

Package ‘MapperAlgo’

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Title Topological Data Analysis: Mapper Algorithm

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Description The Mapper algorithm from Topological Data Analysis, the steps are as follows 1. Define a filter (lens) function on the data. 2. Perform clustering within each level set. 3. Generate a complex from the clustering results.

Depends R (>= 3.1.2)

Imports parallel, doParallel, foreach, networkD3, igraph, ggraph, tidygraph, ggplot2, htmlwidgets

Suggests fastcluster, cluster, dbscan, testthat (>= 3.0.0)

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URL <https://github.com/kennywang112/MapperAlgo/>

BugReports <https://github.com/kennywang112/MapperAlgo/issues>

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cluster_cutoff_at_first_empty_bin

Cut the hierarchical clustering tree to define clusters

Description

Cut the hierarchical clustering tree to define clusters

Usage

cluster_cutoff_at_first_empty_bin(heights, diam, num_bins_when_clustering)

Arguments

heights Heights of the clusters.
diam Diameter of the clusters.
num_bins_when_clustering
 Number of bins when clustering.

Value

The cutoff height for the clusters.

cover_points

Cover points based on intervals and overlap

Description

Cover points based on intervals and overlap

Usage

```
cover_points(
  lsfi,
  filter_min,
  interval_width,
  percent_overlap,
  filter_values,
  num_intervals,
  type = "stride"
)
```

Arguments

lsfi	Level set flat index.
filter_min	Minimum filter value.
interval_width	Width of the interval.
percent_overlap	Percentage overlap between intervals.
filter_values	The filter values to be analyzed.
num_intervals	Number of intervals.
type	Type of interval, either 'stride' or 'extension'.

Value

Indices of points in the range.

find_best_k_for_kmeans

Find the optimal number of clusters for k-means

Description

This function calculates the total within-cluster sum of squares (WSS) for a range of cluster numbers and identifies the best number of clusters (k) based on the elbow method.

Usage

```
find_best_k_for_kmeans(dist_object, max_clusters = 10)
```

Arguments

dist_object	A distance matrix or data frame containing the data to be clustered.
max_clusters	The maximum number of clusters to test for k-means. Default is 10.

Value

The optimal number of clusters (k) based on the elbow method.

MapperAlgo

Mapper Algorithm

Description

Implements the Mapper algorithm for Topological Data Analysis (TDA). It divides data into intervals, applies clustering within each interval, and constructs a simplicial complex representing the structure of the data.

Usage

```
MapperAlgo(
  filter_values,
  intervals,
  percent_overlap,
  methods,
  method_params = list(),
  cover_type = "extension",
  num_cores = 1
)
```

Arguments

<code>filter_values</code>	A data frame or matrix of the data to be analyzed.
<code>intervals</code>	An integer specifying the number of intervals.
<code>percent_overlap</code>	Percentage of overlap between consecutive intervals.
<code>methods</code>	Specify the clustering method to be used, e.g., "hclust" or "kmeans".
<code>method_params</code>	A list of parameters for the clustering method.
<code>cover_type</code>	Type of interval, either 'stride' or 'extension'.
<code>num_cores</code>	Number of cores to use for parallel computing.

Value

A list containing the Mapper graph components:

- adjacency** The adjacency matrix of the Mapper graph.
- num_vertices** The number of vertices in the Mapper graph.
- level_of_vertex** A vector specifying the level of each vertex.
- points_in_vertex** A list of the indices of the points in each vertex.
- points_in_level_set** A list of the indices of the points in each level set.
- vertices_in_level_set** A list of the indices of the vertices in each level set.

mapperEdges	<i>Create Mapper Edges</i>
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Description

This function generates the edges of the Mapper graph by analyzing the adjacency matrix. It returns a data frame with source and target vertices that are connected by edges.

Usage

```
mapperEdges(m)
```

Arguments

m	The Mapper output object that contains the adjacency matrix and other graph components.
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Value

A data frame containing the source (Linksource), target (Linktarget), and edge values (Linkvalue) for the graph's edges.

MapperPlotter	<i>Plot Mapper Result</i>
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Description

Visualizes the Mapper output using either networkD3 or ggraph.

Usage

```
MapperPlotter(Mapper, label, data, type = "forceNetwork")
```

Arguments

Mapper	Mapper object.
label	Label of the data.
data	Data.
type	Visualization type: "forceNetwork" or "ggraph".

Value

Plot of the Mapper.

mapperVertices	<i>Create Mapper Vertices</i>
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Description

This function generates the vertices of the Mapper graph, including their labels and groupings. It returns a data frame with the vertex names, the group each vertex belongs to, and the size of each vertex.

Usage

```
mapperVertices(m, pt_labels)
```

Arguments

m	The Mapper output object that contains information about the vertices and level sets.
pt_labels	A vector of point labels to be assigned to the points in each vertex.

Value

A data frame containing the vertex names (Nodename), group information (Nodegroup), and vertex sizes (Nodesize).

perform_clustering	<i>Perform clustering within a level set</i>
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Description

Perform clustering within a level set

Usage

```
perform_clustering(
  points_in_this_level,
  filter_values,
  methods,
  method_params = list()
)
```

Arguments

points_in_this_level	Points in the current level set.
filter_values	The filter values.
methods	Specify the clustering method to be used, e.g., "hclust" or "kmeans".
method_params	A list of parameters for the clustering method.

Value

A list containing the number of vertices, external indices, and internal indices.

simplicial_complex	<i>Construct adjacency matrix of the simplicial complex</i>
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Description

Construct adjacency matrix of the simplicial complex

Usage

```
simplicial_complex(  
  filter_values,  
  vertex_index,  
  num_levelsets,  
  num_intervals,  
  vertices_in_level_set,  
  points_in_vertex  
)
```

Arguments

`filter_values` A matrix of filter values.

`vertex_index` The number of vertices.

`num_levelsets` The total number of level sets.

`num_intervals` A vector representing the number of intervals for each filter.

`vertices_in_level_set`
A list where each element contains the vertices corresponding to each level set.

`points_in_vertex`
A list where each element contains the points corresponding to each vertex.

Value

An adjacency matrix representing the simplicial complex.

to_lsfi	<i>Convert level set multi-index (lsmi) to flat index (lsfi)</i>
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Description

Convert level set multi-index (lsmi) to flat index (lsfi)

Usage

```
to_lsfi(lsmi, num_intervals)
```

Arguments

lsmi Level set multi-index.
num_intervals Number of intervals.

Value

A flat index corresponding to the multi-index.

to_lsmi	<i>Convert level set flat index (lsfi) to multi-index (lsmi)</i>
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Description

Convert level set flat index (lsfi) to multi-index (lsmi)

Usage

```
to_lsmi(lsfi, num_intervals)
```

Arguments

lsfi Level set flat index.
num_intervals Number of intervals.

Value

A multi-index corresponding to the flat index.

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