Package 'tspmeta'

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Title Instance Feature Calculation and Evolutionary Instance Generation for the Traveling Salesman Problem

Description Instance feature calculation and evolutionary instance generation for the traveling salesman problem. Also contains code to ``morph'' two TSP instances into each other. And the possibility to conveniently run a couple of solvers on TSP instances.

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URL https://github.com/berndbischl/tspmeta

BugReports https://github.com/berndbischl/tspmeta/issues

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Suggests testthat

LazyData yes

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Contents

`as_TSP` *Convert to TSP instance object of package TSP.*

Description

Convert to TSP instance object of package TSP.

Usage

```
as_TSP(x)
```

Arguments

`x`	[`tsp_instance`] TSP instance.

Value

[TSP].

`autoplot.tsp_instance` *Plot TSP instance.*

Description

Plot TSP instance.

Usage

```
## S3 method for class 'tsp_instance'
autoplot(object, opt_tour, ...)
```

Arguments

`object`	[tsp_instance] TSP instance.
`opt_tour`	[TOUR] TOUR object from package TSP, containing order of cities, tour length and method name that generated this solution.
`...`	[any] Not used.

Value

[ggplot].

`center_of_mass` *Return the center of all cities of a TSP instance.*

Description

Return the center of all cities of a TSP instance.

Usage

```
center_of_mass(instance)
```

Arguments

`instance`	[tsp_instance] TSP instance.

Value

[`numeric(2)`] Center of all cities of the TSP instance.

fast_two_opt *Runs 2-Opt local search on TSP instance.*

Description

Runs 2-Opt local search on TSP instance.

Usage

```
fast_two_opt(x, initial_tour)
```

Arguments

x	[tsp_instance] TSP instance.
initial_tour	[numeric] Initial tour.

Value

[TOUR] TOUR object from package TSP, containing order of cities, tour length and method name that generated this solution.

features *Calculates list of all TSP features for an instance.*

Description

Calculates list of all TSP features for an instance.

Usage

```
features(x, rescale = TRUE)
```

Arguments

x	[tsp_instance] TSP instance
rescale	[logical(1)] Rescale x to $[0, 1]^2$ before calculation of features? Default is TRUE.

Value

[list].

See Also

feature_angle, feature_centroid, feature_cluster, feature_bounding_box, feature_chull, feature_distance, feature_modes, feature_mst, feature_nnds

Examples

```
x = random_instance(10)
print(features(x))
```

`feature_angle` *Angle features.*

Description

Statistics of the distribution of the angle between a node and its 2 next neighbors.

Usage

```
feature_angle(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[list].

`feature_bounding_box` *Bounding box features.*

Description

Determines the ratio of cities which lie within a certain distance to the bounding box.

Usage

```
feature_bounding_box(x, distance_fraction = 0.1)
```

Arguments

x	[tsp_instance] TSP instance.
distance_fraction	[numeric(1)] Distance ratio to bounding box.

Value

[list].

`feature_centroid` *Centroid features.*

Description

Includes the coordinates of the mean coordinates of the the point cloud and the statistics of the distances of all cities from it.

Usage

```
feature_centroid(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[list].

`feature_chull` *Convex hull features.*

Description

Determines the area of the convex hull and the ratio of the cities which lie on the convex hull in the euklidean space.

Usage

```
feature_chull(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[list].

feature_cluster *Cluster features.*

Description

Determines the number of clusters and the mean distances from all cities in a cluster to its centroid.

Usage

```
feature_cluster(x, epsilon)
```

Arguments

x	[tsp_instance] TSP instance.
epsilon	[numeric(1)] Probability in [0,1]. Used to compute the reachability distance for the underlying dbscan clustering algorithm.

Value

[list].

feature_distance *Distance features.*

Description

Computes different statistics describing the distribution of pairwise distances between cities.

Usage

```
feature_distance(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[list] List of statistics describing the distribution of distances.

feature_modes *Modes of edge cost distribution feature.*

Description

Includes the number of modes of the edge cost distribution.

Usage

```
feature_modes(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[list] List containing (estimated) number of modes.

feature_mst *MST features.*

Description

Construct minimun spanning tree, then calculate the statistics of a) the distances in the MST, b) the depths of all nodes in the MST.

Usage

```
feature_mst(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[list].

feature_nnds *Nearest neighbor features.*

Description

Statistics describing the distribution of distances of each city to its nearest neighbor.

Usage

```
feature_nnds(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[list].

get_solvers *Returns integrated solver names.*

Description

Returns integrated solver names.

Usage

```
get_solvers()
```

Value

[character].

greedy_point_matching *Greedy point matching*

Description

Pairs of cities are matched in a greedy fashion for morphing, first the closest pair w.r.t. euclidean distance, then the clostest pair of the remaining cities, and so on.

Usage

```
greedy_point_matching(x, y)
```

Arguments

x	[tsp_instance] First TSP instance.
y	[tsp_instance] Second TSP instance.

Value

[matrix] Numeric matrix of point indices with shortest distance.

instance_dim *Get instance dimensionality (space where coords live).*

Description

Get instance dimensionality (space where coords live).

Usage

```
instance_dim(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[integer(1)].

morph_instances — *Morphing (convex-combination) of two instances with parameter alpha.*

Description

Pairs of cities are matched in a greedy fashion, see greedy_point_matching.

Usage

```
morph_instances(x, y, alpha)
```

Arguments

x	[tsp_instance]
y	[tsp_instance]
alpha	[numeric(1)] Coefficient alpha for convex combination.

Value

[tsp_instance] Morphed TSP instance.

Examples

```
x = random_instance(10)
y = random_instance(10)
z = morph_instances(x, y, 0.5)
autoplot(x)
autoplot(y)
autoplot(z)
```

normalization_angle — *Calculate rotation angle such that the main axis through the cities is aligned with the X axis.*

Description

Calculate rotation angle such that the main axis through the cities is aligned with the X axis.

Usage

```
normalization_angle(instance)
```

Arguments

instance	[tsp_instance] TSP instance.

Value

[numeric(1)]

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normalize_rotation *Normalize an instance w.r.t. its rotation.*

Description

Normalization is performed by aligning the main axis of the cities with the X axis.

Usage

```
normalize_rotation(instance)
```

Arguments

instance	[tsp_instance]

Value

A rotated tsp_instance.

See Also

normalization_angle

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number_of_cities *Get number of cities in tsp instance.*

Description

Get number of cities in tsp instance.

Usage

```
number_of_cities(x)
```

Arguments

x	[tsp_instance] TSP instance.

Value

[integer(1)].

---

numvec_feature_statistics *Computes statistics from a vector of of values.*

Description

E.g. computes features from distribution of distances. Computed statistics: min, median, mean, max, sd, span, coeff_of_var.

Usage

```
numvec_feature_statistics(x, name, na.rm = TRUE)
```

Arguments

x	[numeric] Numeric vector.
name	[numeric] Prefix name for elements in result list.
na.rm	[logical(1)] Should NAs in x be removed? Default is TRUE.

Value

[list] Elements are named <name_statistic>.

---

print.tsp_instance *Print TSP instance*

Description

Print TSP instance

Usage

```
## S3 method for class 'tsp_instance'
print(x, ...)
```

Arguments

x	[tsp_instance] TSP instance.
...	[any] Not used.

`random_instance` *Generates a random TSP instance by scattering random points in a hypercube.*

Description

Generates a random TSP instance by scattering random points in a hypercube.

Usage

```
random_instance(size, d = 2, lower = 0, upper = 1)
```

Arguments

`size`	[`integer(1)`] Number of cities.
`d`	[`integer(1)`] Space dimensionality, e.g. 2D. Default is 2D.
`lower`	[`numeric(1)`] Lower box constraint for hypercube. Default is 0.
`upper`	[`numeric(1)`] upper box constraint for hypercube. Default is 1.

Value

[`tsp_instance`].

`read_tsplib_instance` *Read in a TSPLIB style Traveling Salesman Problem from a file.*

Description

The current state of the parser does not understand all variants of the TSPLIB format. Much effort has been spent making the parser as robust as possible. It will stop as soon as it sees input it cannot handle.

Usage

```
read_tsplib_instance(path)
```

Arguments

`path`	[`character(1)`] Character string containing path to file in TSPLIB format.

Value

[tsp_instance].

`read_tsplib_instances` *Read in multiple TSPLIB style Traveling Salesman Problems from a directory.*

Description

Read in multiple TSPLIB style Traveling Salesman Problems from a directory.

Usage

```
read_tsplib_instances(path, pattern = "*.tsp", max_size = 1000,
  use_names = TRUE, on_no_coords = "stop")
```

Arguments

`path`	[`character(1)`] Character string containing path to file in TSPLIB format.
`pattern`	[`character(1)`] Pattern of files under `path` that are considered as instances.
`max_size`	[`numeric(1)`] Upper bound for instance size (i.e. number of cities). Only applicable, if instance size is contained in file name. Default value ist 1000.
`use_names`	[`logical(1)`] Use base names of files as names of instances in returned list.
`on_no_coords`	[`character(1)`] How to handle instances which do not have any coordinates. Possible values are, "stop" and "warn" which either stop or raise a warning respectivly.

Value

A `list` List of `tsp_instance` objects.

read_tsplib_tour *Read in a TSPLIB style Traveling Salesman Problem tour from a file*

Description

Read in a TSPLIB style Traveling Salesman Problem tour from a file

Usage

```
read_tsplib_tour(path)
```

Arguments

path	[character(1)] Filename of file containing a TSP tour.

Value

[TOUR] TOUR object from package TSP, containing order of cities, tour length and method name that generated this solution.

remove_zero_distances *Remove any duplicate cities in a tsp instance.*

Description

Remove any duplicate cities in a tsp instance.

Usage

```
remove_zero_distances(instance)
```

Arguments

instance	[tsp_instance] TSP instance object.

Value

New TSP instance in which all duplicate cities have been removed.

rescale_instance *Rescale coords of TSP instance to* $[0, 1]$^2.

Description

Rescale coords of TSP instance to $[0, 1]^2$.

Usage

```
rescale_instance(x)

rescale_coords(coords)
```

Arguments

x	[tsp_instance] TSP instance.
coords	[matrix] Numeric matrix of city coordinates, rows denote cities.

Value

[matrix] for rescale_coords and tsp_instance for rescale_instance. Numeric matrix of scaled city coordinates.

rotate_coordinates *Rotate a matrix of 2D coordinates*

Description

Rotate a matrix of 2D coordinates

Usage

```
rotate_coordinates(coords, angle, center)
```

Arguments

coords	[matrix] Numeric matrix of 2D coordinates to rotate
angle	[numeric(1)] Angle by which to rotate the coordinates. In radians.
center	[matrix] Center around which to rotate the coordinates.

Value

A matrix of rotated coordinates.

`rotate_instance` *Rotate the cities of a TSP instance around a point.*

Description

Rotate the cities of a TSP instance around a point.

Usage

```
rotate_instance(instance, angle, center)
```

Arguments

`instance`	[`tsp_instance`] TSP instance.
`angle`	[`numeric(1)`] Angle by which to rotate the coordinates. In radians.
`center`	[`numeric`] Point around which to rotate the cities. If missing, defaults to the center of mass of the cities.

Value

[`tsp_instance`] New TSP instance.

`run_solver` *Runs a solver on a TSP instance.*

Description

Currently the following solvers are supported: nearest_insertion: See `solve_TSP`. farthest_insertion : See `solve_TSP`. cheapest_insertion : See `solve_TSP`. arbitrary_insertion: See `solve_TSP`. nn: See `solve_TSP`. repetitive_nn: See `solve_TSP`. concorde: See `solve_TSP`.

Usage

```
run_solver(x, method, ...)
```

Arguments

x	[tsp_instance] TSP instance.
method	[character(1)] Solver to use on TSP instance. To use concorde and/or linkern it is necessary to specify the path to the concorde/linkern executable with concorde_path.
...	[any] Control parameters for solver.

Value

[TOUR] TOUR object from package TSP, containing order of cities, tour length and method name that generated this solution.

Examples

```
x = random_instance(10)
tours = sapply(c("nn", "cheapest_insertion", "arbitrary_insertion"), function(solver) {
  list(solver = run_solver(x, method = solver))
})
## Not run:
  concorde_path(path = "/absolute/path/to/concorde/executable")
  concorde_tour = run_solver(x, method = "concorde")
  concorde_tour = run_solver(x, method = "linkern")

## End(Not run)
```

---

tsp_generation_ea *TSP generating EA.*

Description

TSP generating EA.

Usage

```
tsp_generation_ea(fitness_function, pop_size = 30L, inst_size = 50L,
  generations = 100L, time_limit = 30L, uniform_mutation_rate,
  normal_mutation_rate, normal_mutation_sd, cells_round = 100L, rnd = TRUE,
  ...)
```

Arguments

fitness_function	[function(x, ...)] Fitness function used to judge the fitness of a TSP instance. x is a numeric matrix with 2 columns, containing the coordinates of a TSP instance.

pop_size [integer(1)]
Number of TSP instances maintained in each population. Default is 30.

inst_size [integer(1)]
Number of cities of each TSP instance. Default is 50.

generations [integer(1)]
Number of generations. Default is 100L.

time_limit [integer(1)]
Time limit in seconds. Default is 30.

uniform_mutation_rate
[numeric(1)]
Mutation probability in uniform mutation (in [0,1]).

normal_mutation_rate
[numeric(1)]
Mutation probability in normal mutation (in [0,1])

normal_mutation_sd
[numeric(1)]
Standard deviation of normal noise in normal mutation

cells_round [numeric(1)]
Grid resolution for rounding Default is 100.

rnd [logical(1)]
Round the coordinates before normal mutation. Default is TRUE.

... [any]
Not used.

Value

[list] List containing best individual form the last population, its fitness value, the genrational fitness and the last population. Default is 50.

---

tsp_instance *Generates a TSP instance S3 object either from city coordinates.*

Description

Generates a TSP instance S3 object either from city coordinates.

Usage

```
tsp_instance(coords, dists)
```

Arguments

coords [matrix]
Numeric matrix of city coordinates, rows denote cities.

dists [dist]
Optional distance matrix containing the inter-city distances. If not provided, the (euclidean) distances are computed from the coordinates.

Value

[tsp_instance].

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