Package 'hypergraph'

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Title A package providing hypergraph data structures

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Description A package that implements some simple capabilities for representing and manipulating hypergraphs.

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Contents

DirectedHyperedge 2
DirectedHyperedge-class 2
Hyperedge 4
Hyperedge-class 4
Hypergraph 5
Hypergraph-class 6
kCoresHypergraph 7
l2hel 8
vCoverHypergraph 8

Index **10**

`DirectedHyperedge` *Constructor for DirectedHyperedge objects*

Description

A convenience constructor for `DirectedHyperedge-class` objects

Usage

```
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 disjount 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 hyperege

`label`: Character string describing the directed 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 Hyeredge 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

Author(s)

Seth Falcon

See Also

Hyperedge-class Hypergraph-class

Hyperedge-class *Class Hyperedge*

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` `Hypergraph-class` `DirectedHyperedge-class`

Examples

```
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

`nodes`	A vector of nodes (character)
`hyperedges`	A list of `Hyperedge-class` objects

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

`nodes`: A `"character"` vector specifying the nodes

`hyperedges`: A `"list"` of `Hyperedge-class` objects

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

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

---

kCoresHypergraph *Find all the k-cores in a hypergraph*

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

A hypergraph model for the yeast protein complex network, Ramadan, E. Tarafdar, A. Pothen, A., Parallel and Distributed Processing Symposium, 2004. Proceedings. 18th International.

Examples

```
# to turn the snacoreex.gxl (from RBGL package) graph to a hypergraph
# this is a rough example
kc_hg_n <- c("A", "C", "B", "E", "F", "D", "G", "H", "J", "K", "I", "L", "M", "N", "O", "P", "Q", "R", "S", "T", "U")
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("D", "H
kc_hg_he <- lapply(kc_hg_e, "Hyperedge")
kc_hg <- new("Hypergraph", nodes=kc_hg_n, hyperedges=kc_hg_he)

kCoresHypergraph(kc_hg)
```

l2hel *Create lists of Hyperedge objects*

Description

Conveniently create lists of Hyperedge-class instances.

Usage

```
l2hel(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

```
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

```
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

A hypergraph model for the yeast protein complex network, Ramadan, E. Tarafdar, A. Pothen, A., Parallel and Distributed Processing Symposium, 2004. Proceedings. 18th International.

Examples

```
# to turn the snacoreex.gxl graph (from RBGL package) to a hypergraph
# this is a rough example
kc_hg_n <- c("A", "C", "B", "E", "F", "D", "G", "H", "J", "K", "I", "L", "M", "N", "O", "P", "Q", "R", "S", "T", "U")
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("D", "H
kc_hg_he <- lapply(kc_hg_e, "Hyperedge")
kc_hg <- new("Hypergraph", nodes=kc_hg_n, hyperedges=kc_hg_he)

vCoverHypergraph(kc_hg)
```

Index

∗ **classes**
DirectedHyperedge, 2
DirectedHyperedge-class, 2
Hyperedge, 4
Hyperedge-class, 4
Hypergraph, 5
Hypergraph-class, 6
l2hel, 8
∗ **models**
kCoresHypergraph, 7
vCoverHypergraph, 8

DirectedHyperedge, *2*, 2, *3*
DirectedHyperedge-class, 2

head *(*DirectedHyperedge-class*)*, 2
head,DirectedHyperedge-method *(*DirectedHyperedge-class*)*, 2
Hyperedge, *3*, 4, *5*
Hyperedge-class, 4
hyperedgeLabels *(*Hypergraph-class*)*, 6
hyperedgeLabels,Hypergraph-method *(*Hypergraph-class*)*, 6
hyperedges *(*Hypergraph-class*)*, 6
hyperedges,Hypergraph-method *(*Hypergraph-class*)*, 6
Hypergraph, 5
Hypergraph-class, 6

inciMat *(*Hypergraph-class*)*, 6
inciMat,Hypergraph-method *(*Hypergraph-class*)*, 6
inciMat2HG *(*Hypergraph-class*)*, 6
inciMat2HG,matrix-method *(*Hypergraph-class*)*, 6
initialize,DirectedHyperedge-method *(*DirectedHyperedge-class*)*, 2
initialize,Hyperedge-method *(*Hyperedge-class*)*, 4
initialize,Hypergraph-method *(*Hypergraph-class*)*, 6

kCoresHypergraph, 7

l2hel, 8
label *(*Hyperedge-class*)*, 4
label,Hyperedge-method *(*Hyperedge-class*)*, 4
label<- *(*Hyperedge-class*)*, 4
label<-,Hyperedge,character-method *(*Hyperedge-class*)*, 4
lapply, *4*

nodes,DirectedHyperedge-method *(*DirectedHyperedge-class*)*, 2
nodes,Hyperedge-method *(*Hyperedge-class*)*, 4
nodes,Hypergraph-method *(*Hypergraph-class*)*, 6
numNodes,Hypergraph-method *(*Hypergraph-class*)*, 6

show,DirectedHyperedge-method *(*DirectedHyperedge-class*)*, 2
show,Hyperedge-method *(*Hyperedge-class*)*, 4

tail *(*DirectedHyperedge-class*)*, 2
tail,DirectedHyperedge-method *(*DirectedHyperedge-class*)*, 2
toGraphNEL *(*Hypergraph-class*)*, 6
toGraphNEL,Hypergraph-method *(*Hypergraph-class*)*, 6
toUndirected *(*DirectedHyperedge-class*)*, 2
toUndirected,DirectedHyperedge-method *(*DirectedHyperedge-class*)*, 2

vCoverHypergraph, 8