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The giRaph package for graph representation in R

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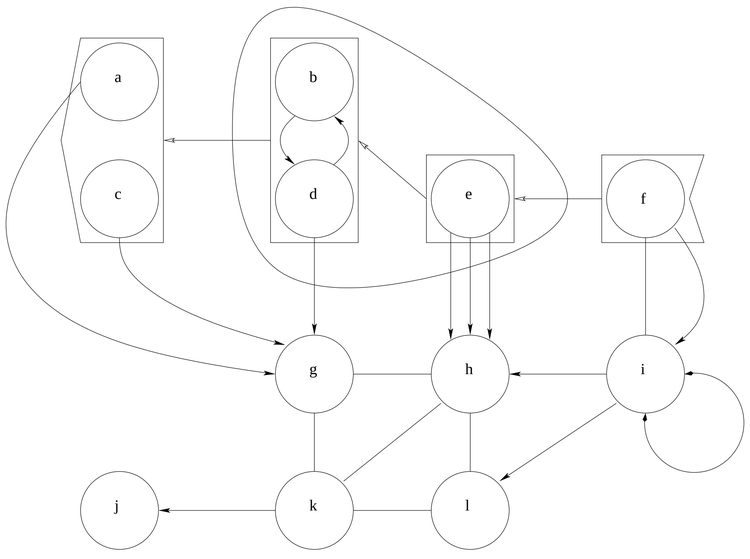
A broad notion of graph



General graphs may have

- *hyper-edges*, such as

  `b--d--e`

  `f->e->b--d->a--c`

- *loops*, such as

  `i<>i`

- *multiple edges*, such as

  `b->d, d->b`

  `e->h, e->h, e->h`

  `f--i, f->i`

Represented via incidence list

```
> 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}
```

or via incidence matrix

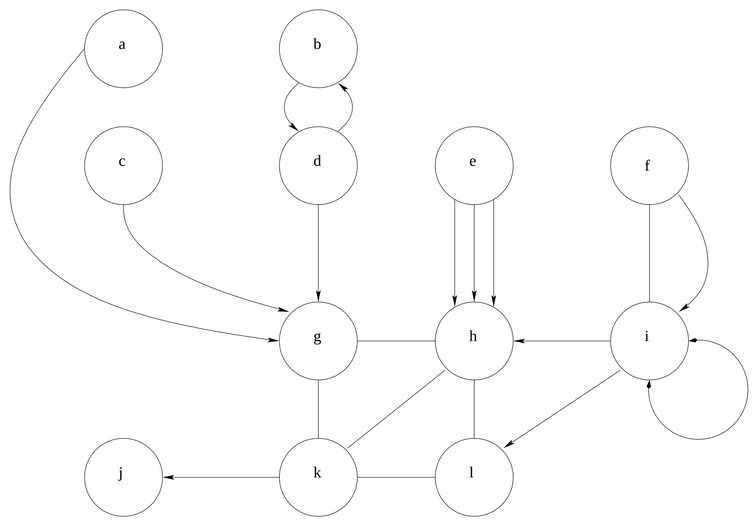
```
> I<-as(G,"incidenceMatrix")
> I[1:6] # incidence matrix of induced subgraph
An object of class incidenceMatrix
     a b c d e f
[1,] 4 3 4 3 2 1
[2,] 0 1 0 1 1 0
[3,] 0 1 0 2 0 0
[4,] 0 2 0 1 0 0
```

Both representations available for objects of class `generalGraph`

```
> gg<-new("generalGraph",incidenceList=G)
> areTheSame(gg,new("generalGraph",incidenceMatrix=I))
[1] TRUE
```

only incidence list for `anyGraph` objects.

Multi-graphs



Hyper-edges banned

```
> mg<-as(gg,"multiGraph")
Warning message:
Coercing generalGraph to multiGraph,
possibly loosing information...
```

adjacency list representation available

```
> adjacencyList(mg[5:9]) # gets induced subgraph first
An object of class "adjacencyList"
e -> {h,h,h}
f -- {i}
  -> {i}
g -- {h}
h <- {e,e,e,i}
  -- {g}
i <- {f}
  -- {f,i}
  -> {h}
```

Setting representations

Representation in use can be changed

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

or a consistent representation can be added

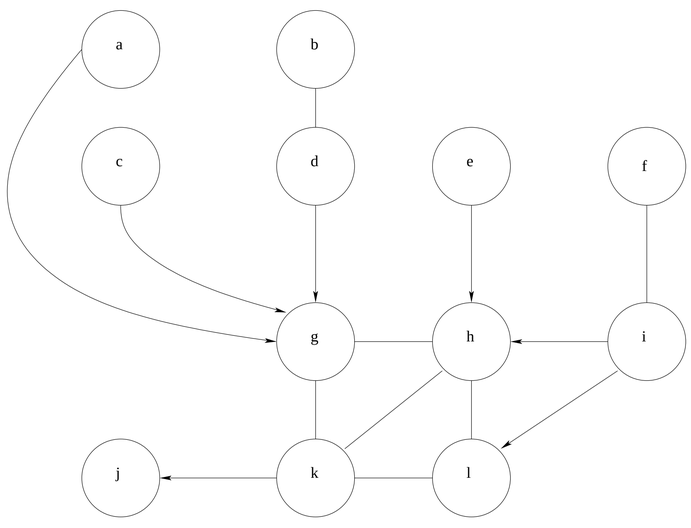
```
> adjacencyList(mg,force=F)<-adjacencyList(mg)
> c(isEmpty(mg@adjacencyList),isEmpty(mg@incidenceList))
[1] FALSE FALSE
```

Working with vertices & edges

Possible via overloaded operators

```
mg<-mg+v("x","y") # adds two isolated vertices

mg<-mg-v("a") # removes a vertex (& an edge...)

mg<-mg+u(1,13) # adds an undirected edge (b--y)

mg<-mg-d(1,3) # removes a directed edge (b->d)

mg<-mg*v("b","d","y") # gets an induced subgraph
```

Simple-graphs



Loops and multiple edges banned

```
> sg<-as(mg,"simpleGraph")
Warning message:
Coercing multiGraph to simpleGraph,
possibly loosing information...
```

adjacency matrix representation available

```
> adjacencyMatrix(sg[7:12]) # gets induced subgraph first
An object of class adjacencyMatrix
  g h i j k l
g 0 1 0 0 1 0
h 1 0 0 0 1 1
i 0 1 0 0 0 1
j 0 0 0 0 0 0
k 1 1 0 1 0 1
l 0 1 0 0 1 0
```

Connection to other packages

Suggests (but does not depend on)

- 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.

References

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

S.L. Lauritzen (2002). gRaphical models in R: A new initiative within the R project. R News, 2(3):39, December 2002.