Package ‘hypergraph’

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Title A package providing hypergraph data structures
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R topics documented:

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### DirectedHyperedge-class

**Constructor for DirectedHyperedge objects**

**Description**

A convenience constructor for `DirectedHyperedge-class` objects

**Usage**

```r
DirectedHyperedge(head, tail, label = "")
```

**Arguments**

- `head`: Character vector of nodes that are part of the head of the hyperedge
- `tail`: Character vector of nodes that part of the tail of the hyperedge
- `label`: A character string describing the directed hyperedge

**Value**

An object of class `DirectedHyperedge-class`

**Author(s)**

Seth Falcon

**See Also**

`DirectedHyperedge-class` `Hyperedge-class` `Hypergraph-class`

### DirectedHyperedge-class

**Class DirectedHyperedge**

**Description**

This class represents directed hyperedges in a `Hypergraph-class`. A directed hyperedge consists of two disjoint sets of nodes, those in the tail and those in the head of the hyperedge. Directed hyperedges are sometimes called hyperarcs.

**Objects from the Class**

Objects can be created by calls of the form `new("DirectedHyperedge", head, tail, label)`. You can also use the convenience function `DirectedHyperedge`.

**Slots**

- `tail`: Character vector of nodes in the tail of the hyperedge
- `head`: Character vector of nodes in the head of the hyperedge
- `label`: Character string describing the directed hyperedge
Hyperedge

Extends

Class "Hyperedge", directly.

Methods

head signature(x = "DirectedHyperedge"): Return a vector containing the nodes in the head of the hyperedge
tail signature(x = "DirectedHyperedge"): Return a vector containing the nodes in the tail of the hyperedge
initialize signature(.Object = "DirectedHyperedge"): Create a new instance.
nodes signature(object = "DirectedHyperedge"): Return a vector containing all nodes present in the hyperedge.
show signature(object = "DirectedHyperedge"): Print me
toUndirected signature(.Object = "DirectedHyperedge"): Return a Hyperedge-class object that results from coercing to an undirected hyperedge.

Author(s)

Seth Falcon

See Also

DirectedHyperedge Hyperedge Hyperedge-class Hypergraph-class

Examples

head <- LETTERS[1:4]
tail <- LETTERS[19:21]
label <- "Directed hyperedge"
dhe <- new("DirectedHyperedge", head=head, tail=tail, label=label)

---

Hyperedge Constructor for Hyperedge objects

Description

A convenience constructor for Hyperedge-class objects

Usage

Hyperedge(nodes, label = "")

Arguments

nodes Character vector of nodes that are part of the hyperedge
label A character string describing the hyperedge

Value

An object of class Hyperedge-class
Hyperedge-class

Description

A Hyperedge object represents a hyperedge in a hypergraph, that is, a subset of the nodes of a hypergraph.

Objects from the Class

Objects can be created by calls of the form `new("Hyperedge", nodes, label)`. You can also use the convenience function `Hyperedge` to create instances. This is especially useful for creating a list of Hyperedge instances using `lapply`.

Slots

- `head`: A vector of mode "character" containing the node labels that are a part of the hyperedge
- `label`: An arbitrary "character" string describing this hyperedge

Methods

- `initialize` signature(.Object = "Hyperedge"): Create an instance
- `label` signature(object = "Hyperedge"): Return the value of the label slot
- `label<-` signature(object = "Hyperedge", value = "character"): Set the label slot.
- `nodes` signature(object = "Hyperedge"): Return a vector containing the nodes in the hyperedge
- `show` signature(object = "Hyperedge"): Print a textual summary of the hyperedge

Author(s)

Seth Falcon

See Also

`Hyperedge-class` `Hypergraph-class` `DirectedHyperedge-class`

Examples

```r
nodes <- LETTERS[1:4]
label <- "Simple hyperedge"
# Use the convenience constructor
he <- Hyperedge(nodes, label)
```
Hypergraph

Constructor for Hypergraph objects

Description
A convenience constructor for link(Hypergraph-class) objects

Usage
Hypergraph(nodes, hyperedges)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>nodes</td>
<td>A vector of nodes (character)</td>
</tr>
<tr>
<td>hyperedges</td>
<td>A list of Hyperedge-class objects</td>
</tr>
</tbody>
</table>

Value
An object of class Hypergraph-class

Author(s)
Seth Falcon

See Also
Hypergraph-class Hyperedge-class DirectedHyperedge-class

Hypergraph-class

Class Hypergraph

Description
A hypergraph consists of a set of nodes and a set of hyperedges. Each hyperedge is a subset of the node set. This class provides a representation of a hypergraph that is (hopefully) useful for computing.

Objects from the Class
Objects can be created by calls of the form new("Hypergraph", nodes, hyperedges). You can also use the convenience function Hypergraph. The nodes argument should be a character vector of distinct labels representing the nodes of the hypergraph. The hyperedges argument must be a list of Hyperedge-class objects.

Slots

<table>
<thead>
<tr>
<th>Slot</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>nodes</td>
<td>A &quot;character&quot; vector specifying the nodes</td>
</tr>
<tr>
<td>hyperedges</td>
<td>A &quot;list&quot; of Hyperedge-class objects</td>
</tr>
</tbody>
</table>
**kCoresHypergraph**

**Methods**

- **hyperedges** signature(.Object = "Hypergraph"): Return the list of Hyperedge objects
- **hyperedgeLabels** signature(.Object = "Hypergraph"): Return a character vector of labels for the Hyperedge objects in the hypergraph.
- **inciMat** signature(.Object = "Hypergraph"): Return the incidence matrix representation of this hypergraph
- **inciMat2HG** signature(.Object = "matrix"): Return the hypergraph representation of this incidence matrix
- **initialize** signature(.Object = "Hypergraph"): Create an instance
- **nodes** signature(object = "Hypergraph"): Return the vector of nodes (character vector)
- **numNodes** signature(object = "Hypergraph"): Return the number of nodes in the hypergraph
- **toGraphNEL** signature(.Object = "Hypergraph"): Return the graphNEL representation of the hypergraph (a bipartite graph)

**Author(s)**

Seth Falcon

**See Also**

Hyperedge-class DirectedHyperedge-class graphNEL-class

**Examples**

```r	nodes <- LETTERS[1:4]
htEdges <- lapply(list("A", LETTERS[1:2], LETTERS[3:4]), "Hyperedge")
hg <- new("Hypergraph", nodes=nodes, hyperedges=htEdges)
```

---

**Description**

Find all the k-cores in a hypergraph

**Usage**

kCoresHypergraph(hg)

**Arguments**

- **hg** an instance of the Hypergraph class

**Details**

A k-core in a hypergraph is a maximal subhypergraph where (a) no hyperedge is contained in another, and (b) each node is adjacent to at least k hyperedges in the subgraph.

The implementation is based on the algorithm by E. Ramadan, A. Tarafdar, A. Pothen, 2004.
Value

A vector of the core numbers for all the nodes in \( g \).

Author(s)

Li Long <li.long@isb-sib.ch>

References


Examples

# to turn the snacoreex.gxl (from RBGL package) graph to a hypergraph
# this is a rough example

k_c_hg_he <- lapply(kc_hg_e, "Hyperedge")
k_c_hg <- new("Hypergraph", nodes=kc_hg_n, hyperedges=k_c_hg_he)
kCoresHypergraph(kc_hg)

Description

Conveniently create lists of Hyperedge-class instances.

Usage

12hel(e)

Arguments

e A list of character vectors. Each element of the list represents a hyperedge and the character vector value specifies the nodes of the hypergraph that are part of the hyperedge. The names of the list elements, if found, will be used as the label for the corresponding Hyperedge object.

Value

A list of Hyperedge-class objects. If the list e did not have names, the labels of the Hyperedges will be set to its index in the list coerced to character.

Author(s)

Seth Falcon
See Also

Hyperedge-class Hypergraph-class

Examples

```r
edges <- list("e1"="A", "e2"=c("A", "B"), "e3"=c("C", "D"))
hEdgeList <- l2hel(edges)
```

---

**vCoverHypergraph**

Approximate minimum weight vertex cover in a hypergraph

**Description**

Approximate minimum weight vertex cover in a hypergraph

**Usage**

```r
vCoverHypergraph(hg, vW=rep(1, numNodes(hg)))
```

**Arguments**

- `hg`: an instance of the Hypergraph class
- `vW`: vertex weights

**Details**

Hypergraph `g` has non-negative weights on its vertices. The minimum weight vertex cover problem is to find a subset of vertices `C` such that `C` includes at least one vertex from each hyperedge and the sum of the weights of the vertices in `C` is minimum. This problem is NP-hard.

We implement the greedy algorithm to approximate near-optimal solution, proposed by E. Ramadan, A. Tarafdar, A. Pothen, 2004.

**Value**

A list of vertices from hypergraph `g`.

**Author(s)**

Li Long <li.long@isb-sib.ch>

**References**

Examples

# to turn the snacoreex.gxl graph (from RBGL package) to a hypergraph
# this is a rough example
kc_hg_e <- list(c("A", "C"), c("B", "C"), c("C", "E"), c("C", "F"), c("E", "D"), c("E", "F"), c("D", "G"), c("G", "M"),
kc_hg_he <- lapply(kc_hg_e, "Hyperedge")
kc_hg <- new("Hypergraph", nodes=kc_hg_n, hyperedges=kc_hg_he)

vCoverHypergraph(kc_hg)
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