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The giRaph package for graph representation in R

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Outline

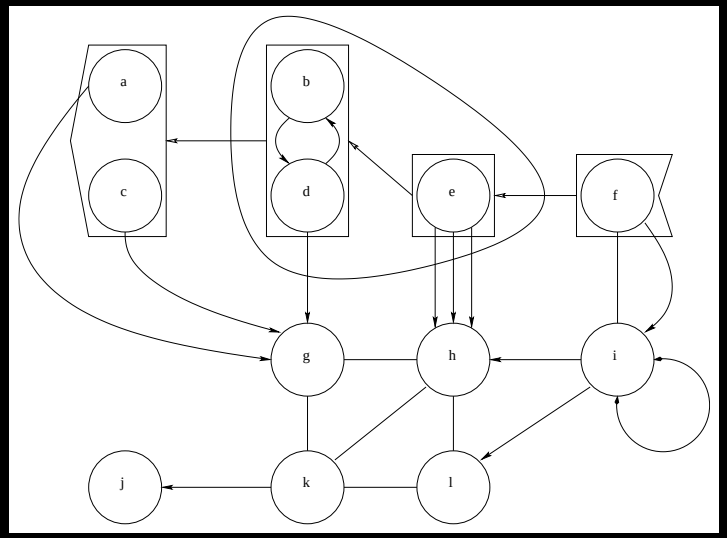
- introduction to the giRaph package
- classes for graphs and graph representations
- methods for basic graph manipulation
- interface to other graph packages

J.H. Badsberg, C. Dethlefsen & L. La Rocca (2006). giRaph: The giRaph package for graph representation in R. R package version 0.0.1.1. `http://www.math.aau.dk/~dethlef/giRaph`

- Intended as a contribution to the gR project described by S.L. Lauritzen (2002). gRaphical models in R: A new initiative within the R project. R News, 2(3):39, December 2002.
- 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.

Example graph



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.

Incidence list of example graph

```
> G<-new("incidenceList",V=letters[1:12],
         E=list(d(6,5,c(2,4),c(1,3)), u(2,4,5), d(2,4),
                d(4,2), d(1,7), d(3,7), d(4,7), d(5,8),
                d(5,8), d(5,8), u(6,9), d(6,9), u(9,9),
                d(9,8), d(9,12), u(7,8), u(8,12),
                u(12,11), u(11,7), u(11,8), d(11,10)))
> G
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, d->b, a->g, c->g,
   d->g, e->h, e->h, e->h, f--i, f->i, i<>i, i->h, i->l,
   g--h, h--l, l--k, k--g, k--h, k->j}
```


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, d->b, a->g, c->g,
   d->g, e->h, e->h, e->h, f--i, f->i, i<>i, i->h, i->l,
   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 1 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

Original S code by P.J. Burns. Ported to R by N. Efthymiou (2005). 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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