The giRaph package for graph representation in R

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Outline

- introduction to the giRaph package
- classes for graphs and graph representations
- methods for basic graph manipulation
- interface to other graph packages

Example graph

- Provides formal (S4) classes and methods to represent and manipulate "graphs" in R.

We consider a broad notion of graph, including graphs with loops, multiple edges and hyper-edges, both directed and undirected.
Graph families and representations

anyGraph  incidenceList
generalGraph  incidenceMatrix
multiGraph  adjacencyList
simpleGraph  adjacencyMatrix

- Each family is defined as a subfamily of the previous one.
- Each representation is also available for narrower families.

Graph objects

They store one or more consistent representations of a graph.

> show(gg<-new("generalGraph",incidenceList=G))
An object of class generalGraph
Slot "incidenceMatrix":
An object of class incidenceMatrix
<0 x 0 matrix>

Slot "incidenceList":
An object of class "incidenceList"
V={a,b,c,d,e,f,g,h,i,j,k,l}
E={f->e->b->d->a->c, b->d->e, b->d, a->g, c->g, d->g, e->h, e->h, e->h, f->i, f->i, i<i, i->h, i->1, g->h, h->l, l->k, k->g, k->h, k->j}

Getting and setting representations

- Any representation available for the graph class can be retrieved; if necessary, it is obtained by converting a representation in use.

> areTheSame(incidenceMatrix(gg),as(G,"incidenceMatrix"))
[1] TRUE

- An available representation can be set via the corresponding replacement method; by default, other representations are dropped.

> incidenceMatrix(gg)<-incidenceMatrix(gg)
> c(isEmpty(gg@incidenceList),isEmpty(gg@incidenceMatrix))
[1] TRUE FALSE

- An available representation can be added via the corresponding replacement method, if it is consistent with the existing ones.

> incidenceList(gg,force=F)<-incidenceList(gg)
## Extraction of induced subgraphs

> gg[1:6]
An object of class `generalGraph`
Slot "incidenceMatrix":
An object of class `incidenceMatrix`
```
a b c d e f
[1,] 4 3 4 3 2 1
[2,] 0 1 0 1 0 0
[3,] 0 1 0 2 0 0
[4,] 0 2 0 1 0 0
```
Slot "incidenceList":
An object of class "incidenceList"
```
V={a,b,c,d,e,f}
E={f->e->b--d->a--c, b--d--e, b->d, d->b}
```

## Adding/removing vertices

We give a class for vertex sets
> v("a","b")
{a,b}

and we overload `+/-` operators
> G[1:6]+v("x","y")
An object of class "incidenceList"
```
V={a,b,c,d,e,f,x,y}
E={f->e->b--d->a--c, b--d--e, b->d, d->b}
```

> G[1:6]-v("e","f")
An object of class "incidenceList"
```
V={a,b,c,d}
E={b->d, d->b}
```

## Adding/removing edges

> G[1:6]+d(1,6)
An object of class "incidenceList"
```
V={a,b,c,d,e,f}
E={f->e->b--d->a--c, b--d--e, b->d, d->b, a->f}
```

> G[1:6]-u(2,4,5)
An object of class "incidenceList"
```
V={a,b,c,d,e,f}
E={f->e->b--d->a--c, b->d, d->b}
```

> isPresent(d(5,8),G-d(5,8))
[1] TRUE
> isPresent(d(5,8),G-d(5,8)-d(5,8)-d(5,8))
[1] FALSE

## Interface to other graph packages


**mathgraph**: Directed and undirected graphs. R package version 0.9-6.

J.H. Badsberg (2005). **dynamicGraph**: dynamicGraph. R package version 0.2.0.1.

Note that giRaph suggests, but does not depend on, these packages. Indeed, the giRaph DESCRIPTION file reads as follows:

Depends: R (>= 2.1.1), graphics, methods
Suggests: mathgraph, dynamicGraph (>= 0.2)
Thank you!

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