Package ‘geneplast’

January 14, 2017

Type Package
Title Evolutionary and plasticity analysis based on orthologous groups distribution
Version 1.0.0
Date 2016-06-13
Author Rodrigo Dalmolin, Mauro Castro
Maintainer Mauro Castro <mauro.a.castro@gmail.com>
Depends R (>= 3.3), methods
Imports snow, ape, grDevices, graphics, stats, utils
Suggests BiocStyle, RUnit, BiocGenerics
Description Geneplast is designed for evolutionary and plasticity analysis based on orthologous groups distribution in a given species tree. It uses Shannon information theory and orthologs abundance to estimate the Evolutionary Plasticity Index. Additionally, it implements the Bridge algorithm to determine the evolutionary root of a given gene based on its orthologs distribution.
biocViews Genetics, GeneRegulation, SystemsBiology
License GPL (>= 2)
LazyLoad yes
NeedsCompilation no

R topics documented:

geneplast-package .............................................................. 2
gpdata ................................................................. 2
gplast ............................................................. 3
gplast.get ............................................................ 4
gplast.preprocess ...................................................... 5
groot .............................................................. 6
groot.get .............................................................. 8
groot.plot ............................................................. 9
groot.preprocess .................................................... 10
OGP-class ............................................................. 11
OGR-class ............................................................. 12
geneplast-package

Geneplast: an R package for evolutionary rooting and plasticity inference based on orthologous groups distribution.

Description

Geneplast is designed for evolutionary and plasticity analysis based on orthologous groups distribution in a given species tree. It uses Shannon information theory and orthologs abundance to estimate the Evolutionary Plasticity Index. Additionally, it implements the Bridge algorithm to determine the evolutionary root of a given gene based on its orthologs distribution.

Details

Package: geneplast
Type: Package
Version: 1.0
Date: 2016-06-10
License: GPL (>= 2)

R package for gene plasticity inference based on orthologous groups distribution.

Author(s)

Rodrigo JS Dalmolin, Mauro AA Castro.

References


gpdata

A pre-processed dataset for the geneplast package.

Description

A dataset used to demonstrate geneplast main functions.

Usage

data(gpdata.gs)

Format

gpdata.gs data frame containing information about clusters of orthologous groups.
The dataset consists of 4 R objects used in the geneplast vignettes.

**cogdata** A data frame with three columns containing the Clusters of Orthologous Groups information retrieved from the STRING database (http://string-db.org/), release 9.1. Column 1 = Ensembl protein ID; column 2 = NCBI species ID; column 3 = OG ID.

**sspids** A data frame containing the species listed in STRING database (http://string-db.org/), release 9.1. Column 1 = NCBI species ID; column 2 = NCBI species name; column 3 = species domain (eukaryotes).

**cogids** A one-column dataframe with orthologous groups IDs available in the 'cogdata' object.

**phyloTree** An object of class "phylo" listing the eukaryotes in the STRING database, release 9.1.

### Value

A dataset.

### References


### Examples

```r
data(gpdata.gs)
```

---

**gplast**

#### Evolutionary plasticity inference.

### Description

Function to calculate abundance, diversity, and evolutionary plasticity of an orthologous group (OG).

### Usage

```r
gplast(object, verbose=TRUE)
```

### Arguments

- **object**: this argument is an object of class 'OGP' (**OGP-class**).
- **verbose**: a single logical value specifying to display detailed messages (when verbose=TRUE) or not (when verbose=FALSE).

### Details

This method computes the abundance and diversity of an OG, and derives the evolutionary plasticity as described in Castro et al. (2008) and Dalmolin et al. (2011). The OG diversity corresponds to the normalized Shannon’s diversity index and estimates the distribution of orthologous proteins across the species listed in the input dataset. The OG abundance is simply the ratio between the number of orthologs of a given OG and the number of organisms listed in the group. Evolutionary Plasticity Index is calculated as described in Dalmolin et al (2011).
gplast.get

Value
A processed object of class 'OGP', including COG's abundance, diversity, and plasticity results.

Author(s)
Rodrigo Dalmolin, Mauro Castro

References


See Also
OGP-class

Examples

```r
#load datasets used for demonstration
data(gpdata.gs)

#create and object of class 'OGP'
ogp <- gplast.preprocess(cogdata=cogdata, sspids=sspids, cogids=cogids)

## run the gplast function
## this example uses the especies/COGs listed in the gpdata object
ogp <- gplast(ogp)
res <- gplast.get(ogp,what="results")
```

---

gplast.get Get information from individual slots in an OGP object.

Description
Get information from individual slots in an OGP object and any available results from previous analysis.

Usage
gplast.get(object, what="status")

Arguments

- object: an object of class 'OGP' OGP-class.
- what: a single character value specifying which information should be retrieved from the slots. Options: "cogids", "sspids", "orthodist", "results", and "status".
Value

slot content from an object of class 'OGP' \textit{OGP-class}.

Author(s)

Rodrigo Dalmolin, Mauro Castro

Examples

```r
#load datasets used for demonstration
data(gpdata.gs)

#create a object of class 'OGP'
ogp <- gplast.preprocess(cogdata=cogdata, sspids=sspids, cogids=cogids)

## run the gplast function
## this example uses the especies/COGs listed in the gpdata object
ogp <- gplast(ogp)
res <- gplast.get(ogp,what="results")
```

gplast.preprocess \textit{Evolutionary plasticity inference.}

Description

Constructor for the 'OGP-class' object.

Usage

```r
gplast.preprocess(cogdata, sspids=NULL, cogids=NULL, verbose=TRUE)
```

Arguments

cogdata a data frame or matrix with COG's data.
sspids an optional data frame with species annotation. Alternatively, it can be a character vector with species IDs.
cogids an optional data frame with COG's annotation. Alternatively, it can be a character vector with COG IDs.
verbose a single logical value specifying to display detailed messages (when verbose=TRUE) or not (when verbose=FALSE).

Details

This function creates an \texttt{OGP-class} object and checks the consistency of the input data for the evolutionary plasticity pipeline. Internally, the function counts the number of orthologs for each species in a given OG and computes the orthodist matrix.

Value

A preprocessed object of class 'OGP'.

**Author(s)**
Rodrigo Dalmolin, Mauro Castro

**References**


**See Also**
OGP-class

**Examples**

```r
#load datasets used for demonstration
data(gpdata.gs)

#create and object of class 'OGP'
ogp <- gplast.preprocess(cogdata=cogdata, sspids=sspids, cogids=cogids)
```

---

**groot**

*Evolutionary rooting inference.*

**Description**
Function to determine the evolutionary root of a gene based on its orthologs distribution.

**Usage**
```
groot(object, method="BR", penalty=2, cutoff=0.3, nPermutations=1000, pAdjustMethod="bonferroni", verbose=TRUE)
```

**Arguments**
- `object` this argument is an object of class 'OGR' (OGR-class).
- `method` a single character value specifying the rooting algorithm. Options: "BR" and "KS" (see details).
- `penalty` a single numeric value specifying the penalty used in the rooting algorithm (see details).
- `cutoff` a single numeric value in [0,1] specifying the cutoff used in the BR statistics (see details).
- `nPermutations` a single integer value specifying the number of permutations used to compute a null distribution for the inferred roots in the species tree.
pAdjustMethod  a single character value specifying the p-value adjustment method to be used (see ‘p.adjust’ for details).

verbose  a single logical value specifying to display detailed messages (when verbose=TRUE) or not (when verbose=FALSE).

Details

This function addresses the problem of finding the evolutionary root of a feature in an evolutionary tree. The method infers the probability that such feature had been present in each last common ancestor (LCA) of a given existent species in the tree. Regarding genes, this is a delicate task, especially due to mechanisms like horizontal gene transfer, gene deletion, de novo gene formation, among others, which add noise to the vertical heritage pattern. The groot function estimates this information by accessing the presence and absence of orthologs in the tree branches and summarizes the available evidences supporting the ancestor ortholog in the LCA. A probability distribution is derived from this process, which sets the searching space used in the rooting algorithm described next. The penalty argument allows weighing gene gain and loss during speciation; penalty=1 indicates same probability; penalty > 1 indicates higher probability of gene loss while penalty < 1 indicates higher probability of gene gain. Penalty value should be greater than zero (default penalty=2). The rooting algorithm is set by the argument method. The current version introduces the Bridge (BR) algorithm, which search the previously computed probability distribution to find the most reliable evolutionary root. The algorithm search for the optimum point that splits the probability distribution in two components: one enriched with the queried feature and another with low evidence in favor of the feature’s presence. The cutoff sets the tolerance for the discrimination (default cutoff=0.3). The groot function also computes the inconsistence score Dscore in order to accesses the significance of the observed root, which is tested against a null distribution derived by permutation analysis.

Value

An processed object of class ’OGR’, including results from the rooting algorithm.

Author(s)

Rodrigo Dalmolin, Mauro Castro

References


See Also

OGR-class

Examples

#load datasets used for demonstration
data(gpdata.gs)

#create and object of class ’OGR’ for H. sapiens
ogr <- groot.preprocess(cogdata=cogdata, phyloTree=phyloTree, spid="9606", cogids=cogids)

## run the groot function
## this example uses the orthologous groups listed in the gpdata object
groot.get

Get information from individual slots in an OGR object.

Description
Get information from individual slots in an OGR object and any available results from a previous analysis.

Usage

```r
groot.get(object, what="status")
```

Arguments

- `object`: an object of class `OGR`.
- `what`: a single character value specifying which information should be retrieved from the slots. Options: "cogids", "spbranches", "orthoroot", "results" and "status".

Value

slot content from an object of class `OGR`.

Author(s)
Rodrigo Dalmolin, Mauro Castro

Examples

```r
# load datasets used for demonstration
data(gpdata.gs)

# create and object of class 'OGR' for H. sapiens
ogr <- groot.preprocess(cogdata=cogdata, phyloTree=phyloTree, spid="9606", cogids=cogids)

## run the groot function
## this example uses the orthologous groups listed in the gpdata object
ogr <- groot(ogr, nPermutations=100)
res <- groot.get(ogr, what="results")
```
groot.plot

Plot the inferred evolutionary root of a given OG or the map of LCAs of a given species.

Description
Plot the inferred evolutionary root of a given OG onto the species tree or the map of LCAs of a given species.

Usage
```r
groot.plot(ogr, whichOG, fname="gproot", width=4.5, height=6.5, cex.lab=0.3, cex.nodes=0.6, adj.tips=c(1, 0.5), lab.offset=1.5, col.tips=c("green2","grey"), col.edges=c("black","grey"), col.root="red", plot.sspnames=TRUE, plot.subtree=FALSE, plot.lcas=FALSE)
```

Arguments
- `ogr`: this argument is an object of class 'OGR' evaluated by the groot `groot` method.
- `whichOG`: a single character value indicating the OG to be plotted.
- `fname`: a character string naming a file.
- `width`: a single numeric value specifying the width of the graphics region in inches.
- `height`: a single numeric value specifying the height of the graphics region in inches.
- `cex.lab`: numeric character expansion factor for tip labels.
- `cex.nodes`: numeric expansion factor for node symbols.
- `adj.tips`: two numeric values specifying the adjustment of the labels.
- `lab.offset`: a single numeric value specifying the offset of the labels.
- `col.tips`: a character vector of length=2 specifying the colors of the tips.
- `col.edges`: a character vector of length=2 specifying the colors of the edges.
- `col.root`: a character value specifying the color of the inferred root.
- `plot.sspnames`: a single logical value specifying whether ssp names should be used to generate the plot.
- `plot.subtree`: a single logical value specifying whether a sub-species tree should be used to generate the plot.
- `plot.lcas`: a single logical value specifying whether a species tree should be generated mapping the positions of all possible roots.

Value
- a pdf file.

Author(s)
Rodrigo Dalmolin, Mauro Castro
References


See Also
groot

Examples

#load datasets used for demonstration
data(gpdata.gs)

#create an object of class 'OGR' for H. sapiens
ogr <- groot.preprocess(cogdata=cogdata, phyloTree=phyloTree, spid="9606", cogids=cogids)

## run the groot function
ogr <- groot(ogr, nPermutations=100)

## this example plots NOG40170 in the phyloTree
groot.plot(ogr, whichOG="NOG40170")

groot.preprocess

Evolutionary rooting inference.

Description

Constructor for the 'OGR-class' object.

Usage

groot.preprocess(cogdata, phyloTree, spid, cogids=NULL, verbose=TRUE)

Arguments

cogdata a data frame with COG’s data.
phyloTree an object of class "phylo".
spid a single character or integer value specifying the reference species to be used in the rooting algorithm. This species should be listed in the 'phyloTree'.
cogids an optional data frame with COG’s annotation. Alternatively, it can be a character vector with COG IDs.
verbose a single logical value specifying to display detailed messages (when verbose=TRUE) or not (when verbose=FALSE).

Details

This function creates an OGR-class object and checks the consistency of the input data for the evolutionary root pipeline. Internally, the function access the presence and absence of orthologs for each species in a given OG and computes the orthoct data.frame.
**OGP-class**

**Value**

A preprocessed object of class 'OGR'.

**Author(s)**

Rodrigo Dalmolin, Mauro Castro

**References**


**See Also**

OGP-class

**Examples**

```r
#load datasets used for demonstration
data(gpdata.gs)

#create and object of class 'OGR' for H. sapiens
ogr <- groot.preprocess(cogdata=cogdata, phyloTree=phyloTree, spid="9606", cogids=cogids)
```

---

**OGP-class**

Class "OGP": an S4 class for genetic plasticity analysis.

**Description**

This S4 class includes methods to access the genetic plasticity of orthologous groups.

**Objects from the Class**

Objects can be created by calls to the "gplast.preprocess" constructor.

**Slots**

- `sspids`: Object of class "data.frame", a data frame with species annotation.
- `cogids`: Object of class "data.frame", a data frame with COG's data.
- `orthodist`: Object of class "matrix", a matrix with COG's information (see return values in the OGP methods).
- `abundance`: Object of class "numeric", a numeric vector with results from the gplast function (see return values in the OGP methods).
- `diversity`: Object of class "numeric", a numeric vector with results from the gplast function (see return values in the OGP methods).
- `plasticity`: Object of class "numeric", a numeric vector with results from the gplast function (see return values in the OGP methods).
- `status`: Object of class "character", a character value specifying the status of the OGP object based on the available methods.
OGR-class

Methods

* **gplast** signature(object = "OGP"): see gplast
* **gplast.get** signature(object = "OGP"): see gplast.get

Author(s)

Rodrigo Dalmolin, Mauro Castro

See Also

  * gplast.preprocess

---

OGR-class

Class "OGR": an S4 class for rooting analysis.

Description

This S4 class includes methods to do inferential analysis of evolutionary roots in a given species tree.

Objects from the Class

Objects can be created by calls to the "groot.preprocess" constructor.

Slots

cogids: Object of class "data.frame", a data frame with COG's data.

tree: Object of class "phylo", a given species tree.

spbranches: Object of class "data.frame", a data frame listing branches of a given species tree.

orthoroot: Object of class "data.frame", a data.frame with results from the 'groot' function (see return values in the OGR methods).

orthoct: Object of class "data.frame", a data.frame with results from the 'groot.preprocess' function (see return values in the OGR methods).

status: Object of class "character", a character value specifying the status of the OGR object based on the available methods.

Methods

* **groot** signature(object = "OGP"): see groot
* **groot.get** signature(object = "OGP"): see groot.get

Author(s)

Rodrigo Dalmolin, Mauro Castro

See Also

  * groot.preprocess
Index

*Topic **classes**
  OGP-class, 11
  OGR-class, 12

*Topic **dataset**
  gpdata, 2

*Topic **methods**
  gplast, 3
  gplast.get, 4
  gplast.preprocess, 5
  groot, 6
  groot.get, 8
  groot.plot, 9
  groot.preprocess, 10

*Topic **package**
  geneplast-package, 2

geneplast (geneplast-package), 2
geneplast-package, 2
gpdata, 2
gplast, 3, 12
gplast,OGP-method (OGP-class), 11
gplast.get, 4, 12
gplast.get,OGP-method (OGP-class), 11
gplast.preprocess, 5, 12
groot, 6, 9, 10, 12
groot,OGP-method (OGP-class), 12
groot.get, 8, 12
groot,OGP-method (OGR-class), 12
groot.plot, 9
groot.preprocess, 10, 12

OGP-class, 11
OGR-class, 12