Package ‘evoper’

October 13, 2022

Type Package

Title Evolutionary Parameter Estimation for 'Repast Simphony' Models

Version 0.5.0

Date 2018-08-30

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URL https://github.com/antonio-pgarcia/evoper

BugReports https://github.com/antonio-pgarcia/evoper/issues

Description
The EvoPER, Evolutionary Parameter Estimation for Individual-based Models is an extensible package providing optimization driven parameter estimation methods using metaheuristics and evolutionary computation techniques (Particle Swarm Optimization, Simulated Annealing, Ant Colony Optimization
for continuous domains, Tabu Search, Evolutionary Strategies, ...) which could be more efficient and require,
in some cases, fewer model evaluations than alternatives relying on experimental design. Currently there
are built in support for models developed with 'Repast Simphony' Agent-Based framework (<https://repast.github.io/>)
and with NetLogo (<https://ccl.northwestern.edu/netlogo/>) which are the most used frameworks for Agent-based modeling.

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LazyData TRUE

Depends rrepast

Imports methods, futile.logger, boot, reshape, ggplot2, deSolve,
plot3D, plyr, data.table, utils, RNetLogo

RoxygenNote 6.0.1

Suggests testthat

NeedsCompilation no

Repository CRAN

Date/Publication 2018-08-30 23:20:06 UTC

R topics documented:

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abm.acor *Ant colony optimization for continuous domains*

Description

An implementation of Ant Colony Optimization algorithm for continuous variables.

Usage

```
abm.acor(objective, options = NULL)
```

Arguments

objective	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
options	An apropiate instance from a sublclass of Options class

References

[1] Socha, K., & Dorigo, M. (2008). Ant colony optimization for continuous domains. European Journal of Operational Research, 185(3), 1155-1173. http://doi.org/10.1016/j.ejor.2006.06.046

Examples

```
## Not run:
 f<- PlainFunction$new(f0.rosenbrock2)

 f$Parameter(name="x1",min=-100,max=100)
 f$Parameter(name="x2",min=-100,max=100)

 extremize("acor", f)

## End(Not run)
```

abm.ees1 *EvoPER Evolutionary Strategy 1*

Description

This function tries to provide a rough approximation to best solution when no information is available for the correct range of input parameters for the objective function. It can useful for studying the behavior of individual-based models with high variability in the output variables showing nonlinear behaviors.

Usage

```
abm.ees1(objective, options = NULL)
```

Arguments

`objective`	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
`options`	An apropiate instance from a sublclass of Options class

Examples

```
## Not run:
 f<- PlainFunction$new(f0.rosenbrock2)

 f$Parameter(name="x1",min=-100,max=100)
 f$Parameter(name="x2",min=-100,max=100)

 extremize("ees1", f)

## End(Not run)
```

abm.ees2 *EvoPER Evolutionary Strategy 2*

Description

This function tries to provide a rough approximation to best solution when no information is available for the correct range of input parameters for the objective function. It can useful for studying the behavior of individual-based models with high variability in the output variables showing nonlinear behaviors.

Usage

```
abm.ees2(objective, options = NULL)
```

Arguments

`objective`	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
`options`	An apropiate instance from a sublclass of Options class

Examples

```
## Not run:
 f<- PlainFunction$new(f0.rosenbrock2)

 f$Parameter(name="x1",min=-100,max=100)
 f$Parameter(name="x2",min=-100,max=100)

 extremize("ees2", f)

## End(Not run)
```

`abm.pso` *abm.pso*

Description

An implementaion of Particle Swarm Optimization method for parameter estimation of Individual-based models.

Usage

```
abm.pso(objective, options = NULL)
```

Arguments

`objective`	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
`options`	An apropiate instance from a sublclass of Options class

References

[1] Kennedy, J., & Eberhart, R. (1995). Particle swarm optimization. In Proceedings of ICNN 95 - International Conference on Neural Networks (Vol. 4, pp. 1942-1948). IEEE.

[2] Poli, R., Kennedy, J., & Blackwell, T. (2007). Particle swarm optimization. Swarm Intelligence, 1(1), 33-57.

Examples

```
## Not run:
 f<- PlainFunction$new(f0.rosenbrock2)

 f$Parameter(name="x1",min=-100,max=100)
 f$Parameter(name="x2",min=-100,max=100)

 extremize("pso", f)

## End(Not run)
```

---

abm.saa *abm.saa*

Description

An implementation of Simulated Annealing Algorithm optimization method for parameter estimation of Individual-based models.

Usage

```
abm.saa(objective, options = NULL)
```

Arguments

objective	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
options	An apropiate instance from a sublclass of Options class

Value

The best solution.

References

[1] Kirkpatrick, S., Gelatt, C. D., & Vecchi, M. P. (1983). Optimization by Simulated Annealing. Science, 220(4598).

Examples

```
## Not run:
 f<- PlainFunction$new(f0.rosenbrock2)

 f$Parameter(name="x1",min=-100,max=100)
 f$Parameter(name="x2",min=-100,max=100)

 extremize("saa", f)

## End(Not run)
```

```
## Not run:
 ## A Repast defined function
 f<- RepastFunction$new("/usr/models/BactoSim(HaldaneEngine-1.0)","ds::Output",300)

 ## or a plain function

 f1<- function(x1,x2,x3,x4) {
   10 * (x1 - 1)^2 + 20 * (x2 - 2)^2 + 30 * (x3 - 3)^2 + 40 * (x4 - 4)^2
 }

 f<- PlainFunction$new(f1)

 f$addFactor(name="cyclePoint",min=0,max=90)
 f$addFactor(name="conjugationCost",min=0,max=100)
 f$addFactor(name="pilusExpressionCost",min=0,max=100)
 f$addFactor(name="gamma0",min=1,max=10)

 abm.saa(f, 100, 1,  100, 0.75)

## End(Not run)
```

`abm.tabu` *Tabu Search metaheuristic*

Description

An implementation of Tabu Search algorithm for parameter estimation

Usage

```
abm.tabu(objective, options = NULL)
```

Arguments

`objective`	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
`options`	An apropiate instance from a sublclass of Options class

References

[1] Fred Glover (1989). "Tabu Search - Part 1". ORSA Journal on Computing, 190-206. doi:10.1287/ijoc.1.3.190.
[2] Fred Glover (1990). "Tabu Search - Part 2". ORSA Journal on Computing, 4-32. doi:10.1287/ijoc.2.1.4.

Examples

```
## Not run:
 f<- PlainFunction$new(f0.rosenbrock2)

 f$Parameter(name="x1",min=-100,max=100)
 f$Parameter(name="x2",min=-100,max=100)

 or

 f$Parameter0(name="x1",levels=c(0:4))
 f$Parameter0(name="x2",levels=c(-2,-1,0,1,2))

 extremize("tabu", f)

## End(Not run)
```

---

acor.archive *acor.archive*

Description

This function is used for creating and maintaining the ACOr archive 'T'. The function keeps the track of 'k' solotion in the archive.

Usage

```
acor.archive(s, f, w, k, T = NULL)
```

Arguments

s	The solution 'ants'
f	The evaluation of solution
w	The weight vector
k	The archive size
T	The current archive

Value

The solution archive

References

[1] Socha, K., & Dorigo, M. (2008). Ant colony optimization for continuous domains. European Journal of Operational Research, 185(3), 1155-1173. http://doi.org/10.1016/j.ejor.2006.06.046

acor.F *acor.F*

Description

Helper function for extracting the 'F' function evaluations from archive ACOr 'T'

Usage

```
acor.F(T)
```

Arguments

T	The solution archive

Value

The F matrix

acor.lthgaussian *Select the lth gaussian function*

Description

Given a weight vector calculate the probabilities of selecting the lth gaussian function and return the index of lht gaussian selected with probability p

Usage

```
acor.lthgaussian(W)
```

Arguments

W	The vector of weights

Value

The index of lht gaussian function

References

[1] Socha, K., & Dorigo, M. (2008). Ant colony optimization for continuous domains. European Journal of Operational Research, 185(3), 1155-1173. http://doi.org/10.1016/j.ejor.2006.06.046

acor.N — *acor.N*

Description

Helper function for getting the size of solution

Usage

```
acor.N(T)
```

Arguments

`T`	The solution archive

Value

The size 'n' of a solution 's'

acor.probabilities — *Gaussian kernel choosing probability*

Description

Calculate the probability of choosing the lth Gaussian function

Usage

```
acor.probabilities(W, l = NULL)
```

Arguments

`W`	The vector of weights
`l`	The lth element of algorithm solution archive T

Value

The vector of probabilities 'p'

References

[1] Socha, K., & Dorigo, M. (2008). Ant colony optimization for continuous domains. European Journal of Operational Research, 185(3), 1155-1173. http://doi.org/10.1016/j.ejor.2006.06.046

acor.S *acor.S*

Description

Helper function for extracting solution 'S' from archive 'T'

Usage

```
acor.S(T)
```

Arguments

`T`	The solution archive

Value

The solution matrix

acor.sigma *Sigma calculation for ACOr*

Description

Calculate the value of sigma

Usage

```
acor.sigma(Xi, k, T)
```

Arguments

`Xi`	The algorithm parameter
`k`	The solution archive size
`T`	The solution archive

Value

The sigma value

References

[1] Socha, K., & Dorigo, M. (2008). Ant colony optimization for continuous domains. European Journal of Operational Research, 185(3), 1155-1173. http://doi.org/10.1016/j.ejor.2006.06.046

`acor.updateants` *acor.updateants*

Description

Update the solution using the gaussian kernel

Usage

```
acor.updateants(S, N, W, t.mu, t.sigma)
```

Arguments

`S`	The current solution ants
`N`	The numnber of required ants in solution
`W`	The weight vector
`t.mu`	The 'mean' from solution archive
`t.sigma`	The value of sigma from solution archive

Value

The new solution ants

References

[1] Socha, K., & Dorigo, M. (2008). Ant colony optimization for continuous domains. European Journal of Operational Research, 185(3), 1155-1173. http://doi.org/10.1016/j.ejor.2006.06.046

`acor.W` *acor.W*

Description

Helper function for extracting the 'W' function evaluations from archive ACOr 'T'

Usage

```
acor.W(T)
```

Arguments

`T`	The solution archive

Value

The weight vector

acor.weigth — *Weight calculation for ant colony optimization*

Description

Calculates the weight element of ACOr algorithm for the solution archive.

Usage

```
acor.weigth(q, k, l)
```

Arguments

`q`	The Algorithm parameter. When small best-ranked solution is preferred
`k`	The Archive size
`l`	The lth element of algorithm solution archive T

Value

A scalar or a vector with calculated weigth.

References

[1] Socha, K., & Dorigo, M. (2008). Ant colony optimization for continuous domains. European Journal of Operational Research, 185(3), 1155-1173. http://doi.org/10.1016/j.ejor.2006.06.046

assert — *assert*

Description

The assert function stop the execution if the logical expression given by the parameter `expresion` is false.

Usage

```
assert(expresion, string)
```

Arguments

`expresion`	Some logical expression
`string`	The text message to show if expression does not hold

bestFitness *bestFitness*

Description

Given a set S of N solutions created with sortSolution, this function returns the fitness component fot the best solution.

Usage

```
bestFitness(S)
```

Arguments

S	The solution set

Value

The best fitness value

bestSolution *bestSolution*

Description

Given a set S of N solutions created with sortSolution, this function returns the best solution found.

Usage

```
bestSolution(S)
```

Arguments

S	The solution set

Value

The best solution

cbuf *cbuf*

Description

Simple implementation of a circular buffer.

Usage

```
cbuf(b, v, e)
```

Arguments

b	The variable holding the current buffer content
v	The new valued to be added to b
e	The length of circular buffer

Value

The buffer b plus the element v minus the least recently added element

compare.algorithms1 *compare.algorithms1*

Description

Compare the number of function evalutions and convergence for the following optimization algorithms, ("saa","pso","acor","ees1").

Usage

```
compare.algorithms1(F, seeds = c(27, 2718282, 36190727, 3141593, -91190721,
  -140743, 1321))
```

Arguments

F	The function to be tested
seeds	The random seeds which will be used for testing algorithms

Examples

```
## Not run:
 rm(list=ls())
 d.cigar4<- compare.algorithms1(f0.cigar4)
 d.schaffer4<- compare.algorithms1(f0.schaffer4)
 d.griewank4<- compare.algorithms1(f0.griewank4)
 d.bohachevsky4<- compare.algorithms1(f0.bohachevsky4)
 d.rosenbrock4<- compare.algorithms1(f0.rosenbrock4)

## End(Not run)
```

`contourplothelper` *contourplothelper*

Description

Simple helper function for countour plots

Usage

```
contourplothelper(d, x, y, z, nbins = 32, binwidth = c(10, 10),
  points = c(300, 300), title = NULL)
```

Arguments

`d`	A data frame.
`x`	A string with the dataframe column name for x axis.
`y`	A string with the dataframe column name for y axis.
`z`	A string with the dataframe column name for z axis.
`nbins`	The number bins. The default is 32.
`binwidth`	The binwidths for 'kde2d'. Can be an scalar or a vector.
`points`	The number of grid points. Can be an scalar or a vector.
`title`	The optional plot title. May be omited.

`ees1.challenge` *ees1.challenge*

Description

Repeat the evalution of best solution to tacke with variability.

Usage

```
ees1.challenge(solution, objective)
```

Arguments

`solution`	The Problem solution
`objective`	The objective function

`ees1.explore` *ees1.explore*

Description

Explore the solution space on the neighborhood of solution ’s’ in order to find a new best.

Usage

```
ees1.explore(s, weight, p = 0.01)
```

Arguments

`s`	The Problem solution
`weight`	The exploration intensity
`p`	The mutation probability

ees1.mating *ees1.mating*

Description

This function 'mix' the elements present in the solution. The parameter 'mu' controls the intensity of mixing. Low values give preference to best solution components and high values make the values being select randomly.

Usage

```
ees1.mating(solution, mu)
```

Arguments

solution	The Problem solution
mu	The mixing intensity ratio, from 0 to 1. The mix intensity controls de the probability of chosing a worst solutions

ees1.mating1 *ees1.mating1*

Description

This function 'mix' the elements present in the solution. The parameter 'mu' controls the intensity of mixing. Low values give preference to best solution components and high values make the values being select randomly.

Usage

```
ees1.mating1(solution, mu)
```

Arguments

solution	The Problem solution
mu	The mixing intensity ratio, from 0 to 1. The mix intensity controls de the probability of chosing a worst solutions

`ees1.mutation` *ees1.mutation*

Description

Performs the mutation on generated solution

Usage

```
ees1.mutation(solution, mates, p = 0.01)
```

Arguments

`solution`	The Problem solution
`mates`	The mixed parents
`p`	The mutation probability

`ees1.recombination` *ees1.recombination*

Description

Performs the recombination on solution

Usage

```
ees1.recombination(solution, mates)
```

Arguments

`solution`	The Problem solution
`mates`	The mixed parents

ees1.selection *ees.selection*

Description

Select the elements with best fitness but accept uphill moves with probability 'kkappa'.

Usage

```
ees1.selection(s0, s1, kkappa)
```

Arguments

s0	The current best solution set
s1	The new solution
kkappa	The selection pressure

elog.debug *elog.debug*

Description

Wrapper for logging debug messages.

Usage

```
elog.debug(...)
```

Arguments

...	Variable number of arguments including a format string.

elog.error *elog.error*

Description

Wrapper for logging error messages.

Usage

```
elog.error(...)
```

Arguments

...	Variable number of arguments including a format string.

elog.info *elog.info*

Description

Wrapper for logging info messages.

Usage

```
elog.info(...)
```

Arguments

`...`	Variable number of arguments including a format string.

elog.level *elog.level*

Description

Configure the current log level

Usage

```
elog.level(level = NULL)
```

Arguments

`level`	The log level (ERROR|WARN|INFO|DEBUG)

Value

The log level

enforceBounds *enforceBounds*

Description

Checks if parameters fall within upper an lower bounds

Usage

```
enforceBounds(particles, factors)
```

Arguments

particles	The particle set
factors	the defined range for objective function parameters

Value

The particle inside the valid limits

es.evaluate *es.evaluate*

Description

For each element in solution 's' evaluate the respective fitness.

Usage

```
es.evaluate(f, s, enforce = TRUE)
```

Arguments

f	A reference to an instance of objective function
s	The set of solutions
enforce	If true the values are enforced to fall within provided range

Value

The solution ordered by its fitness.

Estimates-class *Estimates*

Description

A simple class for encapsulating the return of metaheuristic methods

extremize *extremize*

Description

Entry point for optimization functions

Usage

```
extremize(type, objective, options = NULL)
```

Arguments

type	The optimization method (aco,pso,saa,sda)
objective	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
options	An apropiate instance from a sublclass of Options class

Examples

```
## Not run:
 f<- PlainFunction$new(f0.rosenbrock2)

 f$Parameter(name="x1",min=-100,max=100)
 f$Parameter(name="x2",min=-100,max=100)

 extremize("pso", f)

## End(Not run)
```

`f0.ackley` *f0.ackley*

Description

The ackley function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0. Domain xi E [-32.768, 32.768], for all i = 1, ..., d

Usage

```
f0.ackley(...)
```

Arguments

`...`	The variadic list of function variables.

Value

The function value

References

https://www.sfu.ca/~ssurjano/ackley.html

`f0.ackley4` *f0.ackley4*

Description

The ackley function of four variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.ackley4(x1, x2, x3, x4)
```

Arguments

`x1`	The first function variable
`x2`	The second function variable
`x3`	The third function variable
`x4`	The fourth function variable

Value

The function value

`f0.adtn.rosenbrock2` *f0.adtn.rosenbrock2*

Description

Two variable Rosenbrock function with random additive noise.

Usage

```
f0.adtn.rosenbrock2(x1, x2)
```

Arguments

`x1`	Parameter 1
`x2`	Parameter 2

`f0.bohachevsky` *f0.bohachevsky*

Description

The Bohachevsky function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.bohachevsky(...)
```

Arguments

`...`	The variadic list of function variables.

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

`f0.bohachevsky4` *f0.bohachevsky4*

Description

The Bohachevsky function of four variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.bohachevsky4(x1, x2, x3, x4)
```

Arguments

`x1`	The first function variable
`x2`	The second function variable
`x3`	The third function variable
`x4`	The fourth function variable

Value

The function value

`f0.cigar` *f0.cigar*

Description

The Cigar function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.cigar(...)
```

Arguments

`...`	The variadic list of function variables.

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f0.cigar4 *f0.cigar4*

Description

The Cigar function of four variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.cigar4(x1, x2, x3, x4)
```

Arguments

`x1`	The first function variable
`x2`	The second function variable
`x3`	The third function variable
`x4`	The fourth function variable

Value

The function value

f0.griewank *f0.griewank*

Description

The griewank function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.griewank(...)
```

Arguments

`...`	The variadic list of function variables.

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f0.griewank4	*f0.griewank4*

Description

The griewank function of four variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.griewank4(x1, x2, x3, x4)
```

Arguments

x1	The first function variable
x2	The second function variable
x3	The third function variable
x4	The fourth function variable

Value

The function value

f0.nlnn.rosenbrock2	*f0.nlnn.rosenbrock2*

Description

Two variable Rosenbrock function with random additive noise.

Usage

```
f0.nlnn.rosenbrock2(x1, x2)
```

Arguments

x1	Parameter 1
x2	Parameter 2

f0.periodtuningpp — *Period tuning for Predator-Prey base*

Description

This function is an example on how EvoPER can be used for estimating the parameter values in order to produce oscilations with the desired period. It is not intended to be used directelly, the provided wrappers should be instead.

Usage

```
f0.periodtuningpp(x1, x2, x3, x4, period)
```

Arguments

x1	The growth rate of prey
x2	The decay rate of predator
x3	The predating effect on prey
x4	The predating effecto on predator
period	The desired oscilation period

Value

The solution fitness cost

f0.periodtuningpp12 — *Period tuning of 12 time units for Predator-Prey*

Description

This function is an example on how EvoPER can be used for estimating the parameter values in order to produce oscilations with the desired period.

Usage

```
f0.periodtuningpp12(x1, x2, x3, x4)
```

Arguments

x1	The growth rate of prey
x2	The decay rate of predator
x3	The predating effect on prey
x4	The predating effecto on predator

Value

The solution fitness cost

Examples

```
## Not run:
rm(list=ls())
set.seed(-27262565)
f<- PlainFunction$new(f0.periodtuningpp12)
f$Parameter(name="x1",min=0.5,max=2)
f$Parameter(name="x2",min=0.5,max=2)
f$Parameter(name="x3",min=0.5,max=2)
f$Parameter(name="x4",min=0.5,max=2)
extremize("pso", f)

## End(Not run)
```

---

f0.periodtuningpp24 *Period tuning of 24 time units for Predator-Prey*

Description

This function is an example on how EvoPER can be used for estimating the parameter values in order to produce oscilations with the desired period.

Usage

```
f0.periodtuningpp24(x1, x2, x3, x4)
```

Arguments

x1	The growth rate of prey
x2	The decay rate of predator
x3	The predating effect on prey
x4	The predating effecto on predator

Value

The solution fitness cost

Examples

```
## Not run:
rm(list=ls())
set.seed(-27262565)
f<- PlainFunction$new(f0.periodtuningpp24)
f$Parameter(name="x1",min=0.5,max=2)
f$Parameter(name="x2",min=0.5,max=2)
f$Parameter(name="x3",min=0.5,max=2)
f$Parameter(name="x4",min=0.5,max=2)
extremize("pso", f)

## End(Not run)
```

---

f0.periodtuningpp48 *Period tuning of 48 time units for Predator-Prey*

Description

This function is an example on how EvoPER can be used for estimating the parameter values in order to produce oscilations with the desired period.

Usage

```
f0.periodtuningpp48(x1, x2, x3, x4)
```

Arguments

x1	The growth rate of prey
x2	The decay rate of predator
x3	The predating effect on prey
x4	The predating effecto on predator

Value

The solution fitness cost

Examples

```
## Not run:
rm(list=ls())
set.seed(-27262565)
f<- PlainFunction$new(f0.periodtuningpp24)
f$Parameter(name="x1",min=0.5,max=2)
f$Parameter(name="x2",min=0.5,max=2)
f$Parameter(name="x3",min=0.5,max=2)
f$Parameter(name="x4",min=0.5,max=2)
extremize("pso", f)
```

```
## End(Not run)
```

`f0.periodtuningpp72` *Period tuning of 72 time units for Predator-Prey*

Description

This function is an example on how EvoPER can be used for estimating the parameter values in order to produce oscilations with the desired period.

Usage

```
f0.periodtuningpp72(x1, x2, x3, x4)
```

Arguments

x1	The growth rate of prey
x2	The decay rate of predator
x3	The predating effect on prey
x4	The predating effecto on predator

Value

The solution fitness cost

Examples

```
## Not run:
rm(list=ls())
set.seed(-27262565)
f<- PlainFunction$new(f0.periodtuningpp24)
f$Parameter(name="x1",min=0.5,max=2)
f$Parameter(name="x2",min=0.5,max=2)
f$Parameter(name="x3",min=0.5,max=2)
f$Parameter(name="x4",min=0.5,max=2)
extremize("pso", f)

## End(Not run)
```

f0.rosenbrock2 *f0.rosenbrock2*

Description

Two variable Rosenbrock function, where f(1,1) = 0

Usage

```
f0.rosenbrock2(x1, x2)
```

Arguments

x1	Parameter 1
x2	Parameter 2

f0.rosenbrock4 *f0.rosenbrock4*

Description

The rosenbrock function of 4 variables for testing optimization methods. The global optima for the function is given by xi = 1, forall i E 1...N, f(x) = 0.

Usage

```
f0.rosenbrock4(x1, x2, x3, x4)
```

Arguments

x1	The first function variable
x2	The second function variable
x3	The third function variable
x4	The fourth function variable

Value

The function value

f0.rosenbrockn *f0.rosenbrockn*

Description

The rosenbrock function of N variables for testing optimization methods. The global optima for the function is given by xi = 1, forall i E 1...N, f(x) = 0.

Usage

```
f0.rosenbrockn(...)
```

Arguments

`...`	The variadic list of function variables.

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f0.schaffer *f0.schaffer*

Description

The schaffer function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.schaffer(...)
```

Arguments

`...`	The variadic list of function variables.

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f0.schaffer4 *f0.schaffer4*

Description

The Schaffer function of four variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f0.schaffer4(x1, x2, x3, x4)
```

Arguments

`x1`	The first function variable
`x2`	The second function variable
`x3`	The third function variable
`x4`	The fourth function variable

Value

The function value

f0.schwefel *f0.schwefel*

Description

The schwefel function of N variables for testing optimization methods. The global optima for the function is given by xi = 420.96874636, forall i E 1...N, f(x) = 0. The range of xi is [-500,500]

Usage

```
f0.schwefel(...)
```

Arguments

`...`	The variadic list of function variables.

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

`f0.schwefel4` *f0.schwefel4*

Description

The schwefel function of N variables for testing optimization methods. The global optima for the function is given by xi = 420.96874636, forall i E 1...N, f(x) = 0. The range of xi is [-500,500]

Usage

```
f0.schwefel4(x1, x2, x3, x4)
```

Arguments

x1	The first function variable
x2	The second function variable
x3	The third function variable
x4	The fourth function variable

Value

The function value

`f0.test` *f0.test*

Description

Simple test function f(1,2,3,4) = 0

Usage

```
f0.test(x1, x2, x3, x4)
```

Arguments

x1	Parameter 1
x2	Parameter 2
x3	Parameter 3
x4	Parameter 4

`f1.ackley` *f1.ackley*

Description

The ackley function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0. Domain xi E [-32.768, 32.768], for all i = 1, ..., d

Usage

```
f1.ackley(x)
```

Arguments

`x`	The vector of function parameters

Value

The function value

References

https://www.sfu.ca/~ssurjano/ackley.html

`f1.adtn.rosenbrock2` *f1.adtn.rosenbrock2*

Description

Two variable Rosenbrock function with random additive noise.

Usage

```
f1.adtn.rosenbrock2(x)
```

Arguments

`x`	Parameter vector

f1.bohachevsky *f1.bohachevsky*

Description

The Bohachevsky function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f1.bohachevsky(x)
```

Arguments

x	The vector of function parameters

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f1.cigar *f1.cigar*

Description

The Cigar function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f1.cigar(x)
```

Arguments

x	The vector of function variables.

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f1.griewank *f1.griewank*

Description

The griewank function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f1.griewank(x)
```

Arguments

`x`	The vector of function parameters

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f1.nlnn.rosenbrock2 *f1.nlnn.rosenbrock2*

Description

Two variable Rosenbrock function with random additive noise.

Usage

```
f1.nlnn.rosenbrock2(x)
```

Arguments

`x`	Parameter vector

`f1.rosenbrock2` *f1.rosenbrock2*

Description

Two variable Rosenbrock function, where f(c(1,1)) = 0

Usage

```
f1.rosenbrock2(x)
```

Arguments

`x`	Parameter vector

`f1.rosenbrockn` *f1.rosenbrockn*

Description

The rosenbrock function of N variables for testing optimization methods. The global optima for the function is given by xi = 1, forall i E 1...N, f(x) = 0.

Usage

```
f1.rosenbrockn(x)
```

Arguments

`x`	The vector of function parameters

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f1.schaffer *f1.schaffer*

Description

The schaffer function of N variables for testing optimization methods. The global optima for the function is given by xi = 0, forall i E 1...N, f(x) = 0.

Usage

```
f1.schaffer(x)
```

Arguments

x	The vector of function parameters

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

f1.schwefel *f1.schwefel*

Description

The schwefel function of N variables for testing optimization methods. The global optima for the function is given by xi = 420.96874636, forall i E 1...N, f(x) = 0. The range of xi is [-500,500]

Usage

```
f1.schwefel(x)
```

Arguments

x	The vector of function variables.

Value

The function value

References

http://deap.gel.ulaval.ca/doc/dev/api/benchmarks.html

`f1.test` *f1.test*

Description

Simple test function f(c(1,2,3,4)) = 0

Usage

```
f1.test(x)
```

Arguments

`x`	Parameter vector

`fixdfcolumns` *fixdfcolumns*

Description

Coerce dataframe columns to a specic type.

Usage

```
fixdfcolumns(df, cols = c(), skip = TRUE, type = as.numeric)
```

Arguments

`df`	The data frame.
`cols`	The dataframe columns to be skiped or included.
`skip`	If TRUE the column names in 'cols' are skiped. When FALSE logic is inverted.
`type`	The type for which data frame columns must be converted.

Value

The data frame with converted column types.

`generateSolution` *generateSolution*

Description

Generates a problema solution using discrete leves

Usage

```
generateSolution(parameters, size)
```

Arguments

`parameters`	The Objective Function parameter list
`size`	The solution size

Value

The solution set

`getFitness` *getFitness*

Description

Given a set S of N solutions created with sortSolution, this function returns the solution component fot the best solution.

Usage

```
getFitness(S, i = NULL)
```

Arguments

`S`	The solution set
`i`	The fitness index, if null return the whole column.

Value

The selected fitness entry

`getSolution` *getSolution*

Description

Given a set S of N solutions created with sortSolution, this function returns the solution component. A solutions is a set of solutions and their associated fitness

Usage

```
getSolution(S)
```

Arguments

`S`	The solution set

Value

The solution set

`gm.mean` *gm.mean*

Description

Simple implementation for geometric mean

Usage

```
gm.mean(x)
```

Arguments

`x`	data

Value

geometric mean for data

gm.sd *gm.sd*

Description

Simple implementation for geometric standard deviation

Usage

```
gm.sd(x, mu = NULL)
```

Arguments

x	data
mu	The geometric mean. If not provided it is calculated.

Value

geometric standard deviation for data

histplothelper *histplothelper*

Description

Simple helper for ploting histograms

Usage

```
histplothelper(d, x, title = NULL)
```

Arguments

d	A data frame.
x	A string with the dataframe column name for histogram
title	The plot title

Value

A ggplot2 plot object

initSolution *initSolution*

Description

Creates the initial Solution population taking into account the lower an upper bounds of provided experiment factors.

Usage

```
initSolution(parameters, N = 20, sampling = "mcs")
```

Arguments

parameters	The Objective Function parameter list
N	The size of Solution population
sampling	The population sampling scheme, namelly <mcs|lhs|ffs> standing respectively for montecarlo sampling, latin hypercube sampling and full factorial sampling

Value

A random set of solutions

lowerBound *lowerBound*

Description

Checks if parameters is greater than the lower bounds

Usage

```
lowerBound(particles, factors)
```

Arguments

particles	The particle set
factors	the defined range for objective function parameters

Value

The particle greater than or equal to lower limit

`Magnitude` *Magnitude*

Description

Calculates the magnitude order for a given value

Usage

```
Magnitude(v)
```

Arguments

`v`	The numerical value

Value

The magnitude order

`naiveperiod` *naiveperiod*

Description

A naive approach for finding the period in a series of data points

Usage

```
naiveperiod(d)
```

Arguments

`d`	The data to search period

Value

A list with the average period and amplitude

`NetLogoFunction-class` *NetLogoFunction*

Description

NetLogoFunction class

`NLWrapper.FindJar` *NLWrapper.FindJar*

Description

Search for the netlogo jar file on the provided path

Usage

```
NLWrapper.FindJar(path)
```

Arguments

`path`	The base path for searching

Value

The path for NetLogo jar file

`NLWrapper.GetParameter` *NLWrapper.GetParameter*

Description

Gets the value of a model parameter

Usage

```
NLWrapper.GetParameter(obj, name)
```

Arguments

`obj`	The object retuned by NLWrapper.Model
`name`	The parameter name string or the collection of parameter names

Value

The parameter values

Examples

```
## Not run:
   rm(list=ls())
   p<- "C:/Program Files/NetLogo 6.0.4/app"
  m<- file.path(nlpath, "models", "Sample Models", "Biology", "Wolf Sheep Predation.nlogo")
   o<- NLWrapper.Model(p, m)
   v<- NLWrapper.GetParameter(o, c("initial-number-sheep"))

   or

   v<- NLWrapper.GetParameter(o, c("initial-number-sheep","initial-number-wolves")))

## End(Not run)
```

NLWrapper.Model *NLWrapper.Model*

Description

This wrapper prepares the environment and instantiates the model

Usage

```
NLWrapper.Model(netlogodir, modelfile, dataset, maxtime)
```

Arguments

`netlogodir`	The base path of NetLogo installation
`modelfile`	The absolute path for NetLogo model file
`dataset`	The names of model variables
`maxtime`	The total number of iterations

Examples

```
## Not run:
   rm(list=ls())
   p<- "C:/Program Files/NetLogo 6.0.4/app"
   output<- c("count sheep", "count wolves")
  m<- file.path(nlpath, "models", "Sample Models", "Biology", model, "Wolf Sheep Predation.nlogo")
   o<- NLWrapper.Model(p, m, output, 150)

## End(Not run)
```

`NLWrapper.Run` *NLWrapper.Run*

Description

Executes a NetLogo Model using rNetLogo

Usage

```
NLWrapper.Run(obj, r = 1, seed = c())
```

Arguments

`obj`	The object retuned by NLWrapper.Model
`r`	The number of replications
`seed`	The collection of random seeds

`NLWrapper.RunExperiment` *NLWrapper.RunExperiment*

Description

Executes a NetLogo Model using rNetLogo

Usage

```
NLWrapper.RunExperiment(obj, r = 1, design, FUN)
```

Arguments

`obj`	The object retuned by NLWrapper.Model
`r`	The number of replications
`design`	The desing matrix holding parameter sampling
`FUN`	THe calibration function.

Value

A list containing the the parameters, the calibration functio output and the whole resultset

Examples

```
## Not run:
   rm(list=ls())
   objectivefn<- function(params, results) { 0 }

   f<- AddFactor(name="initial-number-sheep",min=100,max=250)
   f<- AddFactor(factors=f, name="initial-number-wolves",min=50,max=150)
   f<- AddFactor(factors=f, name="grass-regrowth-time",min=30,max=100)
   f<- AddFactor(factors=f, name="sheep-gain-from-food",min=1,max=50)
   f<- AddFactor(factors=f, name="wolf-gain-from-food",min=1,max=100)
   f<- AddFactor(factors=f, name="sheep-reproduce",min=1,max=20)
   f<- AddFactor(factors=f, name="wolf-reproduce",min=1,max=20)

   design<- AoE.LatinHypercube(factors=f)

   p<- "C:/Program Files/NetLogo 6.0.4/app"
   m<- file.path(p, "models", "Sample Models", "Biology", "Wolf Sheep Predation.nlogo")
   output<- c("count sheep", "count wolves")
   o<- NLWrapper.Model(p, m, output, 150)
   v<- RunExperiment(o, r=1, design, objectivefn)
   NLWrapper.Shutdown(o)

## End(Not run)
```

`NLWrapper.SetParameter` *NLWrapper.SetParameter*

Description

Set parameter values

Usage

```
NLWrapper.SetParameter(obj, parameters)
```

Arguments

`obj`	The object retuned by NLWrapper.Model
`parameters`	The data frame containing the paramters

Examples

```
## Not run:
   rm(list=ls())
   p<- "C:/Program Files/NetLogo 6.0.4/app"
  m<- file.path(nlpath, "models", "Sample Models", "Biology", "Wolf Sheep Predation.nlogo")
   o<- NLWrapper.Model(p, m)
```

```
## End(Not run)
```

`NLWrapper.SetRandomSeed` *NLWrapper.SetRandomSeed*

Description

Configures the random seed

Usage

```
NLWrapper.SetRandomSeed(obj, seed)
```

Arguments

`obj`	The object retuned by NLWrapper.Model
`seed`	The new random seed

`NLWrapper.Shutdown` *NLWrapper.Shutdown*

Description

This wrapper terminates RNetLogo execution environment

Usage

```
NLWrapper.Shutdown(obj)
```

Arguments

`obj`	The object retuned by NLWrapper.Model

`ObjectiveFunction-class` *ObjectiveFunction class*

Description

The base class for optimization functions.

Fields

`object` The raw output of objective function

`objective` The objective function

`parameters` The parameter list for objective function

`value` The results from objective function

`Options-class` *Options*

Description

The base class for the options for the optimization metaheuristics

Fields

`type` The configuration type

`neighborhood` The neighborhood function for population methods

`discrete` Flag indicating that and specific algorithm is discrete or continuous

`nlevelz` Default value for generating parameter levels when range is provided, default value is 5

`container` The object holding the configuration otions

`OptionsACOR-class` *OptionsACOR*

Description

Options for ACOR method

OptionsEES1-class *OptionsEES1*

Description

Options for EvoPER Evolutionary Stratety 1

OptionsEES2-class *OptionsEES2*

Description

Options for Serial Dilutions method

Fields

`dilutions` The desired dilutions

OptionsFactory *OptionsFactory*

Description

Instantiate the Options class required for the specific metaheuristic method.

Usage

```
OptionsFactory(type, v = NULL)
```

Arguments

`type`	The metaheuristic method
`v`	The options object

Value

Options object

OptionsPSO-class *OptionsPSO*

Description

Options for PSO optimization metaheuristic

OptionsSAA-class *OptionsSAA*

Description

Options for SAA method

Fields

`temperature` The temperature dacay function

OptionsTS-class *OptionsTS*

Description

Options for Tabu search optimization metaheuristic

paramconverter *paramconverter*

Description

Convert parameter from continuous to discrete and vice-versa if needed

Usage

```
paramconverter(parameters, discrete, levelz = 5)
```

Arguments

`parameters`	The current parameter set
`discrete`	The desired parameter type
`levelz`	When discrete is true the number of levels to be generated

Value

The parameter collection casted to desired mode

`partSolutionSpace` *partSolutionSpace*

Description

Creates the initial Solution population taking into account the lower an upper bounds of provided experiment factors. This method works by dividing the solution space into partitions of size 'd' and then creating a full factorial combination of partitions.

Usage

```
partSolutionSpace(parameters, d = 4)
```

Arguments

`parameters`	The Objective Function parameter list
`d`	The partition size. Default value 4.

Value

A set of solutions

`PlainFunction-class` *PlainFunction*

Description

PlainFunction Class

`pop.first` *pop.first*

Description

pop an element

Usage

```
pop.first(x)
```

Arguments

`x`	The element collection

Value

The first element added to list FIFO

pop.last *pop.last*

Description

pop an element

Usage

```
pop.last(x)
```

Arguments

x	The element collection

Value

The last element added to list LIFO

predatorprey *predatorprey*

Description

The solver for Lotka-Volterra differential equation.

Usage

```
predatorprey(x1, x2, x3, x4)
```

Arguments

x1	The growth rate of prey
x2	The decay rate of predator
x3	The predating effect on prey
x4	The predating effecto on predator

Value

The ODE solution

predatorprey.plot0 *predatorprey.plot0*

Description

Generate a plot for the predator-prey ODE output.

Usage

```
predatorprey.plot0(x1, x2, x3, x4, title = NULL)
```

Arguments

x1	The growth rate of prey
x2	The decay rate of predator
x3	The predating effect on prey
x4	The predating effect on predator
title	The optional plot title. May be omited.

Value

An ggplot2 object

Examples

```
## Not run:
 predatorprey.plot0(1.351888, 1.439185, 1.337083, 0.9079049)

## End(Not run)
```

predatorprey.plot1 *predatorprey.plot1*

Description

Simple wrapper for 'predatorprey.plot0' accepting the parameters as a list.

Usage

```
predatorprey.plot1(x, title = NULL)
```

Arguments

`x`	A list containing the values of predator/prey parameters c1, c2, c3 and c4 denoting respectivelly the growth rate of prey, the decay rate of predator, the predating effect on prey and the predating effect on predator
`title`	The optional plot title. May be omited.

Value

An ggplot2 object

Examples

```
## Not run:
 rm(list=ls())
 predatorprey.plot1(v$getBest()[1:4])

## End(Not run)
```

`pso.best` *pso.best*

Description

Search for the best particle solution which minimize the objective function.

Usage

```
pso.best(objective, particles)
```

Arguments

`objective`	The results of evaluating the objective function
`particles`	The particles tested

Value

The best particle

pso.chi *pso.chi*

Description

Implementation of constriction coefficient

Usage

```
pso.chi(phi1, phi2)
```

Arguments

`phi1`	Acceleration coefficient toward the previous best
`phi2`	Acceleration coefficient toward the global best

Value

The calculated constriction coefficient

pso.lbest *pso.lbest*

Description

Finds the lbest for the particle 'i' using the topology function given by the topology parameter.

Usage

```
pso.lbest(i, pbest, topology)
```

Arguments

`i`	The particle position
`pbest`	The pbest particle collection
`topology`	The desired topology function

Value

The lbes for i th particle

`pso.neighborhood.K2` *pso.neighborhood.K2*

Description

The neighborhood function for a simple linear topology where every particle has k = 2 neighbors

Usage

```
pso.neighborhood.K2(i, n)
```

Arguments

`i`	The particle position
`n`	the size of particle population

`pso.neighborhood.K4` *pso.neighborhood.K4*

Description

The von neumann neighborhood function for a lattice-based topology where every particle has k = 4 neighbors

Usage

```
pso.neighborhood.K4(i, n)
```

Arguments

`i`	The particle position
`n`	the size of particle population

pso.neighborhood.KN *pso.neighborhood.KN*

Description

Simple helper method for 'gbest' neighborhood

Usage

```
pso.neighborhood.KN(i, n)
```

Arguments

`i`	The particle position
`n`	the size of particle population

pso.printbest *pso.printbest*

Description

Shows the best particle of each of simulated generations

Usage

```
pso.printbest(objective, particles, generation, title)
```

Arguments

`objective`	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
`particles`	The current particle population
`generation`	The current generation
`title`	Some informational text to be shown

pso.Velocity *pso.velocity*

Description

Calculates the PSO Velocity

Usage

```
pso.Velocity(W = 1, Vi, phi1, phi2, Pi, Pg, Xi)
```

Arguments

W	Weight (Inertia weight or constriction coefficient)
Vi	Current Velocity vector
phi1	Acceleration coefficient toward the previous best
phi2	Acceleration coefficient toward the global best
Pi	Personal best
Pg	Neighborhood best
Xi	Particle vector

Value

Updated velocity

push *push*

Description

push an element

Usage

```
push(x, v)
```

Arguments

x	The collection of elements
v	The value to be pushed

Value

The collection of elements

`random.wheel` *random.whell*

Description

A simple randon seed generator

Usage

```
random.wheel()
```

Value

A random number for seeding

`RepastFunction-class` *RepastFunction*

Description

RepastFunction class

`saa.bolt` *saa.bolt*

Description

Temperature function boltzmann

Usage

```
saa.bolt(t0, k)
```

Arguments

`t0`	The current temperature
`k`	The annealing value

Value

The new temperature

`saa.neighborhood` *saa.neighborhood*

Description

Generates neighbor solutions for simulated annealing

Usage

```
saa.neighborhood(f, S, d, n)
```

Arguments

`f`	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
`S`	The current solution to find a neighbor
`d`	The distance from current solution S `distance = (max - min) * d`
`n`	The number of parameters to be perturbed

Value

The neighbor of solution S

`saa.neighborhood1` *saa.neighborhood1*

Description

Generates neighbor solutions perturbing one parameter from current solution `S` picked randonly.

Usage

```
saa.neighborhood1(f, S, d)
```

Arguments

`f`	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
`S`	The current solution to find a neighbor
`d`	The distance from current solution S `distance = (max - min) * d`

Value

The neighbor of solution of S

saa.neighborhoodH *saa.neighborhoodH*

Description

Generates neighbor solutions perturbing half parameters from current solution S.

Usage

```
saa.neighborhoodH(f, S, d)
```

Arguments

f	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
S	The current solution to find a neighbor
d	The distance from current solution S distance = (max - min) * d

Value

The neighbor of solution of S

saa.neighborhoodN *saa.neighborhoodN*

Description

Generates neighbor solutions perturbing all parameters from current solution S.

Usage

```
saa.neighborhoodN(f, S, d)
```

Arguments

f	An instance of ObjectiveFunction (or subclass) class ObjectiveFunction
S	The current solution to find a neighbor
d	The distance from current solution S distance = (max - min) * d

Value

The neighbor of solution of S

saa.tbyk *saa.tbyk*

Description

Temperature function t/k

Usage

```
saa.tbyk(t0, k)
```

Arguments

t0	The current temperature
k	The annealing value

Value

The new temperature

saa.tcte *saa.tcte*

Description

Temperature function cte * t0

Usage

```
saa.tcte(t0, k)
```

Arguments

t0	The current temperature
k	The annealing value

Value

The new temperature

saa.texp *saa.texp*

Description

Temperature function exponential

Usage

```
saa.texp(t0, k)
```

Arguments

`t0`	The current temperature
`k`	The annealing value

Value

The new temperature

scatterplotlothelper *scatterplotlothelper*

Description

Simple helper for ploting 3d scaterplots

Usage

```
scatterplotlothelper(d, x, y, z, title = NULL)
```

Arguments

`d`	A data frame.
`x`	A string with the dataframe column name for x axis
`y`	A string with the dataframe column name for y axis
`z`	A string with the dataframe column name for z axis
`title`	The optional plot title. May be omited.

Value

A scatter3D plot

searchrow *searchrow*

Description

Search for a value value on a matrix

Usage

```
searchrow(ddata, value)
```

Arguments

ddata	The matrix containing the dataset
value	The value to search for

Value

Boolean TRUE for those indexes matching value

show.comp1 *show.comp1*

Description

Generates a barplot comparing the number of evalutions for algorithms ("saa","pso","acor","ees1").

Usage

```
show.comp1(mydata, what, title = NULL)
```

Arguments

mydata	The data generated with 'summarize.comp1'
what	The name of variable to plot on 'y' axis
title	the plot title

Examples

```
## Not run:
p.a<- show.comp1(d.cigar4,"evals","(a) Cigar function")
p.b<- show.comp1(d.schaffer4,"evals","(b) Schafer function")
p.c<- show.comp1(d.griewank4,"evals","(c) Griewank function")
p.d<- show.comp1(d.bohachevsky4,"evals","(d) Bohachevsky function")

## End(Not run)
```

`slope` *slope*

Description

Simple function for calculate the slope on the ith element position

Usage

```
slope(x, y, i)
```

Arguments

`x`	The x vector
`y`	The y vector
`i`	The position

Value

The slope

`slopes` *slopes*

Description

Calcule all slopes for the discrete x,y series

Usage

```
slopes(x, y)
```

Arguments

`x`	The x vector
`y`	The y vector

Value

A vector with all slopes

`sortSolution` *sortSolution*

Description

Sort solution by its respective fitness

Usage

```
sortSolution(s, f)
```

Arguments

`s`	Problem solution
`f`	The function evaluation for s

`summarize.comp1` *summarize.comp1*

Description

Provides as summary with averged values of experimental setup

Usage

```
summarize.comp1(mydata)
```

Arguments

`mydata`	The data frame generated with 'compare.algorithms1'

Value

The summarized data

tabu.getNeighbors *tabu.getNeighbors*

Description

create neighbor solutions

Usage

```
tabu.getNeighbors(tabu, parameters, solution, size)
```

Arguments

`tabu`	The tabu list
`parameters`	The parameter set
`solution`	The current solution
`size`	The neigborhood size

Value

The neighbor for solution

tabu.istabu *tabu.istabu*

Description

Check whether a solution is present on tabulist

Usage

```
tabu.istabu(tabulist, solution)
```

Arguments

`tabulist`	The matrix of tabu solutions
`solution`	The solution value to be checked

Value

Boolean TRUE tabulist contains the solution

upperBound *upperBound*

Description

Checks if parameters is below the upper bounds

Usage

```
upperBound(particles, factors)
```

Arguments

`particles`	The particle set
`factors`	the defined range for objective function parameters

Value

The particle inside the valid upper bound

xmeanci1 *xmeanci1*

Description

Calculates confidence interval of mean for provided data with desired confidence level. This functions uses bootstrap resampling scheme for estimanting the CI.

Usage

```
xmeanci1(x, alpha = 0.95)
```

Arguments

`x`	The data set for which CI will be calculated
`alpha`	The confidence level. The default value is 0.95 (95%)

Value

The confidence interval for the mean calculated using 'boot.ci'

xmeanci2 *xmeanci2*

Description

Calculates confidence interval of mean for provided data with desired confidence level.

Usage

```
xmeanci2(x, alpha = 0.95)
```

Arguments

`x`	The data set for which CI will be calculated
`alpha`	The confidence level. The default value is 0.95 (95%)

Value

The confidence interval for the mean

xyplothelper *xyplothelper*

Description

Simple helper for ploting xy dispersion points.

Usage

```
xyplothelper(d, x, y, title = NULL)
```

Arguments

`d`	A data frame.
`x`	A string with the dataframe column name for x axis
`y`	A string with the dataframe column name for y axis
`title`	The optional plot title. May be omited.

Value

A ggplot2 plot object

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