadata = TRUE)
```

getConfigurationByIteration *Returns the configurations by the iteration in which they were executed.*

Description

Returns the configurations by the iteration in which they were executed.

Usage

```
getConfigurationByIteration(iraceResults, iterations, drop.metadata = FALSE)
```

Arguments

iraceResults	list()|character(1) Object created by **irace** and typically saved in the log file `irace.Rdata`. If a character string is given, then it is interpreted as the path to the log file from which the `iraceResults` object will be loaded.
iterations	integer() The iteration number or a vector of iteration numbers from where the configurations should be obtained. Negative values start counting from the last iteration.
drop.metadata	logical(1) Remove metadata, such as the configuration ID and the ID of the parent, from the returned configurations. See `removeConfigurationsMetaData()`.

Value

A data frame containing the elite configurations required.

Author(s)

Manuel López-Ibáñez and Leslie Pérez Cáceres

Examples

```
log_file <- system.file("exdata/irace-acotsp.Rdata", package="irace", mustWork=TRUE)
getConfigurationByIteration(log_file, iterations = c(-2, -1), drop.metadata = TRUE)
```

`getFinalElites` *Return the elite configurations of the final iteration.*

Description

Return the elite configurations of the final iteration.

Usage

```
getFinalElites(iraceResults, n = 0L, drop.metadata = FALSE)
```

Arguments

`iraceResults`	`list()|character(1)` Object created by **irace** and typically saved in the log file `irace.Rdata`. If a character string is given, then it is interpreted as the path to the log file from which the `iraceResults` object will be loaded.
`n`	`integer(1)` Number of elite configurations to return, if `n` is larger than the number of configurations, then only the existing ones are returned. The default (`n=0`) returns all of them.
`drop.metadata`	`logical(1)` Remove metadata, such as the configuration ID and the ID of the parent, from the returned configurations. See `removeConfigurationsMetaData()`.

Value

A data frame containing the elite configurations required.

Author(s)

Manuel López-Ibáñez and Leslie Pérez Cáceres

Examples

```
log_file <- system.file("exdata/irace-acotsp.Rdata", package="irace", mustWork=TRUE)
print(removeConfigurationsMetaData(getFinalElites(log_file, n=1)))
```

`get_instanceID_seed_pairs` *Returns the pairs of instance IDs and seeds used as instances in the race (and optionally the actual instances).*

Description

Returns the pairs of instance IDs and seeds used as instances in the race (and optionally the actual instances).

Usage

```
get_instanceID_seed_pairs(iraceResults, index, instances = FALSE)
```

Arguments

`iraceResults`	`list()|character(1)` Object created by **irace** and typically saved in the log file `irace.Rdata`. If a character string is given, then it is interpreted as the path to the log file from which the `iraceResults` object will be loaded.
`index`	`integer()` Indexes of the (instanceID,seed) pairs to be returned. The default returns everything.
`instances`	`logical(1)` Whether to add the actual instances as an additional column (only if the instances are of atomic type).

Value

`data.table()`
With default arguments, a `data.table` containing two columns `"instanceID"` and `"seed"`. With `instances=TRUE` and if the instances are of atomic type (see `is.atomic()`) type, another column `instance` is added that contains the actual instance.

Author(s)

Manuel López-Ibáñez

Examples

```
log_file <- system.file("exdata/irace-acotsp.Rdata", package="irace", mustWork=TRUE)
head(get_instanceID_seed_pairs(log_file))
# Add the instance names
get_instanceID_seed_pairs(log_file, index=1:10, instances=TRUE)
```

has_testing_data *Check if the results object generated by irace has data about the testing phase.*

Description

Check if the results object generated by irace has data about the testing phase.

Usage

```
has_testing_data(iraceResults)
```

Arguments

iraceResults	list()|character(1) Object created by **irace** and typically saved in the log file `irace.Rdata`. If a character string is given, then it is interpreted as the path to the log file from which the `iraceResults` object will be loaded.

Value

`logical(1)`

Examples

```
irace_results <- read_logfile(system.file("exdata/irace-acotsp.Rdata", package="irace",
                                          mustWork=TRUE))
print(has_testing_data(irace_results))
```

irace *Execute one run of the Iterated Racing algorithm.*

Description

The function `irace` implements the Iterated Racing procedure for parameter tuning. It receives a configuration scenario and a parameter space to be tuned, and returns the best configurations found, namely, the elite configurations obtained from the last iterations. As a first step, it checks the correctness of `scenario` using `checkScenario()` and recovers a previous execution if `scenario$recoveryFile` is set. A R data file log of the execution is created in `scenario$logFile`.

Usage

```
irace(scenario)
```

Arguments

scenario	list() Data structure containing **irace** settings. The data structure has to be the one returned by the function defaultScenario() or readScenario().

Details

The execution of this function is reproducible under some conditions. See the FAQ section in the User Guide.

Value

(data.frame)

A data frame with the set of best algorithm configurations found by **irace**. The data frame has the following columns:

- .ID. : Internal id of the candidate configuration.
- Parameter names : One column per parameter name in parameters.
- .PARENT. : Internal id of the parent candidate configuration.

Additionally, this function saves an R data file containing an object called iraceResults. The path of the file is indicated in scenario$logFile. The iraceResults object is a list with the following structure:

scenario The scenario R object containing the **irace** options used for the execution. See defaultScenario for more information. The element scenario$parameters contains the parameters R object that describes the target algorithm parameters. See readParameters.

allConfigurations The target algorithm configurations generated by **irace**. This object is a data frame, each row is a candidate configuration, the first column (.ID.) indicates the internal identifier of the configuration, the following columns correspond to the parameter values, each column named as the parameter name specified in the parameter object. The final column (.PARENT.) is the identifier of the configuration from which model the actual configuration was sampled.

allElites A list that contains one element per iteration, each element contains the internal identifier of the elite candidate configurations of the corresponding iteration (identifiers correspond to allConfigurations$.ID.).

iterationElites A vector containing the best candidate configuration internal identifier of each iteration. The best configuration found corresponds to the last one of this vector.

experiments A matrix with configurations as columns and instances as rows. Column names correspond to the internal identifier of the configuration (allConfigurations$.ID.).

experimen_log A data.table with columns iteration, instance, configuration, time. This matrix contains the log of all the experiments that **irace** performs during its execution. The instance column refers to the index of the race_state$instances_log data frame. Time is saved ONLY when reported by the targetRunner.

softRestart A logical vector that indicates if a soft restart was performed on each iteration. If FALSE, then no soft restart was performed.

`state` An environment that contains the state of **irace**, the recovery is done using the information contained in this object.

`testing` A list that contains the testing results. The elements of this list are: `experiments` a matrix with the testing experiments of the selected configurations in the same format as the explained above and `seeds` a vector with the seeds used to execute each experiment.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

`irace_main()` a higher-level interface to `irace()`.

`irace_cmdline()` a command-line interface to `irace()`.

`readScenario()` for reading a configuration scenario from a file.

`readParameters()` read the target algorithm parameters from a file.

`defaultScenario()` returns the default scenario settings of **irace**.

`checkScenario()` to check that the scenario is valid.

Examples

```
## Not run:
# In general, there are three steps:
scenario <- readScenario(filename = "scenario.txt")
irace(scenario = scenario)

## End(Not run)
################################################################################
# This example illustrates how to tune the parameters of the simulated
# annealing algorithm (SANN) provided by the optim() function in the
# R base package.  The goal in this example is to optimize instances of
# the following family:
#      f(x) = lambda * f_rastrigin(x) + (1 - lambda) * f_rosenbrock(x)
# where lambda follows a normal distribution whose mean is 0.9 and
# standard deviation is 0.02. f_rastrigin and f_rosenbrock are the
# well-known Rastrigin and Rosenbrock benchmark functions (taken from
# the cmaes package). In this scenario, different instances are given
# by different values of lambda.
################################################################################
## First we provide an implementation of the functions to be optimized:
f_rosenbrock <- function (x) {
  d <- length(x)
  z <- x + 1
  hz <- z[1L:(d - 1L)]
  tz <- z[2L:d]
  sum(100 * (hz^2 - tz)^2 + (hz - 1)^2)
}
f_rastrigin <- function (x) {
  sum(x * x - 10 * cos(2 * pi * x) + 10)
}
```

```
## We generate 20 instances (in this case, weights):
weights <- rnorm(20, mean = 0.9, sd = 0.02)

## On this set of instances, we are interested in optimizing two
## parameters of the SANN algorithm: tmax and temp. We setup the
## parameter space as follows:
parameters_table <- '
  tmax "" i,log (1, 5000)
  temp "" r (0, 100)
  '
## We use the irace function readParameters to read this table:
parameters <- readParameters(text = parameters_table)

## Next, we define the function that will evaluate each candidate
## configuration on a single instance. For simplicity, we restrict to
## three-dimensional functions and we set the maximum number of
## iterations of SANN to 1000.
target_runner <- function(experiment, scenario)
{
    instance <- experiment$instance
    configuration <- experiment$configuration

    D <- 3
    par <- runif(D, min=-1, max=1)
    fn <- function(x) {
      weight <- instance
      return(weight * f_rastrigin(x) + (1 - weight) * f_rosenbrock(x))
    }
    # For reproducible results, we should use the random seed given by
    # experiment$seed to set the random seed of the target algorithm.
    res <- withr::with_seed(experiment$seed,
                     stats::optim(par,fn, method="SANN",
                                  control=list(maxit=1000
                                               , tmax = as.numeric(configuration[["tmax"]])
                                               , temp = as.numeric(configuration[["temp"]])
                                                  )))
    ## This list may also contain:
    ## - 'time' if irace is called with 'maxTime'
    ## - 'error' is a string used to report an error
    ## - 'outputRaw' is a string used to report the raw output of calls to
    ##   an external program or function.
    ## - 'call' is a string used to report how target_runner called the
    ##   external program or function.
    return(list(cost = res$value))
}

## We define a configuration scenario by setting targetRunner to the
## function define above, instances to the first 10 random weights, and
## a maximum budget of 'maxExperiments' calls to targetRunner.
scenario <- list(targetRunner = target_runner,
                 instances = weights[1:10],
                 maxExperiments = 500,
```

```
                # Do not create a logFile
                logFile = "",
                parameters = parameters)

## We check that the scenario is valid. This will also try to execute
## target_runner.
checkIraceScenario(scenario)


## We are now ready to launch irace. We do it by means of the irace
## function. The function will print information about its
## progress. This may require a few minutes, so it is not run by default.
tuned_confs <- irace(scenario = scenario)

## We can print the best configurations found by irace as follows:
configurations_print(tuned_confs)

## We can evaluate the quality of the best configuration found by
## irace versus the default configuration of the SANN algorithm on
## the other 10 instances previously generated.
test_index <- 11:20
test_seeds <- sample.int(2147483647L, size = length(test_index), replace = TRUE)
test <- function(configuration)
{
  res <- lapply(seq_along(test_index),
                function(x) target_runner(
                              experiment = list(instance = weights[test_index[x]],
                                                seed = test_seeds[x],
                                                configuration = configuration),
                              scenario = scenario))
  return (sapply(res, getElement, name = "cost"))
}
## To do so, first we apply the default configuration of the SANN
## algorithm to these instances:
default <- test(data.frame(tmax=10, temp=10))

## We extract and apply the winning configuration found by irace
## to these instances:
tuned <- test(removeConfigurationsMetaData(tuned_confs[1,]))

## Finally, we can compare using a boxplot the quality obtained with the
## default parametrization of SANN and the quality obtained with the
## best configuration found by irace.
boxplot(list(default = default, tuned = tuned))
```

`irace_cmdline` *Launch* `irace` *with command-line options.*

Description

Calls `irace_main()` using command-line options, maybe parsed from the command line used to invoke R.

Usage

```
irace_cmdline(argv = commandArgs(trailingOnly = TRUE))

irace.cmdline(argv = commandArgs(trailingOnly = TRUE))
```

Arguments

argv	`character()` The arguments provided on the R command line as a character vector, e.g., `c("--scenario", "scenario.txt", "-p", "parameters.txt")`. Using the default value (not providing the parameter) is the easiest way to call `irace_cmdline()`.

Details

The function reads the parameters given on the command line used to invoke R, finds the name of the scenario file, initializes the scenario from the file (with the function `readScenario()`) and possibly from parameters passed in the command line. It finally starts **irace** by calling `irace_main()`.

List of command-line options:

```
-h,--help                Show this help.
-v,--version             Show irace package version.
-c,--check               Check scenario.
-i,--init                Initialize the working directory with template config
                         files.
   --only-test           Only test the configurations given in the file passed
                         as argument.
-s,--scenario            File that describes the configuration scenario setup
                         and other irace settings. Default: ./scenario.txt.
   --exec-dir            Directory where the programs will be run. Default: ./.
-p,--parameter-file      File that contains the description of the parameters
                         of the target algorithm. Default: ./parameters.txt.
   --configurations-file  File that contains a table of initial configurations.
                         If empty or `NULL`, all initial configurations are
                         randomly generated.
-l,--log-file            File to save tuning results as an R dataset, either
                         absolute path or relative to execDir. Default:
                         ./irace.Rdata.
   --recovery-file       Previously saved log file to recover the execution of
                         `irace`, either absolute path or relative to the
                         current directory.  If empty or `NULL`, recovery is
                         not performed.
   --train-instances-dir  Directory where training instances are located;
                         either absolute path or relative to current directory.
```

```
                      If no `trainInstancesFiles` is provided, all the files
                      in `trainInstancesDir` will be listed as instances.
--train-instances-file  File that contains a list of training instances and
                      optionally additional parameters for them. If
                      `trainInstancesDir` is provided, `irace` will search
                      for the files in this folder.
--sample-instances    Randomly sample the training instances or use them in
                      the order given. Default: 1.
--test-instances-dir  Directory where testing instances are located, either
                      absolute or relative to current directory.
--test-instances-file  File containing a list of test instances and
                      optionally additional parameters for them.
--test-num-elites     Number of elite configurations returned by irace that
                      will be tested if test instances are provided.
                      Default: 1.
--test-iteration-elites  Enable/disable testing the elite configurations
                      found at each iteration. Default: 0.
--test-type           Statistical test used for elimination. The default
                      value selects `t-test` if `capping` is enabled or
                      `F-test`, otherwise. Valid values are: F-test
                      (Friedman test), t-test (pairwise t-tests with no
                      correction), t-test-bonferroni (t-test with
                      Bonferroni's correction for multiple comparisons),
                      t-test-holm (t-test with Holm's correction for
                      multiple comparisons).
--first-test          Number of instances evaluated before the first
                      elimination test. It must be a multiple of `eachTest`.
                      Default: 5.
--block-size          Number of training instances, that make up a 'block'
                      in `trainInstancesFile`. Elimination of configurations
                      will only be performed after evaluating a complete
                      block and never in the middle of a block. Each block
                      typically contains one instance from each instance
                      class (type or family) and the block size is the
                      number of classes. The value of `blockSize` will
                      multiply `firstTest`, `eachTest` and
                      `elitistNewInstances`. Default: 1.
--each-test           Number of instances evaluated between elimination
                      tests. Default: 1.
--target-runner       Executable called for each configuration that executes
                      the target algorithm to be tuned. See the templates
                      and examples provided. Default: ./target-runner.
--target-runner-launcher  Executable that will be used to launch the target
                      runner, when `targetRunner` cannot be executed
                      directly (e.g., a Python script in Windows).
--target-cmdline      Command-line arguments provided to `targetRunner` (or
                      `targetRunnerLauncher` if defined). The substrings
                      `\{configurationID\}`, `\{instanceID\}`, `\{seed\}`,
```

```
                        `\{instance\}`, and `\{bound\}` will be replaced by
                        their corresponding values. The substring
                        `\{targetRunnerArgs\}` will be replaced by the
                        concatenation of the switch and value of all active
                        parameters of the particular configuration being
                        evaluated.  The substring `\{targetRunner\}`, if
                        present, will be replaced by the value of
                        `targetRunner` (useful when using
                        `targetRunnerLauncher`). Default: {configurationID}
                        {instanceID} {seed} {instance} {bound}
                        {targetRunnerArgs}.
    --target-runner-retries  Number of times to retry a call to `targetRunner`
                        if the call failed. Default: 0.
    --target-runner-timeout  Timeout in seconds of any `targetRunner` call (only
                        applies to `target-runner` executables not to R
                        functions), ignored if 0. Default: 0.
    --target-evaluator  Optional script or R function that provides a numeric
                        value for each configuration. See
                        templates/target-evaluator.tmpl
    --deterministic     If the target algorithm is deterministic,
                        configurations will be evaluated only once per
                        instance. Default: 0.
    --max-experiments   Maximum number of runs (invocations of `targetRunner`)
                        that will be performed. It determines the maximum
                        budget of experiments for the tuning. Default: 0.
    --min-experiments   Minimum number of runs (invocations of `targetRunner`)
                        that will be performed. It determines the minimum
                        budget of experiments for the tuning. The actual
                        budget depends on the number of parameters and
                        `minNbSurvival`.
    --max-time          Maximum total execution time for the executions of
                        `targetRunner`. `targetRunner` must return two values:
                        cost and time. This value and the one returned by
                        `targetRunner` must use the same units (seconds,
                        minutes, iterations, evaluations, ...). Default: 0.
    --budget-estimation Fraction (smaller than 1) of the budget used to
                        estimate the mean computation time of a configuration.
                        Only used when `maxTime` > 0 Default: 0.05.
    --min-measurable-time  Minimum time unit that is still (significantly)
                        measureable. Default: 0.01.
    --parallel          Number of calls to `targetRunner` to execute in
                        parallel. Values `0` or `1` mean no parallelization.
                        Default: 0.
    --load-balancing    Enable/disable load-balancing when executing
                        experiments in parallel. Load-balancing makes better
                        use of computing resources, but increases
                        communication overhead. If this overhead is large,
                        disabling load-balancing may be faster. Default: 1.
```

```
   --mpi                 Enable/disable MPI. Use `Rmpi` to execute
                         `targetRunner` in parallel (parameter `parallel` is
                         the number of slaves). Default: 0.
   --batchmode           Specify how irace waits for jobs to finish when
                         `targetRunner` submits jobs to a batch cluster: sge,
                         pbs, torque, slurm or htcondor. `targetRunner` must
                         submit jobs to the cluster using, for example, `qsub`.
                         Default: 0.
-q,--quiet               Reduce the output generated by irace to a minimum.
                         Default: 0.
   --debug-level         Debug level of the output of `irace`. Set this to 0 to
                         silence all debug messages. Higher values (1, 2 or 3)
                         provide more verbose debug messages. Default: 0.
   --seed                Seed of the random number generator (by default,
                         generate a random seed).
   --soft-restart        Enable/disable the soft restart strategy that avoids
                         premature convergence of the probabilistic model.
                         Default: 1.
   --soft-restart-threshold  Soft restart threshold value for numerical
                         parameters. Default: 1e-04.
-e,--elitist             Enable/disable elitist irace. Default: 1.
   --elitist-new-instances  Number of instances added to the execution list
                         before previous instances in elitist irace. Default:
                         1.
   --elitist-limit       In elitist irace, maximum number per race of
                         elimination tests that do not eliminate a
                         configuration. Use 0 for no limit. Default: 2.
   --capping             Enable the use of adaptive capping, a technique
                         designed for minimizing the computation time of
                         configurations. Capping is enabled by default if
                         `elitist` is active, `maxTime > 0` and `boundMax > 0`.
   --capping-after-first-test  If set to 1, elimination due to capping only
                         happens after `firstTest` instances are seen. Default:
                         0.
   --capping-type        Measure used to obtain the execution bound from the
                         performance of the elite configurations: median, mean,
                         worst, best. Default: median.
   --bound-type          Method to calculate the mean performance of elite
                         configurations: candidate or instance. Default:
                         candidate.
   --bound-max           Maximum execution bound for `targetRunner`. It must be
                         specified when capping is enabled. Default: 0.
   --bound-digits        Precision used for calculating the execution time. It
                         must be specified when capping is enabled. Default: 0.
   --bound-par           Penalization multiplication constant (PARX) for timed
                         out executions (executions that reach `boundMax`
                         execution time). Default: 1.
   --bound-as-timeout    Replace the configuration cost of bounded executions
```

```
                        with `boundMax`. Default: 1.
  --postselection       Perform a postselection race after the execution of
                        irace to consume all remaining budget. Value 0
                        disables the postselection race. Default: 1.
  --aclib               Enable/disable AClib mode. This option enables
                        compatibility with GenericWrapper4AC as targetRunner
                        script. Default: 0.
  --iterations          Maximum number of iterations. Default: 0.
  --experiments-per-iteration  Number of runs of the target algorithm per
                        iteration. Default: 0.
  --min-survival        Minimum number of configurations needed to continue
                        the execution of each race (iteration). Default: 0.
  --num-configurations  Number of configurations to be sampled and evaluated
                        at each iteration. Default: 0.
  --mu                  Parameter used to define the number of configurations
                        sampled and evaluated at each iteration. Default: 5.
  --confidence          Confidence level for the elimination test. Default:
                        0.95.
```

Value

`(invisible(data.frame))`

A data frame with the set of best algorithm configurations found by **irace**. The data frame has the following columns:

- `.ID.` : Internal id of the candidate configuration.
- `Parameter names` : One column per parameter name in `parameters`.
- `.PARENT.` : Internal id of the parent candidate configuration.

Additionally, this function saves an R data file containing an object called `iraceResults`. The path of the file is indicated in `scenario$logFile`. The `iraceResults` object is a list with the following structure:

`scenario` The scenario R object containing the **irace** options used for the execution. See `defaultScenario` for more information. The element `scenario$parameters` contains the parameters R object that describes the target algorithm parameters. See `readParameters`.

`allConfigurations` The target algorithm configurations generated by **irace**. This object is a data frame, each row is a candidate configuration, the first column (`.ID.`) indicates the internal identifier of the configuration, the following columns correspond to the parameter values, each column named as the parameter name specified in the parameter object. The final column (`.PARENT.`) is the identifier of the configuration from which model the actual configuration was sampled.

`allElites` A list that contains one element per iteration, each element contains the internal identifier of the elite candidate configurations of the corresponding iteration (identifiers correspond to `allConfigurations$.ID.`).

`iterationElites` A vector containing the best candidate configuration internal identifier of each iteration. The best configuration found corresponds to the last one of this vector.

`experiments` A matrix with configurations as columns and instances as rows. Column names correspond to the internal identifier of the configuration (`allConfigurations$.ID.`).

`experimen_log` A `data.table` with columns `iteration`, `instance`, `configuration`, `time`. This matrix contains the log of all the experiments that **irace** performs during its execution. The instance column refers to the index of the `race_state$instances_log` data frame. Time is saved ONLY when reported by the `targetRunner`.

`softRestart` A logical vector that indicates if a soft restart was performed on each iteration. If `FALSE`, then no soft restart was performed.

`state` An environment that contains the state of **irace**, the recovery is done using the information contained in this object.

`testing` A list that contains the testing results. The elements of this list are: `experiments` a matrix with the testing experiments of the selected configurations in the same format as the explained above and `seeds` a vector with the seeds used to execute each experiment.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

`irace_main()` to start **irace** with a given scenario.

Examples

```
irace_cmdline("--version")
```

---

irace_license *irace_license*

Description

A character string containing the license information of **irace**.

Usage

```
irace_license
```

Format

An object of class `character` of length 1.

`irace_main` *Higher-level interface to launch irace.*

Description

Higher-level interface to launch irace.

Usage

```
irace_main(scenario, output.width = 9999L)
```

Arguments

`scenario`	`list()` Data structure containing **irace** settings. The data structure has to be the one returned by the function `defaultScenario()` or `readScenario()`.
`output.width`	`integer(1)` The width used for the screen output.

Details

This function checks the correctness of the scenario, reads the parameter space from `scenario$parameterFile`, invokes `irace()`, prints its results in various formatted ways, (optionally) calls `psRace()` and, finally, evaluates the best configurations on the test instances (if provided). If you want a lower-level interface that just runs irace, please see function `irace()`.

Value

`(invisible(data.frame))`

A data frame with the set of best algorithm configurations found by **irace**. The data frame has the following columns:

- `.ID.` : Internal id of the candidate configuration.
- `Parameter names` : One column per parameter name in `parameters`.
- `.PARENT.` : Internal id of the parent candidate configuration.

Additionally, this function saves an R data file containing an object called `iraceResults`. The path of the file is indicated in `scenario$logFile`. The `iraceResults` object is a list with the following structure:

`scenario` The scenario R object containing the **irace** options used for the execution. See `defaultScenario` for more information. The element `scenario$parameters` contains the parameters R object that describes the target algorithm parameters. See `readParameters`.

`allConfigurations` The target algorithm configurations generated by **irace**. This object is a data frame, each row is a candidate configuration, the first column (`.ID.`) indicates the internal identifier of the configuration, the following columns correspond to the parameter values, each column named as the parameter name specified in the parameter object. The final column

(.PARENT.) is the identifier of the configuration from which model the actual configuration was sampled.

allElites A list that contains one element per iteration, each element contains the internal identifier of the elite candidate configurations of the corresponding iteration (identifiers correspond to allConfigurations$.ID.).

iterationElites A vector containing the best candidate configuration internal identifier of each iteration. The best configuration found corresponds to the last one of this vector.

experiments A matrix with configurations as columns and instances as rows. Column names correspond to the internal identifier of the configuration (allConfigurations$.ID.).

experimen_log A data.table with columns iteration, instance, configuration, time. This matrix contains the log of all the experiments that **irace** performs during its execution. The instance column refers to the index of the race_state$instances_log data frame. Time is saved ONLY when reported by the targetRunner.

softRestart A logical vector that indicates if a soft restart was performed on each iteration. If FALSE, then no soft restart was performed.

state An environment that contains the state of **irace**, the recovery is done using the information contained in this object.

testing A list that contains the testing results. The elements of this list are: experiments a matrix with the testing experiments of the selected configurations in the same format as the explained above and seeds a vector with the seeds used to execute each experiment.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

irace_cmdline() a command-line interface to irace().

readScenario() for reading a configuration scenario from a file.

readParameters() read the target algorithm parameters from a file.

defaultScenario() returns the default scenario settings of **irace**.

---

irace_summarise *Summarise the results of a run of irace*

Description

Summarise the results of a run of irace

Usage

```
irace_summarise(iraceResults)
```

Arguments

iraceResults	list()|character(1) Object created by **irace** and typically saved in the log file irace.Rdata. If a character string is given, then it is interpreted as the path to the log file from which the iraceResults object will be loaded.

Value

list()

Author(s)

Manuel López-Ibáñez

Examples

```
irace_results <- read_logfile(system.file("exdata/irace-acotsp.Rdata",
                                          package="irace", mustWork=TRUE))
irace_summarise(irace_results)
```

---

irace_version *A character string containing the version of* irace *including git SHA.*

Description

A character string containing the version of irace including git SHA.

Usage

```
irace_version
```

Format

An object of class character of length 1.

multi_irace *Execute* irace() *multiple times with the same or different scenarios and parameter space definitions.*

Description

There are three modes of operation:

- One scenarios and k parameters: k runs with the same scenario and each parameter space definition.
- One parameters and k scenarios: k runs with the same parameter space definition and each scenario.
- k parameters and k scenarios: k runs with each scenario and parameter space definition.

Each of the k runs can be repeated n times by supplying a value for n.

Usage

```
multi_irace(
  scenarios,
  parameters,
  n = 1L,
  parallel = 1L,
  split_output = parallel > 1L,
  global_seed = NULL
)
```

Arguments

scenarios	list() A list of scenarios. If only a single scenario is supplied, it is used for all parameters.
parameters	list() A list of parameter space definitions. If only a single definition is supplied, it is used for all scenarios.
n	integer(1) The number of repetitions.
parallel	integer(1) The number of workers to use. A value of 1 means sequential execution. Note that parallel > 1 is not supported on Windows.
split_output	logical(1) If TRUE, the output of irace() is written to {execDir}/run_{i}/irace.out instead of the standard output.
global_seed	integer(1) The global seed used to seed the individual runs.

Value

A list of the outputs of `irace()`.

See Also

`irace()` the main interface for single irace runs.

`parameters` *Create a parameter space to be tuned.*

Description

- `param_cat()` creates a categorical parameter.
- `param_ord()` creates an ordinal parameter.
- `param_real()` creates a real-valued parameter.
- `param_int()` creates an integer parameter.

Usage

```
parametersNew(..., forbidden = NULL, debugLevel = 0L)

param_cat(name = name, values, label = "", condition = TRUE)

param_ord(name, values, label = "", condition = TRUE)

param_real(
  name,
  lower,
  upper,
  label = "",
  condition = TRUE,
  transf = "",
  digits = 15L
)

param_int(name, lower, upper, label = "", condition = TRUE, transf = "")
```

Arguments

`...`	one or more parameters created by `param_int()`, `param_real()`, `param_ord()`, or `param_cat()`.
`forbidden`	`expression()|character(1)` String or list of expressions that define forbidden parameter configurations.
`debugLevel`	`integer(1)` Larger values produce more verbose output.

name	character(1) Parameter name (must be alphanumeric).
values	character() Domain as a vector of strings.
label	character(1) Label associated to the parameter. Often used to encode a command-line switch that activates the parameter.
condition	expression(1)|character(1) Expression that defines when the parameter is active according to the value of other parameters.
lower, upper	Lower and upper limits of the valid domain.
transf	character(1) If "log", then the parameter is sampled in a logarithmic scale.
digits	integer(1) The number of decimal places to be considered for real-valued parameters.

Value

ParameterSpace

Examples

```
digits <- 4L
parametersNew(
  param_cat(name = "algorithm", values = c("as", "mmas", "eas", "ras", "acs"), label = "--"),
  param_ord(name = "localsearch", values = c("0", "1", "2", "3"), label = "--localsearch "),
   param_real(name = "alpha", lower = 0.0, upper=5.0, label = "--alpha ", digits = digits),
   param_real(name = "beta", lower = 0.0, upper = 10.0, label = "--beta ", digits = digits),
   param_real(name = "rho", lower = 0.01, upper = 1.00, label = "--rho ", digits = digits),
    param_int(name = "ants", lower = 5, upper = 100, transf = "log", label = "--ants "),
    param_real(name = "q0", label = "--q0 ", lower=0.0, upper=1.0,
               condition = expression(algorithm == "acs")),
   param_int(name = "rasrank", label = "--rasranks ", lower=1, upper=quote(min(ants, 10)),
             condition = 'algorithm == "ras"'),
  param_int(name = "elitistants", label = "--elitistants ", lower=1, upper=expression(ants),
             condition = 'algorithm == "eas"'),
   param_int(name = "nnls", label = "--nnls ", lower = 5, upper = 50,
             condition = expression(localsearch %in% c(1,2,3))),
   param_cat(name = "dlb",  label = "--dlb ", values = c(0,1),
             condition = "localsearch %in% c(1,2,3)"),
   forbidden = "(alpha == 0) & (beta == 0)")
```

path_rel2abs *Converts a relative path to an absolute path.*

Description

If the path passed corresponds to an executable, it tries to find its path using `Sys.which()`. Expansion of `'~'` in Windows follows the definition of `fs::path_expand()` rather than `base::path.expand()`. This function tries really hard to create canonical paths.

Usage

```
path_rel2abs(path, cwd = getwd())
```

Arguments

`path`	(`character(1)`) Character string representing a relative path.
`cwd`	(`character(1)`) Current working directory.

Value

(`character(1)`) Character string representing the absolute path

Examples

```
path_rel2abs("..")
```

plotAblation *Create plot from an ablation log*

Description

Create plot from an ablation log

Usage

```
plotAblation(
  ablog,
  pdf_file = NULL,
  width = 20,
  height = 7,
  type = c("mean", "boxplot", "rank"),
  n = 0L,
  mar = NULL,
  ylab = "Mean configuration cost",
  ylim = NULL,
  rename_labels = NULL,
  ...
)
```

Arguments

ablog	(list()|character(1)) Ablation log object returned by ablation(). Alternatively, the path to an .Rdata file, e.g., "log-ablation.Rdata", from which the object will be loaded.
pdf_file	Output filename.
width	Width provided to create the PDF file.
height	Height provided to create the PDF file.
type	Type of plot. Supported values are "mean" and "boxplot". Adding "rank" will plot rank per instance instead of raw cost value.
n	integer(1) Number of parameters included in the plot. By default all parameters are included.
mar	Vector with the margins for the ablation plot.
ylab	Label of y-axis.
ylim	Numeric vector of length 2 giving the y-axis range.
rename_labels	character() Renaming table for nicer labels. For example, c("No value"="NA", "LongParameterName"="LPN").
...	Further graphical parameters may also be supplied as arguments. See graphics::plot.default().

Author(s)

Leslie Pérez Cáceres and Manuel López-Ibáñez

See Also

ablation() ablation_cmdline()

Examples

```
logfile <- file.path(system.file(package="irace"), "exdata", "log-ablation.Rdata")
plotAblation(ablog = logfile)
plotAblation(ablog = logfile, type = "mean")
plotAblation(ablog = logfile, type = c("rank","boxplot"), rename_labels = c(
            "localsearch"="ls", algorithm="algo", source="default"))
```

---

printParameters *Print parameter space in the textual format accepted by irace.*

Description

Print parameter space in the textual format accepted by irace.

Usage

```
printParameters(parameters)
```

Arguments

parameters	ParameterSpace Data structure containing the parameter space definition. The data structure has to similar to the one returned by the function readParameters.

Value

character()

See Also

readParameters()

Examples

```
parameters_table <- '
 # name       switch           type  values               [conditions (using R syntax)]
 algorithm    "--"             c     (as,mmas,eas,ras,acs)
 localsearch  "--localsearch " c     (0, 1, 2, 3)
 alpha        "--alpha "       r     (0.00, 5.00)
 beta         "--beta "        r     (0.00, 10.00)
 rho          "--rho  "        r     (0.01, 1.00)
 ants         "--ants "        i,log (5, 100)
 q0           "--q0 "          r     (0.0, 1.0)           | algorithm == "acs"
 q0dep       "--q0 "           r     (0.0, q0)            | algorithm != "acs"
 rasrank      "--rasranks "    i     (1, "min(ants, 10)") | algorithm == "ras"
 elitistants  "--elitistants " i     (1, ants)            | algorithm == "eas"
 nnls         "--nnls "        i     (5, 50)              | localsearch %in% c(1,2,3)
 dlb          "--dlb "         c     (0, 1)               | localsearch %in% c(1,2,3)

 [forbidden]
 (alpha == 0.0) & (beta == 0.0)
'
parameters <- readParameters(text=parameters_table)
printParameters(parameters)
```

---

printScenario *Prints the given scenario*

Description

Prints the given scenario

Usage

```
printScenario(scenario)
```

Arguments

scenario	list() Data structure containing **irace** settings. The data structure has to be the one returned by the function defaultScenario() or readScenario().

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

readScenario() for reading a configuration scenario from a file.

printScenario() prints the given scenario.

defaultScenario() returns the default scenario settings of **irace**.

checkScenario() to check that the scenario is valid.

---

psRace *Post-selection race*

Description

psRace performs a post-selection race of a set of configurations.

Usage

```
psRace(
  iraceResults,
  max_experiments,
  conf_ids = NULL,
  iteration_elites = FALSE,
  psrace_logFile = NULL
)
```

Arguments

iraceResults	list()|character(1) Object created by **irace** and typically saved in the log file irace.Rdata. If a character string is given, then it is interpreted as the path to the log file from which the iraceResults object will be loaded.
max_experiments	numeric(1) Number of experiments for the post-selection race. If it is equal to or smaller than 1, then it is a fraction of the total budget given by iraceResults$scenario$maxExperiments or iraceResults$scenario$maxTime / iraceResults$state$boundEstimate.
conf_ids	IDs of the configurations in iraceResults$allConfigurations to be used for the post-selection. If NULL, then the configurations are automatically selected.

`iteration_elites`
: If `FALSE`, give priority to selecting the configurations that were elite in the last iteration. If `TRUE`, select from all elite configurations of all iterations. This parameter only has an effect when `conf_ids` is not `NULL`.

`psrace_logFile` `character(1)`
: Log file to save the post-selection race log. If `NULL`, the log is saved in `iraceResults$scenario$logFile`

Value

The elite configurations after the post-selection. In addition, if `iraceResults$scenario$logFile` is defined, it saves an updated copy of `iraceResults` in that file, where `iraceResults$psrace_log` is a list with the following elements:

configurations Configurations used in the post-selection race.

instances Data frame with the instances used in the post-selection race. First column has the instances IDs from `iraceResults$scenario$instances`, second column the seed assigned to the instance.

max_experiments Configuration budget assigned to the post-selection race.

experiments Matrix of results generated by the post-selection race, in the same format as the matrix `iraceResults$experiments`. Column names are the configuration IDs and row names are the instance IDs.

elites Best configurations found in the experiments.

Author(s)

Leslie Pérez Cáceres and Manuel López-Ibáñez

Examples

```
irace_log <- read_logfile(system.file(package="irace", "exdata", "sann.rda"))
# Use a temporary file to not change the original "sann.rda".
psrace_logFile <- withr::local_tempfile(fileext = ".Rdata")
# Execute the post-selection after the execution of irace. Use 10% of the total budget.
psRace(irace_log, max_experiments=0.1, psrace_logFile = psrace_logFile)
# Print psrace_log
irace_log <- read_logfile(psrace_logFile)
str(irace_log$psrace_log)
```

---

random_seed *Get, set and restore the state of the random number generator state.*

Description

Get, set and restore the state of the random number generator state.

Usage

```
get_random_seed()

set_random_seed(seed)

restore_random_seed(seed)
```

Arguments

seed	(list()|integer(1)) Either an integer or the list returned gy get_random_seed().

Details

These functions originate from the withr package.

Value

get_random_seed() returns a list with two components random_seed and rng_kind or NULL if no seed was set; set_random_seed() and restore_random_seed() do not return anything.

Examples

```
old_seed <- get_random_seed()
on.exit(restore_random_seed(old_seed))
set_random_seed(42)
value1 <- runif(1)
set_random_seed(42)
value2 <- runif(1)
stopifnot(all.equal(value1,value2))
```

---

readConfigurationsFile

Read parameter configurations from a file

Description

Reads a set of target-algorithm configurations from a file and puts them in **irace** format. The configurations are checked to match the parameters description provided.

Usage

```
readConfigurationsFile(filename, parameters, debugLevel = 0L, text)
```

Arguments

filename	character(1) Filename from which the configurations should be read. The contents should be readable by read.table(, header=TRUE).
parameters	ParameterSpace Data structure containing the parameter space definition. The data structure has to similar to the one returned by the function readParameters.
debugLevel	integer(1) Larger values produce more verbose output.
text	character(1) If file is not supplied and this is, then configurations are read from the value of text via a text connection.

Details

Example of an input file:

```
# This is a comment line
param_1    param_2
    0.5  "value_1"
    1.0         NA
    1.2  "value_3"
```

The order of the columns does not necessarily have to be the same as in the file containing the definition of the parameters.

Value

A data frame containing the obtained configurations. Each row of the data frame is a candidate configuration, the columns correspond to the parameter names in parameters.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

readParameters() to obtain a valid parameter structure from a parameters file.

`readParameters` *Reads the parameters to be tuned by* **irace** *from a file or from a character string.*

Description

Reads the parameters to be tuned by **irace** from a file or from a character string.

Usage

```
readParameters(file, digits = 4L, debugLevel = 0L, text)
```

Arguments

`file`	`character(1)` Filename containing the definitions of the parameters to be tuned.
`digits`	`integer(1)` The number of decimal places to be considered for real-valued parameters.
`debugLevel`	`integer(1)` Larger values produce more verbose output.
`text`	`character(1)` If `file` is not supplied and this is, then parameters are read from the value of `text` via a text connection.

Details

Either `file` or `text` must be given. If `file` is given, the parameters are read from the file `file`. If `text` is given instead, the parameters are read directly from the `text` character string. In both cases, the parameters must be given (in `text` or in the file whose name is `file`) in the expected form. See the documentation for details. If none of these parameters is given, **irace** will stop with an error.

A fixed parameter is a parameter that should not be sampled but instead should be always set to the only value of its domain. In this function we set `isFixed` to TRUE only if the parameter is a categorical and has only one possible value. If it is an integer and the minimum and maximum are equal, or it is a real and the minimum and maximum values satisfy `round(minimum, digits) == round(maximum, digits)`, then the parameter description is rejected as invalid to identify potential user errors.

The order of the parameters determines the order in which parameters are given to `targetRunner`. Changing the order may also change the results produced by `irace`, even with the same random seed.

Value

A list containing the definitions of the parameters read. The list is structured as follows:

`names` Vector that contains the names of the parameters.

`types` Vector that contains the type of each parameter 'i', 'c', 'r', 'o'. Numerical parameters can be sampled in a log-scale with 'i,log' and 'r,log' (no spaces).

`switches` Vector that contains the switches to be used for the parameters on the command line.

`domain` List of vectors, where each vector may contain two values (minimum, maximum) for real and integer parameters, or possibly more for categorical parameters.

`conditions` List of R logical expressions, with variables corresponding to parameter names.

`isFixed` Logical vector that specifies which parameter is fixed and, thus, it does not need to be tuned.

`nbParameters` An integer, the total number of parameters.

`nbFixed` An integer, the number of parameters with a fixed value.

`nbVariable` Number of variable (to be tuned) parameters.

`depends` List of character vectors, each vector specifies which parameters depend on this one.

`is_dependent` Logical vector that specifies which parameter has a dependent domain.

`digits` Integer vector that specifies the number of digits per parameter.

`forbidden` List of expressions that define which parameter configurations are forbidden.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

Examples

```
## Read the parameters directly from text
parameters_table <- '
# name       switch           type  values               [conditions (using R syntax)]
algorithm    "--"             c     (as,mmas,eas,ras,acs)
localsearch  "--localsearch " o     (0, 1, 2, 3)
alpha        "--alpha "       r     (0.00, 5.00)
beta         "--beta "        r     (0.00, 10.00)
rho          "--rho  "        r     (0.01, 1.00)
ants         "--ants "        i,log (5, 100)
q0           "--q0 "          r     (0.0, 1.0)           | algorithm == "acs"
rasrank      "--rasranks "    i     (1, "min(ants, 10)") | algorithm == "ras"
elitistants  "--elitistants " i     (1, ants)            | algorithm == "eas"
nnls         "--nnls "        i     (5, 50)              | localsearch %in% c(1,2,3)
dlb          "--dlb "         c     (0, 1)               | localsearch %in% c(1,2,3)

[forbidden]
(alpha == 0.0) & (beta == 0.0)
[global]
digits = 4
'
parameters <- readParameters(text=parameters_table)
str(parameters)
```

readScenario *Reads from a file the scenario settings to be used by* **irace**.

Description

The scenario argument is an initial scenario that is overwritten for every setting specified in the file to be read.

Usage

```
readScenario(filename = "", scenario = list(), params_def = .irace.params.def)
```

Arguments

filename	character(1) Filename from which the scenario will be read. If empty, the default scenarioFile is used. An example scenario file is provided in system.file(package="irace", "templates/scenario.txt.tmpl").
scenario	list() Data structure containing **irace** settings. The data structure has to be the one returned by the function defaultScenario() or readScenario().
params_def	data.frame() Definition of the options accepted by the scenario. This should only be modified by packages that wish to extend **irace**.

Value

The scenario list read from the file. The scenario settings not present in the file are not present in the list, i.e., they are NULL.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

printScenario() prints the given scenario.

defaultScenario() returns the default scenario settings of **irace**.

checkScenario() to check that the scenario is valid.

read_ablogfile *Read the log file (*log-ablation.Rdata*) produced by* ablation().

Description

Read the log file (log-ablation.Rdata) produced by ablation().

Usage

```
read_ablogfile(filename)
```

Arguments

filename	character(1) Filename that contains the log file saved by ablation(). Example: log-ablation.Rdata.

Value

list()

read_logfile *Read the log file produced by irace (*irace.Rdata*).*

Description

Read the log file produced by irace (irace.Rdata).

Usage

```
read_logfile(filename, name = "iraceResults")
```

Arguments

filename	Filename that contains the log file saved by irace. Example: irace.Rdata.
name	Optional argument that allows overriding the default name of the object in the file.

Value

(list())

Examples

```
irace_results <- read_logfile(system.file("exdata/irace-acotsp.Rdata", package="irace",
                                          mustWork=TRUE))
str(irace_results)
```

`read_pcs_file` *Read parameters in PCS (AClib) format and write them in irace format.*

Description

Read parameters in PCS (AClib) format and write them in irace format.

Usage

```
read_pcs_file(file, digits = 4L, debugLevel = 0L, text)
```

Arguments

`file`	`character(1)` Filename containing the definitions of the parameters to be tuned.
`digits`	`integer(1)` The number of decimal places to be considered for real-valued parameters.
`debugLevel`	`integer(1)` Larger values produce more verbose output.
`text`	`character(1)` If `file` is not supplied and this is, then parameters are read from the value of `text` via a text connection.

Details

Either `file` or `text` must be given. If `file` is given, the parameters are read from the file `file`. If `text` is given instead, the parameters are read directly from the `text` character string. In both cases, the parameters must be given (in `text` or in the file whose name is `file`) in the expected form. See the documentation for details. If none of these parameters is given, **irace** will stop with an error.

FIXME: Multiple conditions and default configuration are currently ignored. See https://github.com/MLopez-Ibanez/irace/issues/31

Value

A string representing the parameters in irace format.

Author(s)

Manuel López-Ibáñez

References

Frank Hutter, Manuel López-Ibáñez, Chris Fawcett, Marius Thomas Lindauer, Holger H. Hoos, Kevin Leyton-Brown, and Thomas Stützle. **AClib: A Benchmark Library for Algorithm Configuration**. In P. M. Pardalos, M. G. C. Resende, C. Vogiatzis, and J. L. Walteros, editors, *Learning and Intelligent Optimization, 8th International Conference, LION 8*, volume 8426 of Lecture Notes in Computer Science, pages 36–40. Springer, Heidelberg, 2014.

See Also

readParameters()

Examples

```
## Read the parameters directly from text
pcs_table <- '
# name       domain
algorithm    {as,mmas,eas,ras,acs}[as]
localsearch  {0, 1, 2, 3}[0]
alpha        [0.00, 5.00][1]
beta         [0.00, 10.00][1]
rho          [0.01, 1.00][0.95]
ants         [1, 100][10]il
q0           [0.0, 1.0][0]
rasrank      [1, 100][1]i
elitistants  [1, 750][1]i
nnls         [5, 50][5]i
dlb          {0, 1}[1]
Conditionals:
q0 | algorithm in {acs}
rasrank | algorithm in {ras}
elitistants | algorithm in {eas}
nnls | localsearch in {1,2,3}
dlb | localsearch in {1,2,3}
{alpha=0, beta=0}'
parameters_table <- read_pcs_file(text=pcs_table)
cat(parameters_table)
parameters <- readParameters(text=parameters_table)
str(parameters)
```

---

removeConfigurationsMetaData *removeConfigurationsMetaData*

Description

Remove the columns with "metadata" of a data frame containing configurations. Currently, metadata corresponds to column names starting with a period. This function should be used before printing the configurations to output only the values for the parameters of the configuration without metadata possibly useless to the user.

Usage

```
removeConfigurationsMetaData(configurations)
```

Arguments

`configurations`	`data.frame` Parameter configurations of the target algorithm (one per row).

Value

The same data frame without "metadata".

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

See Also

`configurations_print_command()` to print the configurations as command lines. `configurations_print()` to print the configurations as a data frame.

`save_irace_logfile` *Save the log generated by* **irace** *to a file (by default* `irace.Rdata`*).*

Description

This function may be useful if you are manually editing the log data generated by a run of **irace**.

Usage

```
save_irace_logfile(iraceResults, logfile)
```

Arguments

`iraceResults`	`list()` Object created by **irace** and typically saved in the log file `irace.Rdata`.
`logfile`	`character(1)` Filename to save `iraceResults`. Usually, this is given by `scenario$logFile`. If `NULL` or `""`, no data is saved.

See Also

`read_logfile()`

scenario_update_paths *Update filesystem paths of a scenario consistently.*

Description

This function should be used to change the filesystem paths stored in a scenario object. Useful when moving a scenario from one computer to another.

Usage

```
scenario_update_paths(scenario, from, to, fixed = TRUE)
```

Arguments

scenario	list() Data structure containing **irace** settings. The data structure has to be the one returned by the function defaultScenario() or readScenario().
from	character(1) Character string containing a regular expression (or character string for fixed = TRUE) to be matched.
to	character(1) The replacement string.character string. For fixed = FALSE this can include backreferences "\1" to "\9" to parenthesized subexpressions of from.
fixed	logical(1) If TRUE, from is a string to be matched as is.

Value

The updated scenario

See Also

base::grep()

Examples

```
## Not run:
scenario <- readScenario(filename = "scenario.txt")
scenario <- scenario_update_paths(scenario, from = "/home/manuel/", to = "/home/leslie")

## End(Not run)
```

target_evaluator_default *target_evaluator_default*

Description

`target_evaluator_default` is the default `targetEvaluator` function that is invoked if `targetEvaluator` is a string (by default `targetEvaluator` is `NULL` and this function is not invoked). You can use it as an advanced example of how to create your own `targetEvaluator` function.

Usage

```
target_evaluator_default(
  experiment,
  num_configurations,
  all_conf_id,
  scenario,
  target_runner_call
)
```

Arguments

`experiment`	A list describing the experiment. It contains at least: `id_configuration` An alphanumeric string that uniquely identifies a configuration; `id_instance` An alphanumeric string that uniquely identifies an instance; `seed` Seed for the random number generator to be used for this evaluation, ignore the seed for deterministic algorithms; `instance` String giving the instance to be used for this evaluation; `bound` (only when `capping` is enabled) Time bound for the execution; `configuration` 1-row data frame with a column per parameter name;
`num_configurations`	Number of configurations alive in the race.
`all_conf_id`	Vector of configuration IDs of the alive configurations.
`scenario`	`list()` Data structure containing **irace** settings. The data structure has to be the one returned by the function `defaultScenario()` or `readScenario()`.
`target_runner_call`	String describing the call to `targetRunner` that corresponds to this call to `targetEvaluator`. This is used for providing extra information to the user, for example, in case `targetEvaluator` fails.

Value

The function `targetEvaluator` must return a list with one element `"cost"`, the numerical value corresponding to the cost measure of the given configuration on the given instance.

The return list may also contain the following optional elements that are used by **irace** for reporting errors in `targetEvaluator`:

`error` is a string used to report an error;

`outputRaw` is a string used to report the raw output of calls to an external program or function;

`call` is a string used to report how `targetRunner` called an external program or function.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

`target_runner_default` *Default* `targetRunner` *function.*

Description

Use it as an advanced example of how to create your own `targetRunner` function.

Usage

```
target_runner_default(experiment, scenario)
```

Arguments

`experiment`	A list describing the experiment. It contains at least: `id_configuration` An alphanumeric string that uniquely identifies a configuration; `id_instance` An alphanumeric string that uniquely identifies an instance; `seed` Seed for the random number generator to be used for this evaluation, ignore the seed for deterministic algorithms; `instance` String giving the instance to be used for this evaluation; `bound` (only when `capping` is enabled) Time bound for the execution; `configuration` 1-row data frame with a column per parameter name;
`scenario`	`list()` Data structure containing **irace** settings. The data structure has to be the one returned by the function `defaultScenario()` or `readScenario()`.

Value

If `targetEvaluator` is `NULL`, then the `targetRunner` function must return a list with at least one element `"cost"`, the numerical value corresponding to the evaluation of the given configuration on the given instance.

If the scenario option `maxTime` is non-zero or if `capping` is enabled then the list must contain at least another element `"time"` that reports the execution time for this call to `targetRunner`. The return list may also contain the following optional elements that are used by **irace** for reporting errors in `targetRunner`:

`error` is a string used to report an error;

`outputRaw` is a string used to report the raw output of calls to an external program or function;

`call` is a string used to report how `targetRunner` called an external program or function.

Author(s)

Manuel López-Ibáñez and Jérémie Dubois-Lacoste

`testConfigurations` *Execute the given configurations on the testing instances specified in the scenario*

Description

Execute the given configurations on the testing instances specified in the scenario

Usage

```
testConfigurations(configurations, scenario)
```

Arguments

`configurations`	`data.frame` Parameter configurations of the target algorithm (one per row).
`scenario`	`list()` Data structure containing **irace** settings. The data structure has to be the one returned by the function `defaultScenario()` or `readScenario()`.

Details

A test instance set must be provided through `scenario[["testInstances"]]`.

Value

A list with the following elements:

`experiments` Experiments results.

`seeds` Array of the instance seeds used in the experiments.

Author(s)

Manuel López-Ibáñez

See Also

testing_fromlog()

---

testing_fromfile *Test configurations given an explicit table of configurations and a scenario file*

Description

Executes the testing of an explicit list of configurations given in filename (same format as in readConfigurationsFile()). A logFile is created unless disabled in scenario. This may overwrite an existing one!

Usage

```
testing_fromfile(filename, scenario)
```

Arguments

filename	character(1) Path to a file containing configurations: one configuration per line, one parameter per column, parameter names in header.
scenario	list() Data structure containing **irace** settings. The data structure has to be the one returned by the function defaultScenario() or readScenario().

Value

iraceResults

Author(s)

Manuel López-Ibáñez

See Also

testing_fromlog() provides a different interface for testing.

`testing_fromlog` *Test configurations given in the logfile (typically* `irace.Rdata`*) produced by* **irace**.

Description

`testing_fromlog` executes the testing of the target algorithm configurations found by an **irace** execution.

Usage

```
testing_fromlog(
  logFile,
  testNbElites,
  testIterationElites,
  testInstancesDir,
  testInstancesFile,
  testInstances
)
```

Arguments

`logFile`	`character(1)` Path to the logfile (typically `irace.Rdata`) produced by **irace**.
`testNbElites`	Number of (final) elite configurations to test. Overrides the value found in `logFile`.
`testIterationElites`	`logical(1)` If `FALSE`, only the final `testNbElites` configurations are tested; otherwise, also test the best configurations of each iteration. Overrides the value found in `logFile`.
`testInstancesDir`	Directory where testing instances are located, either absolute or relative to current directory.
`testInstancesFile`	File containing a list of test instances and optionally additional parameters for them.
`testInstances`	Character vector of the instances to be used in the `targetRunner` when executing the testing.

Details

The function `testing_fromlog` loads the `logFile` and obtains the testing setup and configurations to be tested. Within the `logFile`, the variable `scenario$testNbElites` specifies how many final elite configurations to test and `scenario$testIterationElites` indicates whether test the best configuration of each iteration. The values may be overridden by setting the corresponding arguments in this function. The set of testing instances must appear in `scenario[["testInstances"]]`.

Value

`logical(1)`
`TRUE` if the testing ended successfully otherwise, `FALSE`.

Author(s)

Manuel López-Ibáñez and Leslie Pérez Cáceres

See Also

`defaultScenario()` to provide a default scenario for **irace**. `testing_fromfile()` provides a different interface for testing.

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