

Package ‘incgraph’

October 12, 2017

Type Package

Title Incremental Graphlet Counting for Network Optimisation

Version 1.0.1

Date 2017-10-02

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Description An efficient and incremental approach for calculating the differences in orbit counts when performing single edge modifications in a network. Calculating the differences in orbit counts is much more efficient than recalculating all orbit counts from scratch for each time point.

License GPL-3

Depends R (>= 3.2)

Imports dplyr, methods, Rcpp (>= 0.11.4), orca, purrr, testthat, tibble

LinkingTo Rcpp, BH

Encoding UTF-8

URL <http://www.github.com/rcannood/incgraph>

BugReports <https://github.com/rcannood/incgraph/issues>

RoxygenNote 6.0.1

NeedsCompilation yes

Repository CRAN

Date/Publication 2017-10-12 08:50:00 UTC

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calculate.delta	<i>Calculate changes in orbit counts</i>
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Description

calculate.delta calculates the changes in orbit counts as a result of a single edge modification.

Usage

```
calculate.delta(network, i, j)
```

Arguments

network	An instance of the incgraph.network class
i	A node in network
j	A node in network

Details

This method iterates over and counts all graphlets which were added to or removed from the network due to one edge modification.

Value

A list containing two N-by-73 matrices, with N the number of nodes in the network and 1 column for each possible orbit. The value of `list$add[i,j]` (resp. `list$rem[i,j]`) is the number of times a subgraph was added to (resp. removed from) the network such that node i has orbit j in that subgraph.

Author(s)

Cannoodt Robrecht, <robrecht.cannoodt@gmail.com>

References

Cannoodt, R. et al. (2015) IncGraph: A graphlet-based approach for characterising topological changes in evolving networks. Submitted to Bioinformatics.

See Also

See [new.incgraph.network](#) for examples and usage.

`calculate.orbit.counts`*Calculate orbit counts from scratch*

Description

`calculate.orbit.counts` calculates the orbit counts of the current network.

Usage

```
calculate.orbit.counts(network)
```

Arguments

`network` An instance of the `incgraph.network` class

Details

The complete orbit counts is calculated using the `count5` from the `orca` package.

Calling this method repeatedly becomes very inefficient for evolving networks. For evolving networks, the usage of `calculate.delta` is recommended.

For more details on this method, see Hočevar and Demšar (2014).

Value

An N-by-73 matrix, with N the number of nodes in the network and 1 column for each possible orbit. The value of `mat[i, j]` is the number of times node `i` has orbit `j` in a subgraph in the network.

References

Hočevar, T. and Demšar J. (2014) A combinatorial approach to graphlet counting. *Bioinformatics*.

See Also

See [new.incgraph.network](#) for examples and usage.

contains	<i>Contains</i>
----------	-----------------

Description

contains returns TRUE if the network contains the edge (i, j).

Usage

```
contains(network, i, j)
```

Arguments

network	An instance of the incgraph.network class
i	A node in network
j	A node in network

Value

TRUE if the network contains (i, j)

See Also

See [new.incgraph.network](#) for examples and usage.

flip	<i>Modify edge</i>
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Description

flip modifies an edge in the network. If it is contained in the network, it is removed from the network, otherwise it is added to the network.

Usage

```
flip(network, i, j)
```

Arguments

network	An instance of the incgraph.network class
i	A node in network
j	A node in network

See Also

See [new.incgraph.network](#) for examples and usage.

```
generate.dynamic.network
      Generate a dynamic network
```

Description

Generate a dynamic network

Usage

```
generate.dynamic.network(
  model, amnt.nodes, amnt.edges, amnt.operations, trace = T, ...)

generate.geometric(amnt.nodes, amnt.edges, amnt.operations,
  amnt.dimensions = 3, trace = T)

generate.barabasiAlbert(amnt.nodes, amnt.edges, amnt.operations,
  offset.exponent = 1, trace = T)

generate.erdosrenyi(amnt.nodes, amnt.edges, amnt.operations, trace = T)
```

Arguments

model	The network model with which to generate the network; "BA" for Barabási–Albert, "ER" for Erdős–Rényi, or "GEO" for geometric
amnt.nodes	the number of nodes in the network at any given type
amnt.edges	the number of edges in the network at any given type
amnt.operations	the number of edge additions/deletions to generate
trace	will print output text if TRUE
...	extra parameters to pass to a specific network generator
amnt.dimensions	(only GEO) the number of dimensions in which to operate
offset.exponent	(only BA) the offset exponent for the weighted sampling

Value

A list containing the starting network `network` and the dynamic operations performed on it `operations`.

Examples

```
# dyn.net.ba <- generate.dynamic.network("BA", 300, 300, 1000)
dyn.net.er <- generate.dynamic.network("ER", 300, 300, 1000)
dyn.net.geo <- generate.dynamic.network("GEO", 300, 300, 1000)
```

`get.neighbours` *Neighbours*

Description

`get.neighbours` returns a vector of all neighbours of `i`.

Usage

```
get.neighbours(network, i)
```

Arguments

<code>network</code>	An instance of the <code>incgraph.network</code> class
<code>i</code>	A node in <code>network</code>

Value

Returns all neighbours of node `i`

See Also

See [new.incgraph.network](#) for examples and usage.

`incgraph` *IncGraph: incremental graphlet counting for network optimisation*

Description

IncGraph: incremental graphlet counting for network optimisation

Author(s)

Cannoodt Robrecht, <robrecht.cannoodt@gmail.com>

References

Cannoodt, R. et al. (2017) IncGraph: incremental graphlet counting for network optimisation. Under submission.

See Also

[new.incgraph.network](#), [calculate.orbit.counts](#), [calculate.delta](#)

Examples

```
# Create a new (empty) network with 4 nodes
net <- new.incgraph.network(amnt.nodes = 4)

# Create a new network with 4 nodes and some edges
net <- new.incgraph.network(links = matrix(c(1, 2, 2, 3, 1, 4), ncol=2))

# Create a new network with 10 nodes and some edges
net <- new.incgraph.network(amnt.nodes = 10, links = matrix(c(1, 2, 2, 3, 1, 4), ncol=2))

# Create a more complex network from a matrix
mat <- matrix(c(1, 2,
               1, 3,
               1, 4,
               1, 5,
               1, 6,
               1, 7,
               2, 7,
               2, 8,
               2, 9,
               2, 10), ncol=2)
net <- new.incgraph.network(links=mat)
# Calculate the initial orbit counts using orca
orb.counts <- calculate.orbit.counts(net)
# Modify an edge and calculate the differences in orbit counts
flip(net, 5, 10) # add (5,10)
delta1 <- calculate.delta(net, 5, 10)
# Modify another edge
flip(net, 6, 10) # add (6, 10)
delta2 <- calculate.delta(net, 6, 10)
# And another
flip(net, 1, 5) # remove (1, 5)
delta3 <- calculate.delta(net, 1, 5)
# Verify that the new orbit counts equals the old orbit counts plus the delta counts
new.orb.counts.incremental <- orb.counts +
  delta1$add - delta1$rem +
  delta2$add - delta2$rem +
  delta3$add - delta3$rem
new.orb.counts <- calculate.orbit.counts(net)
all(new.orb.counts.incremental == new.orb.counts) # TRUE

## Additional helper functions
# Transform the network to a matrix
network.as.matrix(net)
# Get all neighbours of a node
get.neighbours(net, 1)
# Does the network contain a specific interaction?
contains(net, 5, 10)
contains(net, 7, 10)
# Reinitialise to an empty network
reset(net)
network.as.matrix(net)
```

network.as.matrix *Network as matrix*

Description

network.as.matrix returns the network as a matrix

Usage

```
network.as.matrix(network)
```

Arguments

network An instance of the incgraph.network class

See Also

See [new.incgraph.network](#) for examples and usage.

new.incgraph.network *IncGraph network*

Description

new.incgraph.network creates a new IncGraph object containing either an empty network or a network initialised from a given matrix.

Usage

```
new.incgraph.network(amnt.nodes, links=NULL)
```

```
new.incgraph.network(amnt.nodes=NULL, links)
```

```
new.incgraph.network(amnt.nodes, links)
```

Arguments

amnt.nodes The number of nodes in the network

links A matrix with 2 columns and N rows, 1 row for each edge to be loaded in the network

Details

This creates a new instance of the incgraph.network class. At least one of the parameters (amnt.nodes or links) needs to be passed to this function. Please note that this is a stateful object.

Value

An instance of the incgraph.network class

See Also

[incgraph](#), [calculate.orbit.counts](#), [calculate.delta](#)

Examples

```
# Create a new (empty) network with 4 nodes
net <- new.incgraph.network(amnt.nodes = 4)

# Create a new network with 4 nodes and some edges
net <- new.incgraph.network(links = matrix(c(1, 2, 2, 3, 1, 4), ncol=2))

# Create a new network with 10 nodes and some edges
net <- new.incgraph.network(amnt.nodes = 10, links = matrix(c(1, 2, 2, 3, 1, 4), ncol=2))

# Create a more complex network from a matrix
mat <- matrix(c(1, 2,
                1, 3,
                1, 4,
                1, 5,
                1, 6,
                1, 7,
                2, 7,
                2, 8,
                2, 9,
                2, 10), ncol=2)
net <- new.incgraph.network(links=mat)
# Calculate the initial orbit counts using orca
orb.counts <- calculate.orbit.counts(net)
# Modify an edge and calculate the differences in orbit counts
flip(net, 5, 10) # add (5,10)
delta1 <- calculate.delta(net, 5, 10)
# Modify another edge
flip(net, 6, 10) # add (6, 10)
delta2 <- calculate.delta(net, 6, 10)
# And another
flip(net, 1, 5) # remove (1, 5)
delta3 <- calculate.delta(net, 1, 5)
# Verify that the new orbit counts equals the old orbit counts plus the delta counts
new.orb.counts.incremental <- orb.counts +
  delta1$add - delta1$rem +
  delta2$add - delta2$rem +
  delta3$add - delta3$rem
new.orb.counts <- calculate.orbit.counts(net)
all(new.orb.counts.incremental == new.orb.counts) # TRUE

## Additional helper functions
# Transform the network to a matrix
network.as.matrix(net)
```

```

# Get all neighbours of a node
get.neighbours(net, 1)
# Does the network contain a specific interaction?
contains(net, 5, 10)
contains(net, 7, 10)
# Reinitialise to an empty network
reset(net)
network.as.matrix(net)

```

orca.halfdelta *Modify edge*

Description

orca.halfdelta calculates the orca counts for a network that has just been changed.

Usage

```
orca.halfdelta(network, i, j)
```

Arguments

network	An instance of the incgraph.network class
i	A node in network
j	A node in network

reset *Reset network*

Description

reset resets all the data structures so that all edges are removed from the network.

Usage

```
reset(network)
```

Arguments

network	An instance of the incgraph.network class
---------	---

See Also

See [new.incgraph.network](#) for examples and usage.

set.network	<i>Set a given network to contain the given links</i>
-------------	---

Description

set.network sets a given network to contain the given links.

Usage

```
set.network(network, links)
```

Arguments

network	An instance of the incgraph.network class
links	A matrix with 2 columns and N rows, 1 row for each edge to be loaded in the network

Details

This first resets the network and adds all given links. For minor changes to the network, the usage of [flip](#) is recommended.

See Also

See [new.incgraph.network](#) for examples and usage.

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