

Package ‘phylobase’

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Type Package

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LinkingTo Rcpp

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Description

Provides a base S4 class for comparative methods, incorporating one or more trees and trait data

License GPL (>= 2)

Collate phylo4.R checkdata.R formatData.R class-multiphylo4.R class-oldclasses.R class-phylo4.R class-phylo4d.R class-phylomats.R methods-multiphylo4.R methods-oldclasses.R methods-phylo4.R methods-phylo4d.R setAs-Methods.R pdata.R subset.R phylobase.options.R prune.R treePlot.R treestruc.R treewalk.R readNCL.R tbind.R zzz.R

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phylobase-package *Utilities and Tools for Phylogenetics*

Description

Base package for phylogenetic structures and comparative data.

Details

- Package:phylobase
- Type:Package
- Date:2009
- Depends:methods, grid, ape(>= 2.1)
- Suggests:adephylo, MASS
- License:GPL Version 2 or later
- Authors:R Hackathon et al. (alphabetically: Ben Bolker, Marguerite Butler, Peter Cowan, Damien de Vienne, Thibaut Jombart, Steve Kembel, Francois Michonneau, David Orme, Brian O'Meara, Emmanuel Paradis, Jim Regetz, Derrick Zwickl)
- URL:<http://phylobase.r-forge.r-project.org/>

MoreInfo

See the help index `help(package="phylobase")` and run `vignette("phylobase", "phylobase")` for further details and examples about how to use phylobase.

addData *Adding data to a phylo4 or a phylo4d object*

Description

addData adds data to a phylo4 (converting it in a phylo4d object) or to a phylo4d object

Usage

```
## S4 method for signature 'phylo4'
addData(x, tip.data, node.data, all.data,
        merge.data=TRUE, pos=c("after", "before"), ...)
## S4 method for signature 'phylo4d'
addData(x, tip.data, node.data, all.data,
        merge.data=TRUE, pos=c("after", "before"), ...)
```

Arguments

<code>x</code>	a <code>phylo4</code> or a <code>phylo4d</code> object
<code>tip.data</code>	a data frame (or object to be coerced to one) containing only tip data
<code>node.data</code>	a data frame (or object to be coerced to one) containing only node data
<code>all.data</code>	a data frame (or object to be coerced to one) containing both tip and node data
<code>merge.data</code>	if both <code>tip.data</code> and <code>node.data</code> are provided, it determines whether columns with common names will be merged together (default TRUE). If FALSE, columns with common names will be preserved separately, with ".tip" and ".node" appended to the names. This argument has no effect if <code>tip.data</code> and <code>node.data</code> have no column names in common.
<code>pos</code>	should the new data provided be bound before or after the pre-existing data?
<code>...</code>	additional arguments to be passed to formatData

Details

Rules for matching data to tree nodes are identical to those used by the [phylo4d](#) constructor.

If any column names in the original data are the same as columns in the new data, ".old" is appended to the former column names and ".new" is appended to the new column names.

The option `pos` is ignored (silently) if `x` is a `phylo4` object. It is provided for compatibility reasons.

Value

`addData` returns a `phylo4d` object.

Author(s)

Francois Michonneau

See Also

[tdata](#) for extracting or updating data and [phylo4d](#) constructor.

Examples

```
data(geospiza)
nDt <- data.frame(a=rnorm(nNodes(geospiza)), b=1:nNodes(geospiza),
  row.names=nodeId(geospiza, "internal"))
t1 <- addData(geospiza, node.data=nDt)
```

as *Converting between phylo4/phylo4d and other phylogenetic tree formats*

Description

Translation functions to convert between phylobase objects (phylo4 or phylo4d), and objects used by other comparative methods packages in R: ape objects (phylo, multiPhylo), ade4 objects (phylog, *now deprecated*), and to data.frame representation.

Usage

```
as(object, class)
```

Arguments

object a tree of class phylo4, phylo or phylog, or tree and data object of class phylo4d.

class the name of the class to which tree should be coerced (e.g., "phylo4" or "data.frame").

Methods

Coerce from one object class to another using as(object, "class"), where the object is of the old class and the returned object is of the new class "class". The as function examines the class of object and the new "class" specified to choose the proper conversion without additional information from the user. Conversions exist for combinations:

phylobase to phylobase formats:

as(object, "phylo4d") where object is of class [phylo4](#) and returns an object of class [phylo4d](#), with empty data.

as(object, "phylo4") where object is of class [phylo4d](#) and returns an object of class [phylo4](#). If data are dropped during the conversion, a warning message is produced. A similar conversion can be done by using the function extractTree, but in this case, no error message is produced.

phylobase to ape formats:

as(object, "phylo") where object is of class [phylo4](#) or [phylo4d](#) and returns an object of class phylo. If data are dropped during the conversion from a phylo4d object, a warning message is produced.

as(object, "multiPhylo") ~~Not implemented yet. where object is of class [multiPhylo4](#) and returns an object of class multiPhylo.

ape to phylobase formats:

as(object, "phylo4") where object is of class phylo and returns an object of class phylo4.

as(object, "phylo4d") where object is of class phylo and returns an object of class phylo4d, with empty data.

as(object, "multiPhylo4") ~~Not implemented yet. where object is of class multiPhylo and returns an object of class multiPhylo4.

phylobase to ade4 formats:

`as(object, "phylog")` where object is of class phylo4 and returns an object of class `phylog`.

Note that this format is now deprecated; the ade4 developers recommend that you use `adephylo` instead, which uses `phylo` and `phylo4` formats natively.

phylobase format to data.frame:

`as(object, "data.frame")` where object is of class phylo4 or phylo4d and returns an object of class data.frame, with data included in the case of phylo4d.

Author(s)

Ben Bolker, Thibaut Jombart, Marguerite Butler, Steve Kembel

See Also

generic `as`, `phylo4`, `phylo4d`, `extractTree`, the original `phylog` from the ade4 package and `as.phylo` from the ape package.

Examples

```
tree.owls <- read.tree(text="(((Strix_aluco:4.2,Asio_otus:4.2):3.1,Athene_noctua:7.3):6.3,Tyto_alba:13.5);")
## round trip conversion
tree_in_phylo <- tree.owls # tree is a phylo object
(tree_in_phylo4 <- as(tree.owls,"phylo4")) # phylo converted to phylo4
identical(tree_in_phylo,as(tree_in_phylo4,"phylo"))
## test if phylo, and phylo4 converted to phylo are identical
## (no, because of dimnames)

## Conversion to phylog (ade4)
as(tree_in_phylo4, "phylog")

## Conversion to data.frame
as(tree_in_phylo4, "data.frame")

## Conversion to phylo (ape)
as(tree_in_phylo4, "phylo")

## Conversion to phylo4d, (data slots empty)
as(tree_in_phylo4, "phylo4d")
```

checkPhylo4

Validity checking for phylo4 objects

Description

Basic checks on the validity of S4 phylogenetic objects

Usage

```
checkPhylo4(object)
checkTree(object)
checkPhylo4Data(object)
```

Arguments

object A prospective phylo4 or phylo4d object

Value

As required by `validObject`, returns an error string (describing problems) or TRUE if everything is OK.

Note

These functions are only intended to be called by other phylobase functions.

`checkPhylo4` is an (inflexible) wrapper for `checkTree`. The rules for phylo4 objects essentially follow those for phylo objects from the ape package, which are in turn defined in http://ape.mpl.ird.fr/misc/FormatTreeR_28July2008.pdf. These are essentially that:

- if the tree has edge lengths defined, the number of edge lengths must match the number of edges;
- the number of tip labels must match the number of tips;
- in a tree with `ntips` tips and `nnodes` (total) nodes, nodes 1 to `ntips` must be tips
- if the tree is rooted, the root must be node number `ntips+1` and the root node must be the first row of the edge matrix
- tip labels, node labels, edge labels, edge lengths must have proper internal names (i.e. internal names that match the node numbers they document)
- tip and node labels must be unique

You can alter some of the default options by using the function `phylobase.options`.

For phylo4d objects, `checkTree` also calls `checkPhylo4Data` to check the validity of the data associated with the tree. It ensures that (1) the data associated with the tree have the correct dimensions, (2) that the row names for the data are correct.

Author(s)

Ben Bolker, Steven Kembel, Francois Michonneau

See Also

the `phylo4` constructor and `phylo4` class; `formatData`, the `phylo4d` constructor and the `phylo4d` class do checks for the data associated with trees. See `coerce-methods` for translation functions and `phylobase.options` to change some of the default options of the validator.

`extractTree`*Get tree from tree+data object*

Description

Extracts a phylo4 tree object from a phylo4d tree+data object.

Usage

```
extractTree(from)
```

Arguments

`from` a phylo4d object, containing a phylogenetic tree plus associated phenotypic data. Created by the `phylo4d()` function.

Details

`extractTree` extracts just the phylogeny from a tree+data object. The phylogeny contains the topology (how the nodes are linked together), the branch lengths (if any), and any tip and/or node labels. This may be useful for extracting a tree from a phylo4d object, and associating with another phenotypic dataset, or to convert the tree to another format.

Author(s)

Ben Bolker

See Also

[phylo4](#), [phylo4d](#), [coerce-methods](#) for translation functions.

Examples

```
tree.phylo <- read.tree(text = "((a,b),c);")
tree <- as(tree.phylo, "phylo4")
plot(tree)
tip.data <- data.frame(size = c(1, 2, 3), row.names = c("a", "b", "c"))
(treedata <- phylo4d(tree, tip.data))
plot(treedata)
(tree1 <- extractTree(treedata))
plot(tree1)
```

formatData

*Format data for use in phylo4d objects***Description**

Associates data with tree nodes and applies consistent formatting rules.

Usage

```
formatData(phy, dt, type=c("tip", "internal", "all"),
           match.data=TRUE, rownamesAsLabels=FALSE,
           label.type=c("rownames", "column"),
           label.column=1, missing.data=c("fail", "warn", "OK"),
           extra.data=c("warn", "OK", "fail"), keep.all=TRUE)
```

Arguments

phy	a valid phylo4 object
dt	a data frame, matrix, vector, or factor
type	type of data to attach
match.data	(logical) should the rownames of the data frame be used to be matched against tip and internal node identifiers? See details.
rownamesAsLabels	(logical), should the row names of the data provided be matched only to labels (TRUE), or should any number-like row names be matched to node numbers (FALSE and default)
label.type	character, rownames or column: should the labels be taken from the row names of dt or from the label.column column of dt?
label.column	if label.type=="column", column specifier (number or name) of the column containing tip labels
missing.data	action to take if there are missing data or if there are data labels that don't match
extra.data	action to take if there are extra data or if there are labels that don't match
keep.all	(logical), should the returned data have rows for all nodes (with NA values for internal rows when type='tip', and vice versa) (TRUE and default) or only rows corresponding to the type argument

Details

formatData is an internal function that should not be called directly by the user. It is used to format data provided by the user before associating it with a tree, and is called internally by the phylo4d, tdata, and addData methods. However, users may pass additional arguments to these methods in order to control how the data are matched to nodes.

Rules for matching rows of data to tree nodes are determined jointly by the match.data and rownamesAsLabels arguments. If match.data is TRUE, data frame rows will be matched exclusively against tip and node labels if rownamesAsLabels is also TRUE, whereas any all-digit row

names will be matched against tip and node numbers if `rownamesAsLabels` is `FALSE` (the default). If `match.data` is `FALSE`, `rownamesAsLabels` has no effect, and row matching is purely positional with respect to the order returned by `nodeId(phy, type)`.

`formatData` (1) converts labels provided in the data into node numbers, (2) makes sure that the data are appropriately matched against tip and/or internal nodes, (3) checks for differences between data and tree, (4) creates a data frame with the correct dimensions given a tree.

Value

`formatData` returns a data frame having node numbers as row names. The data frame is also formatted to have the correct dimension given the `phylo4` object provided.

Author(s)

Francois Michonneau

See Also

the [phylo4d](#) constructor, the [phylo4d](#) class. See also the [checkPhylo4](#), the [phylo4](#) constructor and the [phylo4](#) class. See [coerce-methods](#) for translation functions.

geospiza

Data from Darwin's finches

Description

Phylogenetic tree and morphological data for Darwin's finches, in different formats

Usage

```
data(geospiza)
data(geospiza_raw)
```

Format

`geospiza` is a `phylo4d` object; `geospiza_raw` is a list containing tree, a `phylo` object (the tree), data, and a data frame with the data (for showing examples of how to merge tree and data)

Note

Stolen from Luke Harmon's Geiger package, to avoid unnecessary dependencies

Source

Dolph Schluter via Luke Harmon

Examples

```
data(geospiza)
plot(geospiza)
```

getNode	<i>node and edge look-up functions</i>
---------	--

Description

Functions for retrieving node and edge IDs (possibly with corresponding labels) from a phylogenetic tree.

Usage

```
getNode(x, node, type=c("all", "tip", "internal"),
        missing=c("warn", "OK", "fail"))
nodeId(x, type=c("all", "tip", "internal", "root"))
edgeId(x, type=c("all", "tip", "internal", "root"))
getEdge(x, node, type=c("descendant", "ancestor"),
        missing = c("warn", "OK", "fail"))
```

Arguments

x	a phylo4 object (or one inheriting from phylo4 , e.g. a phylo4d object)
node	either an integer vector corresponding to node ID numbers, or a character vector corresponding to node labels; if missing, all nodes appropriate to the specified type will be returned by <code>getNode</code> , and all edges appropriate to the specified type will be returned by <code>getEdge</code> .
type	(<code>getNode</code>) specify whether to return nodes matching "all" tree nodes (default), only "tip" nodes, or only "internal" nodes; (<code>nodeId</code> , <code>edgeId</code>) specify whether to return "all" tree nodes, or only those corresponding to "tip", "internal", or "root" nodes; (<code>getEdge</code>) specify whether to look up edges based on their descendant node ("descendant") or ancestral node ("ancestor")
missing	what to do if some requested node IDs or names are not in the tree: warn, do nothing, or stop with an error

Details

`getNode` and `getEdge` are primarily intended for looking up the IDs either of nodes themselves or of edges associated with those nodes. Note that they behave quite differently. With `getNode`, any input nodes are looked up against tree nodes of the specified type, and those that match are returned as numeric node IDs with node labels (if they exist) as element names. With `getEdge`, any input nodes are looked up against edge ends of the specified type, and those that match are returned as character edge IDs with the corresponding node ID as element names.

If `missing` is "warn" or "OK", NA is returned for any nodes that are unmatched for the specified type. This can provide a mechanism for filtering a set of nodes or edges.

`nodeId` provides similar output to `getNode` in the case when no node is supplied, but it is faster and returns an unnamed vector of the numeric IDs of all nodes of the specified node type. Similarly, `edgeId` simply returns an unnamed vector of the character IDs of all edges for which the descendant node is of the specified node type.

Value

getNode	returns a named integer vector of node IDs, in the order of input nodes if provided, otherwise in nodeId order
getEdge	returns a named character vector of edge IDs, in the order of input nodes if provide, otherwise in nodeId order
nodeId	returns an unnamed integer vector of node IDs, in ascending order
getEdge	returns an unnamed character vector of edge IDs, in edge matrix order

Examples

```

data(geospiza)
nodeLabels(geospiza) <- LETTERS[1:nNodes(geospiza)]
plot(as(geospiza, "phylo4"), show.node.label=TRUE)
getNode(geospiza, 18)
getNode(geospiza, "D")
getEdge(geospiza, "D")
getEdge(geospiza, "D", type="ancestor")

## match nodes only to tip nodes, flagging invalid cases as NA
getNode(geospiza, c(1, 18, 999), type="tip", missing="OK")

## get all edges that descend from internal nodes
getEdge(geospiza, type="ancestor")

## identify an edge from its terminal node
getEdge(geospiza, c("olivacea", "B", "fortis"))
getNode(geospiza, c("olivacea", "B", "fortis"))
geospiza@edge[c(26, 1, 11),]

## quickly get all tip node IDs and tip edge IDs
nodeId(geospiza, "tip")
edgeId(geospiza, "tip")

```

hasSingle

Test trees for polytomies, inline nodes, or reticulation

Description

checks to see whether trees have (structural) polytomies, inline nodes (i.e., nodes with a single descendant), or reticulation (i.e., nodes with more than one ancestor)

Usage

```

hasSingle(object)
hasPoly(object)
hasRetic(object)

```

Arguments

object an object inheriting from class phylo4

Value

Logical value

Note

Some algorithms are unhappy with structural polytomies (i.e., >2 descendants from a node), with single-descendant nodes, or with reticulation; these functions check those properties. We haven't bothered to check for zero branch lengths: the consensus is that it doesn't come up much, and that it's simple enough to test `any(edgeLength(x) == 0)` in these cases. (Single-descendant nodes are used e.g. in OUCH, or in other cases to represent events occurring along a branch.)

Author(s)

Ben Bolker

Examples

```
library(ape)
tree.owls.bis <- read.tree(text = "((Strix_aluco:4.2,Asio_otus:4.2):3.1,Athene_noctua:7.3);")
owls4 <- as(tree.owls.bis, "phylo4")
hasPoly(owls4)
hasSingle(owls4)
```

Import Nexus and Newick files

Create a phylo4, phylo4d or data.frame object from a Nexus or a Newick file

Description

`readNexus` reads a Nexus file and outputs a phylo4 or phylo4d or data.frame object.

`readNewick` reads a Newick file and outputs a phylo4 or phylo4d object.

Usage

```
readNexus(file, simplify=FALSE, type=c("all", "tree", "data"),
          char.all=FALSE, polymorphic.convert=TRUE, levels.uniform=FALSE,
          quiet=TRUE, check.node.labels=c("keep", "drop", "asdata"),
          return.labels=TRUE, check.names=TRUE, ...)

readNewick(file, simplify=FALSE, quiet=TRUE,
           check.node.labels=c("keep", "drop", "asdata"), ...)
```

Arguments

<code>file</code>	a Nexus file for <code>readNexus</code> or a file that contains Newick formatted trees for <code>readNewick</code>
<code>simplify</code>	If there are multiple trees in the file, only the first one is returned if <code>TRUE</code> and a list of <code>phylo4/phylo4d</code> objects is returned if the file contains multiple trees.
<code>type</code>	Determines which type of objects to return, if present in the file (see Details).
<code>char.all</code>	If <code>TRUE</code> , returns all characters, even those excluded in the NEXUS file
<code>polymorphic.convert</code>	If <code>TRUE</code> , converts polymorphic characters to missing data
<code>levels.uniform</code>	If <code>TRUE</code> , uses the same levels for all characters
<code>quiet</code>	If <code>FALSE</code> the output of the NCL interface is printed. This is mainly for debugging purposes. This option can considerably slow down the process if the tree is big or there are many trees in the file.
<code>check.node.labels</code>	Determines how the node labels in the Nexus or Newick files should be treated in the <code>phylo4</code> object, see Details for more information.
<code>return.labels</code>	Determines whether state names (if <code>TRUE</code>) or state codes should be returned.
<code>check.names</code>	logical. If <code>'TRUE'</code> then the names of the characters from the NEXUS file are checked to ensure that they are syntactically valid variable names and are not duplicated. If necessary they are adjusted (by <code>'make.names'</code>) so that they are.
<code>...</code>	Additional arguments to be passed to <code>phylo4</code> or <code>phylo4d</code> constructor (see Details)

Details

`readNexus` extracts data held in a Nexus file, specifically from `DATA`, `CHARACTER` or `TREES` blocks present in the file. The `type` argument specifies which of these is returned:

data will only return a `data.frame` of the contents of all `DATA` and `CHARACTER` blocks.

tree will only return a `phylo4` object of the contents of the `TREES` block.

all if only data or a tree are present in the file, this option will act as the options above, returning either a `data.frame` or a `phylo4` object respectively. If both are present then a `phylo4d` object is returned containing both.

The function returns `NULL` if the type of data requested is not present in the file, or if neither data nor tree blocks are present.

Depending on the context `readNexus` will call either the `phylo4` or `phylo4d` constructor. In addition with `type="all"`, the `phylo4d` constructor will be used if `check.node.labels="asdata"`.

`readNewick` imports newick formatted tree files and will return a `phylo4` or a `phylo4d` object if the option `check.node.labels="asdata"` is invoked.

For both `readNexus` and `readNewick`, the options for `check.node.labels` can take the values:

keep the node labels of the trees will be passed as node labels in the `phylo4` object

drop the node labels of the trees will be ignored in the `phylo4` object

asdata the node labels will be passed as data and a phylo4d object will be returned.

If you use the option `asdata` on a file with no node labels, a warning message is issued, and thus `check.node.labels` takes the value `drop`.

For both `readNexus` and `readNewick`, additional arguments can be passed to the constructors such as `annotate`, `missing.data` or `extra.data`. See the documentation of [phylo4-methods](#), [phylo4d](#) and [formatData](#) for the complete list of options.

Value

Depending on the value of `type` and the contents of the file, one of: a `data.frame`, a [phylo4](#) object, a [phylo4d](#) object or `NULL`. If several trees are included in the Nexus file and the option `simplify=FALSE` a list of [phylo4](#) or [phylo4d](#) objects is returned.

Note

Underscores in state labels (i.e. trait or taxon names) will be translated to spaces when read by NCL. Unless `check.names=FALSE`, trait names will be converted to valid R names (see [make.names](#)) on input to R, so spaces will be translated to periods.

Note

This relies on Version 2.1.13 of the Nexus Class Library by Paul Lewis and Mark Holder. Tree reading is done initially using internal APE functions; these functions can be confused if tree names include the word (“tree”) in them.

Author(s)

Brian O’Meara, Francois Michonneau, Derrick Zwickl

See Also

the [phylo4d](#) class, the [phylo4](#) class

multiPhylo-class

multiPhylo4 and extended classes

Description

Classes for lists of phylogenetic trees. These classes and methods are planned for a future version of `phylobase`.

nData	<i>Retrieves the number of datasets in phylo4d objects</i>
-------	--

Description

Method to retrieve the number of datasets associated with a phylogenetic tree stored as a phylo4d object

Usage

```
## S4 method for signature 'phylo4d'  
nData(x)
```

Arguments

x A phylo4d object

Details

nData returns the number of datasets (i.e., columns) that are associated with a phylo4d object.

Value

nData returns a vector.

Author(s)

Francois Michonnea

See Also

[tdata](#), [phylo4d](#)

Examples

```
data(geospiza)  
nData(geospiza)
```

pdata	<i>Constructor for pdata (phylogenetic data) class</i>
-------	--

Description

Combine data, type, comments, and metadata information to create a new pdata object, or check such an object for consistency

Usage

```
pdata(data, type, comment, metadata)
check_pdata(object)
```

Arguments

data	a data frame
type	a factor with levels as specified by pdata , the same length as <code>ncol(data)</code>
comment	a character vector, the same length as <code>ncol(data)</code>
metadata	an arbitrary list
object	an object of class <code>pdata</code>

Value

An object of class `pdata`

Author(s)

Ben Bolker

See Also

[pdata](#)

pdata-class	<i>Class "pdata"</i>
-------------	----------------------

Description

Data class for phylo4d objects

Objects from the Class

Objects can be created by calls of the form `new("pdata", ...)`.

Slots

data: A data frame of tip or node data. Can be accessed transparently with any of the data frame accessor methods

type: A factor with length equal to `ncol(data)` and levels("multitype", "binary", "continuous", "DNA", "RNA", "acid")

comment: A character vector of length `ncol(data)`

metadata: An arbitrary list, for storing other user-defined metadata

Methods

[signature(x = "pdata"): access data rows, columns or elements

[<- signature(x = "pdata"): set data rows, columns or elements

[[<- signature(x = "pdata"): set data columns or elements

[[signature(x = "pdata", i = "ANY", j = "ANY"): access data columns or elements

[[signature(x = "pdata", i = "ANY", j = "missing"): set data columns or elements

Author(s)

Ben Bolker

phylo4-accessors

Methods for S4 phylogeny classes

Description

Generic methods for phylogenetic trees represented as S4 classes

Usage

```
## S4 method for signature 'phylo4'
nNodes(x)
## S4 method for signature 'phylo4'
nTips(x)
## S4 method for signature 'phylo4'
depthTips(x)
## S4 method for signature 'phylo4'
edges(x, drop.root=FALSE, ...)
## S4 method for signature 'phylo4'
nEdges(x)
## S4 method for signature 'phylo4'
edgeOrder(x, ...)
## S4 method for signature 'phylo4'
hasEdgeLength(x)
```

```

## S4 method for signature 'phylo4'
edgeLength(x, node)
## S4 replacement method for signature 'phylo4'
edgeLength(x, use.names=TRUE) <- value
## S4 method for signature 'phylo4'
nodeType(x)
## S4 method for signature 'phylo4'
nodeDepth(x, node)
## S4 method for signature 'phylo4'
isRooted(x)
## S4 method for signature 'phylo4'
rootEdge(x)
## S4 method for signature 'phylo4'
rootNode(x)
## S4 replacement method for signature 'phylo4'
rootNode(x) <- value
## S4 method for signature 'phylo4'
isUltrametric(x, tol=.Machine$double.eps^0.5)

```

Arguments

x	a phylo4/phylo4d object
node	which edge to extract (indexed by descendant node)
value	a vector of edge lengths or a node number
use.names	Should the names of value be used to match edge lengths provided?
drop.root	logical: drop root row from edge matrix?
tol	tolerance in rounding error to determine whether the tree is ultrametric
...	additional parameters passed (currently ignored)

Methods

nTips signature(object="phylo4"): number of tips

depthTips signature(object="phylo4"): distance between the tips and the root

nNodes signature(object="phylo4"): number of internal nodes

nEdges signature(object = "phylo4"): number of edges

edges signature(object = "phylo4"): returns the edge matrix

edgeOrder signature(object = "phylo4"): returns the order in which the edges are stored

hasEdgeLength signature(object = "phylo4"): whether tree has edge (branch) lengths

edgeLength signature(object = "phylo4"): edge (branch) lengths (or NAs if missing) ordered according to the edge matrix

nodeType signature(object = "phylo4"): named vector which has the type of node (internal, tip, root) for value, and the node number for name

nodeDepth signature(object = "phylo4"): named vector which gives the distance between nodes and the root

isRooted signature(object = "phylo4"): whether tree is rooted (i.e. has explicit root edge defined *or* root node has ≤ 2 descendants)

rootEdge signature(object = "phylo4"): root edge

isUltrametric signature(object = "phylo4"): whether the tree is ultrametric

Examples

```
data(geospiza)
edgeLength(geospiza, 5)
edgeLength(geospiza, "olivacea")
edgeLength(geospiza, 5:7)
```

phylo4-class

The phylo4 class

Description

Classes for phylogenetic trees

Objects from the Class

Phylogenetic tree objects can be created by calls to the [phylo4](#) constructor function. Translation functions from other phylogenetic packages are also available. See [coerce-methods](#).

Slots

edge: Matrix of edges

edge.label: Character vector of edge (branch) labels

edge.length: Numeric vector of edge (branch) lengths

label: Character vector of tip (and optionally internal) node labels

order: character: tree ordering (allowable values are listed in `phylo4_orderings`, currently "unknown", "preorder" (= "cladewise" in `ape`), and "postorder", with "cladewise" and "pruning-wise" also allowed for compatibility with `ape`)

annotate: annotation data for tree (currently unstructured/unused by methods)

metadata: metadata for node/tip data (currently unstructured/unused by methods)

Author(s)

Ben Bolker, Thibaut Jombart

See Also

The [phylo4](#) constructor, the [checkPhylo4](#) function to check the validity of `phylo4` objects. See also the [phylo4d](#) constructor and the [phylo4d](#) class.

phylo4-display *Displaying phylo4 object*

Description

Display methods for phylo4 and phylo4d phylogenetic trees

Usage

```
## S4 method for signature 'phylo4'
print(x, edgeOrder = c("pretty", "real"), printall)
## S4 method for signature 'phylo4'
summary(object, quiet=FALSE)
## S4 method for signature 'phylo4'
show(object)
## S4 method for signature 'phylo4'
names(x)
```

Arguments

x	a phylo4 object
object	a phylo4 object
edgeOrder	Character string indicating whether the edges should be printed as ordered in the tree "real" (e.g. preorder or postorder), or "pretty" printed with tips collated together
printall	If TRUE all tip labels are printed
quiet	a logical stating whether the results of the summary should be printed to the screen (FALSE, default) or not (TRUE)

Value

The summary method invisibly returns a list with the following components:

name	the name of the object
nb.tips	the number of tips
nb.nodes	the number of nodes
mean.el	mean of edge lengths
var.el	variance of edge lengths (estimate for population)
sumry.el	summary (i.e. range and quartiles) of the edge lengths
degree	(optional) degree (i.e. number of descendants) of each node; displayed only when there are polytomies
polytomy	(optional) type of polytomy for each node: 'node', 'terminal' (all descendants are tips) or 'internal' (at least one descendant is an internal node); displayed only when there are polytomies

The names method returns a vector of characters corresponding to the names of the slots.

Methods

print signature(x = "phylo4"): print method
show signature(object = "phylo4"): show method
summary signature(object = "phylo4"): summary method
names signature(x = "phylo4"): gives the slot names
head signature(object = "phylo4"): show first few nodes
tail signature(object = "phylo4"): show last few nodes

Author(s)

Ben Bolker, Thibaut Jombart

See Also

The [phylo4](#) constructor, the [checkPhylo4](#) function to check the validity of phylo4 objects. See also the [phylo4d](#) constructor and the [phylo4d](#) class.

Examples

```
tOwls <- "(((Strix_aluco:4.2,Asio_otus:4.2):3.1,Athene_noctua:7.3):6.3,Tyto_alba:13.5);"
tree.owls <- read.tree(text=tOwls)
P1 <- as(tree.owls, "phylo4")
P1
summary(P1)

## summary of a polytomous tree
E <- matrix(c(
  8, 9,
  9, 10,
  10, 1,
  10, 2,
  9, 3,
  9, 4,
  8, 11,
  11, 5,
  11, 6,
  11, 7,
  0, 8), ncol=2, byrow=TRUE)

P2 <- phylo4(E)
nodeLabels(P2) <- as.character(nodeId(P2, "internal"))
plot(P2, show.node.label=TRUE)
sumryP2 <- summary(P2)
sumryP2
```

 phylo4-labels

Labels for phylo4/phylo4d objects

Description

Methods for creating, accessing and updating labels in phylo4/phylo4d objects

Usage

```
## S4 method for signature 'phylo4'
labels(object, type=c("all", "tip", "internal"))
## S4 replacement method for signature 'phylo4,ANY,ANY,character'
labels(x, type=c("all", "tip",
  "internal"), use.names=FALSE) <- value

## S4 method for signature 'phylo4'
hasDuplicatedLabels(x, type=c("all", "tip", "internal"))

## S4 method for signature 'phylo4'
tipLabels(x)
## S4 replacement method for signature 'phylo4,character'
tipLabels(x) <- value

## S4 method for signature 'phylo4'
hasNodeLabels(x)
## S4 method for signature 'phylo4'
nodeLabels(x)
## S4 replacement method for signature 'phylo4,character'
nodeLabels(x) <- value

## S4 method for signature 'phylo4'
hasEdgeLabels(x)
## S4 method for signature 'phylo4'
edgeLabels(x)
## S4 replacement method for signature 'phylo4,character'
edgeLabels(x) <- value
```

Arguments

x	a phylo4 or phylo4d object.
object	a phylo4 or phylo4d object.
type	which type of labels: all (tips and internal nodes), tip (tips only), internal (internal nodes only).
value	a vector of class character, see Details for more information.

`use.names` should the names of the vector used to create/update labels be used to match the labels? See Details for more information.

Details

In phylo4/phylo4d objects, tips must have labels (that's why there is no method for `hasTipLabels`), internal nodes and edges can have labels.

Labels must be provided as a vector of class character. The length of the vector must match the number of elements they label.

The option `use.names` allows the user to match a label to a particular node. In this case, the vector must have names that match the node numbers.

The function `labels` is mostly intended to be used internally.

Methods

labels signature(object = "phylo4"): tip and/or internal node labels, ordered by node ID

hasDuplicatedLabels signature(object = "phylo4"): are any labels duplicated?

tipLabels signature(object = "phylo4"): tip labels, ordered by node ID

hasNodeLabels signature(object = "phylo4"): whether tree has (internal) node labels

nodeLabels signature(object = "phylo4"): internal node labels, ordered by node ID

hasEdgeLabels signature(object = "phylo4"): whether tree has (internal) edge labels

edgeLabels signature(object = "phylo4"): internal edge labels, ordered according to the edge matrix

Examples

```
data(geospiza)

## Return labels from geospiza
tipLabels(geospiza)

## Internal node labels in geospiza are empty
nodeLabels(geospiza)

## Creating internal node labels
ndLbl <- paste("n", 1:nNodes(geospiza), sep="")
nodeLabels(geospiza) <- ndLbl
nodeLabels(geospiza)

## naming the labels
names(ndLbl) <- nodeId(geospiza, "internal")

## shuffling the labels
(ndLbl <- sample(ndLbl))

## by default, the labels are attributed in the order
## they are given:
```

```

nodeLabels(geospiza) <- ndLb1
nodeLabels(geospiza)

## but use.names puts them in the correct order
labels(geospiza, "internal", use.names=TRUE) <- ndLb1
nodeLabels(geospiza)

```

phylo4-methods

Create a phylogenetic tree

Description

phylo4 is a generic constructor that creates a phylogenetic tree object for use in phylobase methods. Phylobase contains functions for input of phylogenetic trees and data, manipulation of these objects including pruning and subsetting, and plotting. The phylobase package also contains translation functions to forms used in other comparative phylogenetic method packages.

Usage

```

## S4 method for signature 'matrix'
phylo4(x, edge.length = NULL, tip.label = NULL,
       node.label = NULL, edge.label = NULL, order="unknown",
       annotate=list())
## S4 method for signature 'phylo'
phylo4(x, check.node.labels = c("keep", "drop"),
       annotate=list())

```

Arguments

x	a matrix of edges or an object of class phylo (see above)
edge	A numeric, two-column matrix with as many rows as branches in the phylogeny.
edge.length	Edge (branch) length. (Optional)
tip.label	A character vector of species names (names of "tip" nodes). (Optional)
node.label	A character vector of internal node names. (Optional)
edge.label	A character vector of edge (branch) names. (Optional)
order	character: tree ordering (allowable values are listed in phylo4_orderings, currently "unknown", "preorder" (= "cladewise" in ape), and "postorder", with "cladewise" and "pruningwise" also allowed for compatibility with ape)
check.node.labels	if x is of class phylo, either "keep" (the default) or "drop" node labels. This argument is useful if the phylo object has non-unique node labels.
annotate	any additional annotation data to be passed to the new object

Details

The minimum information necessary to create a phylobase tree object is a valid edge matrix. The edge matrix describes the topology of the phylogeny. Each row describes a branch of the phylogeny, with the (descendant) node number in column 2 and its ancestor's node number in column 1. These numbers are used internally and must be unique for each node.

The labels designate either nodes or edges. The vector `node.label` names internal nodes, and together with `tip.label`, name all nodes in the tree. The vector `edge.label` names all branches in the tree. All label vectors are optional, and if they are not given, internally-generated labels will be assigned. The labels, whether user-specified or internally generated, must be unique as they are used to join species data with phylogenetic trees.

Methods

`x = "matrix"` creates a phylobase tree from a matrix of edges

`x = "phylo"` creates a phylobase tree from an object of class `phylo`

Note

Translation functions are available from many valid tree formats. See [coerce-methods](#).

Author(s)

phylobase team

See Also

[coerce-methods](#) for translation functions. The `phylo4` class, the `formatData` function to check the validity of `phylo4` objects. See also the `phylo4d` constructor, and `phylo4d` class.

Examples

```
# a three species tree:
mytree <- phylo4(x=matrix(data=c(4,1, 4,5, 5,2, 5,3, 0,4), ncol=2,
byrow=TRUE), tip.label=c("speciesA", "speciesB", "speciesC"))
mytree
plot(mytree)

# another way to specify the same tree:
mytree <- phylo4(x=cbind(c(4, 4, 5, 5, 0), c(1, 5, 2, 3, 4)),
tip.label=c("speciesA", "speciesB", "speciesC"))

# another way:
mytree <- phylo4(x=rbind(c(4, 1), c(4, 5), c(5, 2), c(5, 3), c(0, 4)),
tip.label=c("speciesA", "speciesB", "speciesC"))

# with branch lengths:
mytree <- phylo4(x=rbind(c(4, 1), c(4, 5), c(5, 2), c(5, 3), c(0, 4)),
tip.label=c("speciesA", "speciesB", "speciesC"), edge.length=c(1, .2,
.8, .8, NA))
plot(mytree)
```

 phylo4d

Combine a phylogenetic tree with data

Description

phylo4d is a generic constructor which merges a phylogenetic tree with data frames to create a combined object of class phylo4d

Usage

```
## S4 method for signature 'phylo'
phylo4d(x, tip.data = NULL, node.data = NULL,
        all.data = NULL, check.node.labels = c("keep", "drop", "asdata"),
        annotate=list(), metadata=list(), ...)
## S4 method for signature 'phylo4'
phylo4d(x, tip.data = NULL, node.data = NULL,
        all.data = NULL, merge.data = TRUE, metadata = list(), ...)
## S4 method for signature 'matrix'
phylo4d(x, tip.data = NULL, node.data = NULL,
        all.data = NULL, merge.data = TRUE, metadata = list(),
        edge.length = NULL, tip.label = NULL, node.label = NULL,
        edge.label = NULL, order = "unknown", annotate=list(), ...)
```

Arguments

x	an object of class phylo4, phylo or a matrix of edges (see above)
tip.data	a data frame (or object to be coerced to one) containing only tip data (Optional)
node.data	a data frame (or object to be coerced to one) containing only node data (Optional)
all.data	a data frame (or object to be coerced to one) containing both tip and node data (Optional)
merge.data	if both tip.data and node.data are provided, should columns with common names will be merged together (default TRUE) or not (FALSE)? See details.
metadata	any additional metadata to be passed to the new object
edge.length	Edge (branch) length. (Optional)
tip.label	A character vector of species names (names of "tip" nodes). (Optional)
node.label	A character vector of internal node names. (Optional)
edge.label	A character vector of edge (branch) names. (Optional)
order	character: tree ordering (allowable values are listed in phylo4_orderings, currently "unknown", "preorder" (= "cladewise" in ape), and "postorder", with "cladewise" and "pruningwise" also allowed for compatibility with ape)
annotate	any additional annotation data to be passed to the new object

`check.node.labels` if `x` is of class `phylo`, use either “keep” (the default) to retain internal node labels, “drop” to drop them, or “asdata” to convert them to numeric tree data. This argument is useful if the `phylo` object has non-unique node labels or node labels with informative data (e.g., posterior probabilities).

... further arguments to be passed to `formatData`. Notably, these additional arguments control the behavior of the constructor in the case of missing/extra data and where to look for labels in the case of non-unique labels that cannot be stored as row names in a data frame.

Details

You can provide several data frames to define traits associated with tip and/or internal nodes. By default, data row names are used to link data to nodes in the tree, with any number-like names (e.g., “10”) matched against node ID numbers, and any non-number-like names (e.g., “n10”) matched against node labels. Alternative matching rules can be specified by passing additional arguments to `formatData`; these include positional matching, matching exclusively on node labels, and matching based on a column of data rather than on row names. See `formatData` for more information.

Matching rules will apply the same way to all supplied data frames. This means that you need to be consistent with the row names of your data frames. It is good practice to use tip and node labels (or node numbers) when you combine data with a tree.

If you provide both `tip.data` and `node.data`, the treatment of columns with common names will depend on the `merge.data` argument. If `TRUE`, columns with the same name in both data frames will be merged; when merging columns of different data types, coercion to a common type will follow standard R rules. If `merge.data` is `FALSE`, columns with common names will be preserved independently, with “.tip” and “.node” appended to the names. This argument has no effect if `tip.data` and `node.data` have no column names in common.

If you provide `all.data` along with either of `tip.data` and `node.data`, it must have distinct column names, otherwise an error will result. Additionally, although supplying columns with the same names *within* data frames is not illegal, automatic renaming for uniqueness may lead to surprising results, so this practice should be avoided.

Value

An object of class `phylo4d`.

Methods

`x = "phylo4"` merges a tree of class `phylo4` with a `data.frame` into a `phylo4d` object

`x = "matrix"` merges a matrix of tree edges similar to the edge slot of a `phylo4` object (or to `\$edge` of a `phylo` object) with a `data.frame` into a `phylo4d` object

`x = "phylo"` merges a tree of class `phylo` with a `data.frame` into a `phylo4d` object

Note

Checking on matches between the tree and the data will be done by the validity checker (label matches between data and tree tips, number of rows of data vs. number of nodes/tips/etc.)


```

exGeo5 <- phylo4d(geoTree, all.data = rAllData)

## Examples using 'rownamesAsLabels' and comparing with match.data=FALSE
tDt <- data.frame(x=letters[1:nTips(trGeo)],
                 row.names=sample(nodeId(trGeo, "tip")))
tipLabels(trGeo) <- as.character(sample(1:nTips(trGeo)))
(exGeo6 <- phylo4d(trGeo, tip.data=tDt, rownamesAsLabels=TRUE))
(exGeo7 <- phylo4d(trGeo, tip.data=tDt, rownamesAsLabels=FALSE))
(exGeo8 <- phylo4d(trGeo, tip.data=tDt, match.data=FALSE))

require(ape) ## for rcoal
## generate a tree and some data
set.seed(1)
p3 <- rcoal(5)
dat <- data.frame(a = rnorm(5), b = rnorm(5), row.names = p3$tip.label)
dat.defaultnames <- dat
row.names(dat.defaultnames) <- NULL
dat.superset <- rbind(dat, rnorm(2))
dat.subset <- dat[-1, ]

## create a phylo4 object from a phylo object
p4 <- as(p3, "phylo4")

## create phylo4d objects with tip data
p4d <- phylo4d(p4, dat)
###checkData(p4d)
p4d.sorted <- phylo4d(p4, dat[5:1, ])
try(p4d.nonames <- phylo4d(p4, dat.defaultnames))
p4d.nonames <- phylo4d(p4, dat.defaultnames, match.data=FALSE)

## Not run:
p4d.subset <- phylo4d(p4, dat.subset)
p4d.subset <- phylo4d(p4, dat.subset)
try(p4d.superset <- phylo4d(p4, dat.superset))
p4d.superset <- phylo4d(p4, dat.superset)

## End(Not run)

## create phylo4d objects with node data
nod.dat <- data.frame(a = rnorm(4), b = rnorm(4))
p4d.nod <- phylo4d(p4, node.data = nod.dat, match.data=FALSE)

## create phylo4 objects with node and tip data
p4d.all1 <- phylo4d(p4, node.data = nod.dat, tip.data = dat, match.data=FALSE)
nodeLabels(p4) <- as.character(nodeId(p4, "internal"))
p4d.all2 <- phylo4d(p4, all.data = rbind(dat, nod.dat), match.data=FALSE)

```

phylo4d-class	<i>phylo4d class</i>
---------------	----------------------

Description

S4 class for phylogenetic tree and data.

Objects from the Class

Objects can be created from various trees and a data.frame using the constructor `phylo4d`, or using `new("phylo4d", ...)` for empty objects.

Slots

`edge`: Matrix of edges

`edge.label`: Character vector of edge (branch) labels

`edge.length`: Numeric vector of edge (branch) lengths

`label`: Character vector of tip (and optionally internal node) labels

`data`: data frame for traits of tips and internal nodes

`order`: character: tree ordering (allowable values are listed in `phylo4_orderings`, currently "unknown", "preorder" (= "cladewise" in ape), and "postorder", with "cladewise" and "pruning-wise" also allowed for compatibility with ape)

`annotate`: annotation data for tree (currently unstructured/unused by methods)

`metadata`: metadata for node/tip data (currently unstructured/unused by methods)

Author(s)

Ben Bolker, Thibaut Jombart

See Also

[coerce-methods](#) for translation functions. The [phylo4d](#) constructor and the [formatData](#) function to check the validity of trees and data. See also the [phylo4](#) constructor, the [phylo4](#) class, and the [checkPhylo4](#) function to check the validity of phylo4 trees.

Examples

```
library(ape)
example(read.tree)
obj <- phylo4d(as(tree.owls.bis, "phylo4"), data.frame(wing=1:3))
obj
names(obj)
summary(obj)
```

Description

Methods used to display information about the data and the tree for phylo4d objects.

Usage

```
## S4 method for signature 'phylo4d'
print(x, edgeOrder = c("pretty", "real"),
      printall=TRUE)
## S4 method for signature 'phylo4d'
summary(object, quiet=FALSE)
## S4 method for signature 'phylo4d'
names(x)
```

Arguments

x	a phylo4d object
object	a phylo4d object
edgeOrder	Character string indicating whether the edges should be printed as ordered in the tree "real" (e.g. preorder or postorder), or "pretty" printed with tips collated together
quiet	Should the summary be displayed on screen?
printall	If TRUE all tip labels are printed

Value

The summary method invisibly returns a list with the following components:

name	the name of the object
nb.tips	the number of tips
nb.nodes	the number of nodes
mean.el	mean of edge lengths
var.el	variance of edge lengths (estimate for population)
sumry.el	summary (i.e. range and quartiles) of the edge lengths
degree	(optional) type of polytomy for each node: 'node', 'terminal' (all descendants are tips) or 'internal' (at least one descendant is an internal node); displayed only when there are polytomies
sumry.tips	(optional) summary for the data associated with the tips
sumry.nodes	(optional) summary for the data associated with the internal nodes

The names method returns a vector of characters corresponding to the names of the slots.

Methods

print signature(x = "phylo4d"): print method
show signature(object = "phylo4d"): show method
summary signature(object = "phylo4d"): summary method
names signature(x = "phylo4d"): gives the slots names
head signature(object = "phylo4d"): show first few nodes
tail signature(object = "phylo4d"): show last few nodes

Author(s)

Ben Bolker, Thibaut Jombart

See Also

[phylo4d](#) constructor and [phylo4d](#) class.

phylo4d-hasData	<i>Tests for presence of data associated with trees stored as phylo4d objects</i>
-----------------	---

Description

Methods that test for the presence of data associated with trees stored as phylo4d objects.

Usage

```
## S4 method for signature 'phylo4d'
hasNodeData(x)
## S4 method for signature 'phylo4d'
hasTipData(x)
```

Arguments

x a phylo4d object

Details

The outcome of the test is based on row names of the data frame stored in data. If there are no rows having row names from the set `nodeId(x, "tip")`, then `hasTipData` returns FALSE. Likewise, if there are no rows having row names from the set `nodeId(x, "internal")`, then `hasNodeData` returns FALSE.

Value

logical return TRUE or FALSE depending whether data are associated with the tree (i.e., the slots `tip.data` or `node.data` are not empty)

Methods

hasNodeData signature(object = "phylo4d"): whether tree has internal node data

hasTipData signature(object = "phylo4d"): whether tree has data associated with its tips

Author(s)

Ben Bolker, Thibault Jombart, Francois Michonneau

See Also

[phylo4d](#) constructor and [phylo4d](#) class.

Examples

```
data(geospiza)
hasTipData(geospiza) ## TRUE
hasNodeData(geospiza) ## FALSE
```

phylobase.options *Set or return options of phylobase*

Description

Provides a mean to control the validity of phylobase objects such as singletons, reticulated trees, polytomies, etc.

Usage

```
phylobase.options(...)
```

Arguments

... a list may be given as the only argument, or any number of arguments may be in the name=value form, or no argument at all may be given. See the Value and Details sections for explanation. Arguments which are set by a function call will remain in effect until the end of the current session, unless overwritten by a subsequent call. In addition, they can be added as optional parameters of calls to specific functions of phylobase; in this case, their effect is limited to that function call. See the documentation of specific functions for the list of options which are recognised by that function.

- retic="warn", "fail" or "OK". Are reticulated trees allowed? "warn" returns a warning (default) and "fail" returns an error message
- singleton="warn", "fail" or "OK". Are singleton nodes allowed? "warn" returns a warning (default) and "fail" returns an error message
- multiroot="warn", "fail" or "OK". Are multiple roots allowed? "warn" returns a warning (default) and "fail" returns an error message

- poly="warn", "fail" or "OK". Are polytomies allowed? "warn" returns a warning (default) and "fail" returns an error message
- allow.duplicated.labels="warn", "fail" or "OK". Are duplicated labels allowed? "warn" returns a warning and "fail" (default) returns an error message

Details

The parameter values set via a call to this function will remain in effect for the rest of the session, affecting the subsequent behavior of phylobase.

Value

A list with the updated values of the parameters. If arguments are provided, the returned list is invisible.

Author(s)

Francois Michonneau (adapted from the package sm)

Examples

```
## Not run:
phylobase.options(poly="fail")
# subsequent trees with polytomies will fail the validity check

## End(Not run)
```

phylobubbles

Bubble plots for phylo4d objects

Description

Plots either circles or squares corresponding to the magnitude of each cell of a phylo4d object.

Usage

```
phylobubbles(type, place.tip.label, show.node.label, rot, edge.color, node.color, tip.color, edge.wid
```

Arguments

type	the type of plot
place.tip.label	A string indicating whether labels should be plotted to the right or to the left of the bubble plot
show.node.label	A logical indicating whether internal node labels should be plotted
rot	The number of degrees that the plot should be rotated

edge.color	A vector of colors for the tree edge segments
node.color	A vector of colors for the coloring the nodes
tip.color	A vector of colors for the coloring the tip labels
edge.width	A vector of line widths for the tree edges
newpage	Logical to control whether the device is cleared before plotting, useful for adding plot inside other plots
...	Additional parameters passed to the bubble plotting functions
XXYY	The out put from the phyloXXYY function
square	Logical indicating whether the plot 'bubbles' should be squares
grid	A logical indicating whether a grey grid should be plotted behind the bubbles

Author(s)

Peter Cowan <pdcc@berkeley.edu>

See Also

[phyloXXYY](#), [treePlot](#)

Examples

```
##---- Should be DIRECTLY executable !! ----
##-- ==> Define data, use random,
##--or do help(data=index) for the standard data sets.
```

phylog-class

Class "phylog"

Description

S4 version of the class phylog from the ade4 package.

Objects from the Class

A virtual Class: No objects may be created from it.

Extends

Class [phylog](#), directly.

Methods

coerce signature(from = "phylo4", to = "phylog"): a [phylo4](#) object can be coerced to a phylog object using `as(object, "phylog")`.

Warning

phylog objects from ade4 are now deprecated; users are encouraged to use the adephylo package, which uses phylo and phylo4 objects directly.

Author(s)

Thibaut Jombart <jombart@biomserv.univ-lyon1.fr>

See Also

The original [phylog](#) from the ade4 package.

phyloamat-class *matrix classes for phylobase*

Description

Classes representing phylogenies as matrices

Usage

as_phylo4vcov(from, ...)

Arguments

from a phylo4 object
 ... optional arguments, to be passed to vcov.phylo in ape (the main useful option is cor, which can be set to TRUE to compute a correlation rather than a variance-covariance matrix)

Objects from the Class

These are square matrices (with rows and columns corresponding to tips, and internal nodes implicit) with different meanings depending on the type (variance-covariance matrix, distance matrix, etc.).

Slots

.Data: square, numeric matrix with row and column labels corresponding to the tip labels
 edge.label: character vector of edge labels
 order: character describing original ordering of edge matrix

Author(s)

Ben Bolker

Examples

```

tree.owl1 <- read.tree(text="(((Strix_aluco:4.2,Asio_otus:4.2):3.1,Athene_noctua:7.3):6.3,Tyto_alba:13.5);")
o2 <- as(tree.owl1,"phylo4")
ov <- as(o2,"phylo4vcov")
o3 <- as(ov,"phylo4")
## these are not completely identical, but are
## topologically identical ...

## edge matrices are in a different order:
## cf. o2@edge and o3@edge
## BUT the edge matrices are otherwise identical
identical(o2@edge[order(o2@edge[,2]),],
          o3@edge[order(o3@edge[,2]),])

## There is left/right ambiguity here in the tree orders:
## in o2 the 5->6->7->1 lineage
## (terminating in Strix aluco)
## is first, in o3 the 5->6->3 lineage
## (terminating in Athene noctua) is first.

```

phyloXXYY

Calculate node x and y coordinates

Description

Calculates the node x and y locations for plotting a phylogenetic tree.

Usage

```
phyloXXYY(phy, tip.order = NULL)
```

Arguments

phy	A phylo4 or phylo4d object.
tip.order	A character vector of tip labels, indicating their order along the y axis (from top to bottom). Or, a numeric vector of tip node IDs indicating the order.

Details

The y coordinates of the tips are evenly spaced from 0 to 1 in pruningwise order. Ancestor y nodes are given the mean value of immediate descendants. The root is given the x coordinate 0 and descendant nodes are placed according to the cumulative branch length from the root, with a maximum x value of 1.

Value

yy	Internal node and tip y coordinates
xx	Internal node and tip x coordinates
phy	A phylo4 or phylo4d object
segs	A list of h0x, h1x, v0x, v1x and h0y, h1y, v0y, v1y describing the start and end points for the plot line segments
torder	The tip order provided as tip.order or if NULL the preoder tip order
eorder	The an index of the reordered edges compared to the result of edges(phy)

Author(s)

Peter Cowan <pdcc@berkeley.edu>

See Also

treePlot, [plotOneTree](#)

Examples

```
data(geospiza)
coord <- phyloXXYY(geospiza)
plot(coord$xx, coord$yy, pch = 20)
```

plotOneTree

Plot a phylo4 object

Description

Plots the phylogenetic tree contained in a phylo4 or phylo4d object.

Usage

```
plotOneTree(xyy, type, show.tip.label, show.node.label,
            edge.color, node.color, tip.color, edge.width, rot)
```

Arguments

xyy	A list created by the phyloXXYY function
type	A character string indicating the shape of plotted tree
show.tip.label	Logical, indicating whether tip labels should be shown
show.node.label	Logical, indicating whether node labels should be shown
edge.color	A vector of colors in the order of edges(phy)

node.color	A vector of colors indicating the colors of the node labels
tip.color	A vector of colors indicating the colors of the tip labels
edge.width	A vector in the order of edges(phy) indicating the widths of edge lines
rot	Numeric indicating the rotation of the plot in degrees

Value

Returns no values, function invoked for the plotting side effect.

Author(s)

Peter Cowan <pdcc@berkeley.edu>

See Also

treePlot, [phyloXXYY](#)

Examples

```

data(geospiza)
grid.newpage()
xxyy <- phyloXXYY(geospiza)
plotOneTree(xxyy, type = 'phylogram',
  show.tip.label = TRUE, show.node.label = TRUE,
  edge.color = 'black', node.color = 'orange', tip.color = 'blue',
  edge.width = 1, rot = 0
)

grid.newpage()
pushViewport(viewport(w = 0.8, h = 0.8))
plotOneTree(xxyy, type = 'phylogram',
  show.tip.label = TRUE, show.node.label = TRUE,
  edge.color = 'black', node.color = 'orange', tip.color = 'blue',
  edge.width = 1, rot = 0
)
popViewport()

```

printphylo4

print a phylogeny

Description

Prints a phylo4 or phylo4d object in data.frame format with user-friendly column names

Usage

```
printphylo4(x, edgeOrder=c("pretty","real"), printall = TRUE)
```

Arguments

x	a phylo4 tree or phylo4d tree+data object
edgeOrder	in the data frame returned, the option 'pretty' returns the internal nodes followed by the tips, the option 'real' returns the nodes in the order they are stored in the edge matrix.
printall	default prints entire tree. printall=FALSE returns the first 6 rows

Details

This is a user-friendly version of the tree representation, useful for checking that objects were read in completely and translated correctly. The phylogenetic tree is represented as a list of numbered nodes, linked in a particular way through time (or rates of evolutionary change). The topology is given by the pattern of links from each node to its ancestor. Also given are the taxon names, node type (root/internal/tip) and phenotypic data (if any) associated with the node, and the branch length from the node to its ancestor. A list of nodes (descendants) and ancestors is minimally required for a phylo4 object.

Value

A data.frame with a row for each node (descendant), sorted as follows: root first, then other internal nodes, and finally tips.

The returned data.frame has the following columns:

label	Label for the taxon at the node (usually species name).
node	Node number, i.e. the number identifying the node in x@edge.
ancestor	Node number of the node's ancestor.
branch.length	The branch length connecting the node to its ancestor (NAs if missing).
node.type	"root", "internal", or "tip". (internally generated)
data	phenotypic data associated with the nodes, with separate columns for each variable.

Note

This is the default show() method for phylo4, phylo4d. It prints the user-supplied information for building a phylo4 object. For a full description of the phylo4 S4 object and slots, see [phylo4](#).

Author(s)

Marguerite Butler Thibaut Jombart <jombart@biomserv.univ-lyon1.fr> Steve Kembel

Examples

```
tree.phylo <- read.tree(text="((a,b),c);")
tree <- as(tree.phylo, "phylo4")
##plot(tree,show.node=TRUE) ## plotting broken with empty node labels: FIXME
tip.data <- data.frame(size=c(1,2,3), row.names=c("a", "b", "c"))
```

```
treedata <- phylo4d(tree, tip.data)
plot(treedata)
print(treedata)
```

reorder-methods *reordering trees within phylobase objects*

Description

Methods for reordering trees into various traversal orders

Usage

```
## S4 method for signature 'phylo'
reorder(x, order = "cladewise")
## S4 method for signature 'phylo4'
reorder(x, order = c("preorder", "postorder"))
```

Arguments

x	a phylo4 or phylo4d object
order	The desired traversal order; currently only 'preorder' and 'postorder' are allowed for phylo4 and phylo4d objects, whereas only 'cladewise' and 'pruningwise' are allowed for phylo objects

Details

The reorder method takes a phylo4 or phylo4d tree and orders the edge matrix (i.e. `edges(x)`) in the requested traversal order. Currently only two orderings are permitted, and both require rooted trees. In "postorder", a node's descendants come before that node, thus the root, which is ancestral to all nodes, comes last. In "preorder", a node is visited before its descendants, thus the root comes first.

A method is also defined that takes an ape phylo object. This also takes an order argument, however, 'pruningwise' and 'cladewise' are the only acceptable parameters. This is because this method actually uses the ape `reorder()` command to complete the ordering.

Value

A phylo4 or phylo4d object with the edge, label, length and data slots ordered as order, which is itself recorded in the order slot.

Methods

```
x = "phylo" reorders a phylo object
x = "phylo4" reorders a phylo4 object
x = "phylo4d" reorders a phylo4d object
```

Note

The "preorder" parameter corresponds to "cladewise" in the ape package, and "postorder" corresponds (almost but close enough?) to "pruningwise".

See http://ape.mpl.ird.fr/misc/FormatTreeR_28July2008.pdf

Author(s)

Peter Cowan, Jim Regetz

See Also

[reorder.phylo](#) in the ape package. [ancestors](#) [ancestor](#) [siblings](#) [children](#) [descendants](#)

Examples

```
phy <- phylo4(rtree(5))
edges(reorder(phy, "preorder"))
edges(reorder(phy, "postorder"))
```

subset-methods

Methods for creating subsets of phylogenies

Description

Methods for creating subsets of phylogenies, based on pruning a tree to include or exclude a set of terminal taxa, to include all descendants of the MRCA of multiple taxa, or to return a subtree rooted at a given node.

Usage

```
## S4 method for signature 'phylo4'
subset(x, tips.include=NULL, tips.exclude=NULL,
       mrca=NULL, node.subtree=NULL, ...)
## S4 method for signature 'phylo4d'
subset(x, tips.include=NULL, tips.exclude=NULL,
       mrca=NULL, node.subtree=NULL, ...)

## S4 method for signature 'phylo4'
prune(x, tips.exclude, trim.internal = TRUE)
## S4 method for signature 'phylo4d'
prune(x, tips.exclude, trim.internal = TRUE)

## S4 method for signature 'phylo4'
x[i]
## S4 method for signature 'phylo4d'
x[i, j]
```

Arguments

<code>x</code>	an object of class "phylo4" or "phylo4d"
<code>tips.include</code>	A vector of tips to include in the subset tree
<code>tips.exclude</code>	A vector of tips to exclude from the subset tree
<code>mrca</code>	A vector of nodes for determining the most recent common ancestor, which is then used as the root of the subset tree
<code>node.subtree</code>	A single internal node specifying the root of the subset tree
<code>trim.internal</code>	A logical specifying whether to remove internal nodes that no longer have tip descendants in the subset tree
<code>i</code>	([method) An index vector indicating tips to include
<code>j</code>	([method, phylo4d only) An index vector indicating columns of node/tip data to include
<code>...</code>	additional arguments to be passed to other methods

Details

The subset methods must be called using no more than one of the four main subsetting criteria arguments (`tips.include`, `tips.exclude`, `mrca`, or `node.subtree`). Each of these arguments can be either character or numeric. In the first case, they are treated as node labels; in the second case, they are treated as node numbers. For the first two arguments, any supplied tips not found in the tree (`tipLabels(x)`) will be ignored, with a warning. Similarly, for the `mrca` argument, any supplied tips or internal nodes not found in the tree will be ignored, with a warning. For the `node.subtree` argument, failure to provide a single, valid internal node will result in an error.

Although `prune` is mainly intended as the workhorse function called by `subset`, it may also be called directly. In general it should be equivalent to the `tips.exclude` form of `subset` (although perhaps with less up-front error checking).

The "[" operator, when used as `x[i]`, is similar to the `tips.include` form of `subset`. However, the indices used with this operator can also be logical, in which case the corresponding tips are assumed to be ordered as in `nodeId(x, "tip")`, and recycling rules will apply (just like with a vector or a matrix). With a [phylo4d](#) object 'x', `x[i, j]` creates a subset of x taking i for a tip index and j for the index of data variables in `tdata(geospiza, "all")`. Note that the second index is optional: `x[i, TRUE]`, `x[i,]`, and `x[i]` are all equivalent.

Regardless of which approach to subsetting is used, the argument values must be such that at least two tips are retained.

If the most recent common ancestor of the retained tips is not the original root node, then the root node of the subset tree will be a descendant of the original root. For rooted trees with non-NA root edge length, this has implications for the new root edge length. In particular, the new length will be the summed edge length from the new root node back to the original root (including the original root edge). As an alternative, see the examples for a way to determine the length of the edge that was immediately ancestral to the new root node in the original tree.

Note that the correspondance between nodes and labels (and data in the case of [phylo4d](#)) will be retained after all forms of subsetting. Beware, however, that the node numbers (IDs) will likely be altered to reflect the new tree topology, and therefore cannot be compared directly between the original tree and the subset tree.

Value

an object of class "phylo4" or "phylo4d"

Methods

x = "phylo4" subset tree

x = "phylo4d" subset tree and corresponding node and tip data

Author(s)

Jim Regetz <regetz@nceas.ucsb.edu>
 Steven Kembel <skembel@berkeley.edu>
 Damien de Vienne <damiende.vienne@psud.fr>
 Thibaut Jombart <jombart@biomserv.univ-lyon1.fr>

Examples

```
data(geospiza)
nodeLabels(geospiza) <- paste("N", nodeId(geospiza, "internal"), sep="")
geotree <- extractTree(geospiza)

## "subset" examples
tips <- c("difficilis", "fortis", "fuliginosa", "fusca", "olivacea",
         "pallida", "parvulus", "scandens")
plot(subset(geotree, tips.include=tips))
plot(subset(geotree, tips.include=tips, trim.internal=FALSE))
plot(subset(geotree, tips.exclude="scandens"))
plot(subset(geotree, mrca=c("scandens", "fortis", "pauper")))
plot(subset(geotree, node.subtree=18))

## "prune" examples (equivalent to subset using tips.exclude)
plot(prune(geotree, tips))

## "[" examples (equivalent to subset using tips.include)
plot(geotree[c(1:6,14)])
plot(geospiza[c(1:6,14)])

## for phylo4d, subset both tips and data columns
geospiza[c(1:6,14), c("wingL", "beakD")]

## note handling of root edge length:
edgeLength(geotree)['0-15'] <- 0.1
geotree2 <- geotree[1:2]
## in subset tree, edge of new root extends back to the original root
edgeLength(geotree2)['0-3']
## edge length immediately ancestral to this node in the original tree
edgeLength(geotree, MRCA(geotree, tipLabels(geotree2)))
```

tdata

*Retrieving or updating tip and node data in phylo4d objects***Description**

Methods to retrieve or update tip, node or all data associated with a phylogenetic tree stored as a phylo4d object

Usage

```
## S4 method for signature 'phylo4d'
tdata(x, type=c("all", "tip", "internal"),
      label.type=c("row.names", "column"), empty.columns=TRUE)
## S4 replacement method for signature 'phylo4d,ANY'
tdata(x, type=c("all", "tip", "internal"),
      merge.data=TRUE, clear.all=FALSE, ...) <- value
## S4 method for signature 'phylo4d'
tipData(x, ...)
## S4 replacement method for signature 'phylo4d,ANY'
tipData(x, ...) <- value
## S4 method for signature 'phylo4d'
nodeData(x, ...)
## S4 replacement method for signature 'phylo4d,ANY'
nodeData(x, ...) <- value
```

Arguments

x	A phylo4d object
type	The type of data to retrieve or update: “all” (default) for data associated with both tip and internal nodes, “tip” for data associated with tips only, “internal” for data associated with internal nodes only.
label.type	How should the tip/node labels from the tree be returned? “row.names” returns them as row names of the data frame, “column” returns them in the first column of the data frame. This options is useful in the case of missing (NA) or non-unique labels.
empty.columns	Should columns filled with NA be returned?
merge.data	if tip or internal node data are provided and data already exists for the other type, this determines whether columns with common names will be merged together (default TRUE). If FALSE, columns with common names will be preserved separately, with “.tip” and “.node” appended to the names. This argument has no effect if tip and node data have no column names in common, or if type=“all”.
clear.all	If only tip or internal node data are to be replaced, should data of the other type be dropped?
...	For the tipData and nodeData accessors, further arguments to be used by tdata. For the replacement forms, further arguments to be used by formatData (e.g. match.data), see formatData for more details.

value a data frame (or object to be coerced to one) to replace the values associated with the nodes specified by the argument type

Value

tdata returns a data frame

Methods

tdata signature(object="phylo4d"): retrieve or update data associated with a tree in a phylo4d object

Author(s)

Ben Bolker, Thibaut Jombart, Francois Michonneau

See Also

[phylo4d](#)

Examples

```
data(geospiza)
tdata(geospiza)
tipData(geospiza) <- 1:nTips(geospiza)
tdata(geospiza)
```

tip.data.plot

Plotting trees and associated data

Description

Plotting phylogenetic trees and associated data

Usage

```
tip.data.plot(xxyy, type = c("phylogram", "cladogram", "fan"), show.tip.label = TRUE, show.node.label =
```

Arguments

xxyy A list created by the [phyloXXXX](#) function

type A character string indicating the shape of plotted tree

show.tip.label Logical, indicating whether tip labels should be shown

show.node.label Logical, indicating whether node labels should be shown

rot Numeric indicating the rotation of the plot in degrees

tip.plot.fun	A function used to plot the data elements of a phylo4d object
edge.color	A vector of colors in the order of edges(phy)
node.color	A vector of colors indicating the colors of the node labels
tip.color	A vector of colors indicating the colors of the tip labels
edge.width	A vector in the order of edges(phy) indicating the widths of edge lines
...	Additional parameters passed to tip.plot.fun

Value

creates a plot on the current graphics device.

Author(s)

Peter Cowan

treePlot-methods *Phylogeny plotting*

Description

Plot phylo4 or phylo4d objects, including associated data.

Usage

```
## S4 method for signature 'phylo4,phylo4d'
treePlot(phy, type = c("phylogram", "cladogram", "fan"), show.tip.label = TRUE,
  show.node.label = FALSE, tip.order = NULL, plot.data = is(phy, "phylo4d"),
  rot = 0, tip.plot.fun = "bubbles", edge.color = "black",
  node.color = "black", tip.color = "black", edge.width = 1, newpage = TRUE, ...)
```

Arguments

phy	A phylo4 or phylo4d object
type	A character string indicating the shape of plotted tree
show.tip.label	Logical, indicating whether tip labels should be shown
show.node.label	Logical, indicating whether node labels should be shown
tip.order	If NULL the tree is plotted with tips in preorder, if "rev" this is reversed. Otherwise, it is a character vector of tip labels, indicating their order along the y axis (from top to bottom). Or, a numeric vector of tip node IDs indicating the order.
plot.data	Logical indicating whether phylo4d data should be plotted
rot	Numeric indicating the rotation of the plot in degrees
tip.plot.fun	A function used to generate plot at the each tip of the phylogenetic trees
edge.color	A vector of colors in the order of edges(phy)

node.color	A vector of colors indicating the colors of the node labels
tip.color	A vector of colors indicating the colors of the tip labels
edge.width	A vector in the order of edges(phy) indicating the widths of edge lines
newpage	Logical indicating whether the page should be cleared before plotting
...	Currently unused, parameters to be passed on to gpar

Value

No return value, function invoked for plotting side effect

Methods

phy = "phylo4" plots a tree of class [phylo4](#)

phy = "phylo4d" plots a tree with one or more quantitative traits contained in a [phylo4d](#) object.

Author(s)

Peter Cowan <pdcc@berkeley.edu>

See Also

[phylobubbles](#)

Examples

```
## example of plotting two grid plots on the same page
data(geospiza)
geotree <- extractTree(geospiza)
grid.newpage()
pushViewport(viewport(layout=grid.layout(nrow=1, ncol=2), name="base"))
  pushViewport(viewport(layout.pos.col=1, name="plot1"))
    treePlot(geotree, newpage=FALSE)
  popViewport()

  pushViewport(viewport(layout.pos.col=2, name="plot2"))
    treePlot(geotree, newpage=FALSE, rot=180)
  popViewport(2)
```

treewalk

*tree traversal and utility functions***Description**

Functions for describing relationships among phylogenetic nodes (i.e. internal nodes or tips).

Usage

```
ancestors(phy, node, type=c("all", "parent", "ALL"))
ancestor(phy, node)
siblings(phy, node, include.self=FALSE)
children(phy, node)
descendants(phy, node, type=c("tips", "children", "all"))
MRCA(phy, ...)
shortestPath(phy, node1, node2)
## S4 method for signature 'phylo4'
sumEdgeLength(x, node)
```

Arguments

phy	a phylo4 object (or one inheriting from phylo4 , e.g. a phylo4d object)
x	a phylo4 object (or one inheriting from phylo4 , e.g. a phylo4d object)
node	either an integer corresponding to a node ID number, or a character corresponding to a node label; for <code>ancestors</code> and <code>descendants</code> , this may be a vector of multiple node numbers or names
type	(<code>ancestors</code>) specify whether to return just direct ancestor ("parent"), all ancestor nodes ("all"), or all ancestor nodes including self ("ALL"); (<code>descendants</code>) specify whether to return just direct descendants ("children"), all extant descendants ("tips"), or all descendant nodes ("all")
include.self	whether to include self in list of siblings
...	a list of node numbers or names, or a vector of node numbers or names
node1	a node number (or name)
node2	a node number (or name)

Details

`ancestors` and `descendants` can take node vectors of arbitrary length, returning a list of output vectors if the number of valid input nodes is greater than one. List element names are taken directly from the input node vector.

If any supplied nodes are not found in the tree, the behavior currently varies across functions. Invalid nodes are automatically omitted by `ancestors` and `descendants`, with a warning. `ancestor` will return NA for any invalid nodes, with a warning. Both `children` and `siblings` will return an empty vector, again with a warning. In contrast, `MRCA` and `shortestPath` will throw an immediate error if any input nodes are invalid.

Value

ancestors and descendants	return a named vector (or a list of such vectors in the case of multiple input nodes) of the ancestors and descendants of a node
ancestor and children	ancestor is analogous to <code>ancestors(..., type="parent")</code> (i.e. direct ancestor only), but returns a single concatenated vector in the case of multiple input nodes; children is analogous to <code>descendants(..., type="children")</code> (i.e. direct descendants only), but is not currently intended to be used with multiple input nodes
siblings	returns sibling nodes (children of the same parent)
MRCA	returns the most recent common ancestor of two or more nodes
shortestPath	returns the nodes of the shortest path from one node to another (excluding node1 and node2)
sumEdgeLength	returns the sum of branch length for branches starting at nodes provided

Note

MRCA is uppercase to avoid conflict with `mrca` in `ape`

See Also

[mrca](#), in the `ape` package, gives a list of all subtrees

Examples

```
data(geospiza)
nodeLabels(geospiza) <- LETTERS[1:nNodes(geospiza)]
plot(as(geospiza, "phylo4"), show.node.label=TRUE)
ancestor(geospiza, "E")
children(geospiza, "C")
descendants(geospiza, "D", type="tips")
descendants(geospiza, "D", type="all")
ancestors(geospiza, "D")
MRCA(geospiza, "conirostris", "difficilis", "fuliginosa")
MRCA(geospiza, "olivacea", "conirostris")

## shortest path between 2 nodes
shortestPath(geospiza, "fortis", "fuliginosa")
shortestPath(geospiza, "F", "L")

## FIXME
## if(require(ape)){ edgelabels() }

## branch length from a tip to the root
sumEdgeLength(geospiza, ancestors(geospiza, "fortis", type="ALL"))
```

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