Package ‘POSetR’

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Description Provides a set of basic tools for generating, analyzing, summarizing and visualizing finite partially ordered sets. In particular, it implements flexible and very efficient algorithms for the extraction of linear extensions and for the computation of mutual ranking probabilities and other user-defined functionals, over them. The package is meant as a computationally efficient "engine", for the implementation of data analysis procedures, on systems of multi-dimensional ordinal indicators and partially ordered data, in the spirit of Fattore, M. (2016) "Partially ordered sets and the measurement of multidimensional ordinal deprivation", Social Indicators Research <DOI:10.1007/s11205-015-1059-6>, and Fattore M. and Arcagni, A. (2018) "A reduced posetic approach to the measurement of multidimensional ordinal deprivation", Social Indicators Research <DOI:10.1007/s11205-016-1501-4>.
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**Description**

Provides a set of basic tools for generating, analyzing, summarizing and visualizing finite partially ordered sets. In particular, it implements flexible and very efficient algorithms for the extraction of linear extensions and for the computation of mutual ranking probabilities and other user-defined functionals, over them. The package is meant as a computationally efficient "engine", for the implementation of data analysis procedures, on systems of multidimensional ordinal indicators and partially ordered data, in the spirit of Fattore, M. (2016) "Partially ordered sets and the measurement of multidimensional ordinal deprivation", Social Indicators Research <DOI:10.1007/s11205-015-1059-6>, and Fattore M. and Arcagni, A. (2018) "A reduced posetic approach to the measurement of multidimensional ordinal deprivation", Social Indicators Research <DOI:10.1007/s11205-016-1501-4>.

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antiChain

Generate an anti-chain from a vector of elements’ labels

Description
The function produces an antichain from the vector of elements’ labels elements. If elements is a numeric vector, it is first coerced to a character vector.

An antichain is a poset with no comparabilities, therefore the order of the labels in elements does not matter.

Usage
antiChain(elements)

Arguments
- elements: a vector of characters with elements’ labels.

Value
an environment of class poset.

See Also
function poset for more details and to create a generic poset and function chain to create a complete order.

Examples
antiChain(LETTERS[1:5])

chain
Generate a complete order from a vector of elements’ labels

Description
The function produces a complete order from the vector of elements’ labels elements. If elements is a numeric vector, it is first coerced to a character vector.

A complete order is a poset where all of the elements are comparable; the order of the labels in elements defines their position in the chain, from bottom to top.

Usage
chain(elements)
Arguments

elements a vector of characters listing the elements’ labels.

Value

an environment of class poset.

See Also

function poset for more details and to create a generic poset and function antiChain to create an anti-chain.

Examples

chain(LETTERS[1:5])

coverMatrix

Poset cover matrix

Description

The function returns the cover matrix for objects of class poset.

Usage

coverMatrix(x)

Arguments

x an object of class poset.

Value

a logical square matrix.

Examples

dom <- matrix(c(
  "a", "b",
  "c", "b",
  "b", "d"
), ncol = 2, byrow = TRUE)
p <- poset(x = dom)
coverMatrix(p)
incidenceMatrix

Description

The function returns the incidence matrix for objects of class poset.

Usage

incidenceMatrix(x)

Arguments

x  
an object of class poset.

Value

a logical square matrix.

Examples

dom <- matrix(c(
  "a", "b",
  "c", "b",
  "b", "d"
), ncol = 2, byrow = TRUE)
p <- poset(x = dom)
incidenceMatrix(p)

intersection

Intersection of two posets

Description

Given two posets X and Y on the same set, intersection returns the poset Z defined by a < b in Z if and only if a < b in X and a < b in Y.

Usage

intersection(x, y)

x %it% y

Arguments

x  
an S4 object of class Rcpp_P0Set, see poset for details.
y  
an S4 object of class Rcpp_P0Set, see poset for details.
Value

an S4 object of class Rcpp_PoSet, see poset for details

References


See Also

poset

Examples

dom <- matrix(c(
  "a", "b",
  "c", "b",
  "b", "d"
), ncol = 2, byrow = TRUE)
p <- poset(x = dom)
plot(p)
dom <- matrix(c(
  "a", "b",
  "c", "b",
  "d", "b"
), ncol = 2, byrow = TRUE)
q <- poset(x = dom)
plot(q)
plot(p %it% q)

---

**LEapply**

Applies scalar functions over the set of linear extensions of a poset and returns the corresponding average values

Description

"LEapply" is composed of three main elements: (i) the linear extensions generator, (ii) the application of the argument functions to the linear extensions and (iii) the computation of the averages of the results, for each function separately; see Fattore M (2016). “Partially ordered sets and the measurement of multidimensional ordinal deprivation.” Social Indicators Research, 128(2), 835–858.

Usage

LEapply(x, ...)

## S3 method for class 'poset'
LEapply(
  x,
FUN = "MutualRankingProbability",
..., 
generator = c("AllLE", "BubleyDyer"), 
bubleydyer.precision = 10,
bubleydyer.nit = NULL,
bubleydyer.progressBar = TRUE,
degrees = NULL 
)

Arguments

x an environment of class poset, see poset for details.
... optional arguments to FUN.
FUN the function, or a list of functions, to be applied to each linear extension: see 'Details'.
generator a string specifying the method used to generate the linear extensions. The default value is "AllLE". See section 'Details' below.
bubleydyer.precision considered only if "BubleyDyer" generator is selected. It corresponds to the number of digit precision of the frequencies in the sampling distributions of linear extensions.
bubleydyer.nit considered only if "BubleyDyer" generator is selected. Number of iterations in the Bubley-Dyer algorithm, if NULL (default) it is set as indicated in Bubley and Dyer (1999) depending on the value of bubleydyer.precision and the number of elements of the poset.
bubleydyer.progressBar logical that indicates whether to show a text progress bar or not

degrees to generate the lexicographic linear extensions of a product order, the poset x describes the dominance (e.g. relative importance) between ordinal variables and degrees is a numerical vector specifying the number of degrees of each variable, represented by in the poset.

Details

Argument FUN must be either a function or a list of functions, each one depending on a vector of characters representing the names of the elements of the poset.

If degrees is not NULL but a numerical vector as long as the number of elements in the poset, the poset elements are considered as ordinal variables. Therefore degrees represents their number of degrees that are represented as integer numbers starting from 0. In this case, LEapply generates the lexicographical linear extensions of the product order of the ordinal variables. Its elements are called profiles and they are obtained by the combination of the degrees of variables separated by a dash. For details about lexicographical linear extensions and profiles see Fattore M, Arcagni A (2018). “A reduced posetic approach to the measurement of multidimensional ordinal deprivation.” Social Indicators Research, 136(3), 1053–1070.

Some functions are already implemented in the C++ library and they can be called by their names. Currently, such functions are "MutualRankingProbability", "Separation", and "AverageHeight".
Each function in \texttt{FUN} must return a numerical or logical matrix. Each function can depend on additional arguments that can be passed through \ldots; such additional arguments must be the same for all the functions in the list.

Argument generator specifies the linear extension generation algorithm. The available generators are "\texttt{AllLE}" , that produces all of the linear extensions of the input poset, and "\texttt{BubleyDyer}" , which samples uniformly from the set of linear extensions, through an MCMC algorithm (Bubley and Dyer 1999).

\textbf{Value}

The average values of the argument functions \texttt{FUN} over the set of linear extensions (or lexicographic ones if degrees argument is not \texttt{NULL}).

\textbf{References}


\textbf{See Also}

\texttt{poset}

\textbf{Examples}

```r
dom <- matrix(c("a", "b", "c", "b", "b", "d" ), ncol = 2, byrow = TRUE)
p <- poset(x = dom)

## Not run:
LEapply(
  x = p,
  FUN = "MutualRankingProbability",
  generator = "AllLE",
  degrees = c(3, 2, 3, 2)
)

a_rank_dist <- function(le) {
  return(matrix(le == "a"))
}
LEapply(x = p, FUN = a_rank_dist)
## End(Not run)
```
plot.poset  

Plotting the Hasse diagram of a poset

Description

plot produces an igraph object and shows the Hasse diagram.

Usage

## S3 method for class 'poset'
plot(
  x,
  vertex.color = rgb(1, 1, 1, 1),
  vertex.label = x$pointer$elements(),
  vertex.label.color = rgb(0, 0, 0, 1),
  vertex.label.family = "sans",
  edge.color = rgb(0, 0, 0, 1),
  edge.label = NA,
  edge.arrow.mode = "-",
  asp = 0,
  ...
  equispaced = FALSE,
  show = TRUE
)

Arguments

x an S4 object of class Rcpp_POSet, see poset for details.
vertex.color argument of the plot.igraph function, see igraph.plotting for details.
vertex.label argument of the plot.igraph function, see igraph.plotting for details.
vertex.label.color argument of the plot.igraph function, see igraph.plotting for details.
vertex.label.family argument of the plot.igraph function, see igraph.plotting for details.
edge.color argument of the plot.igraph function, see igraph.plotting for details.
edge.label argument of the plot.igraph function, see igraph.plotting for details.
edge.arrow.mode argument of the plot.igraph function, see igraph.plotting for details.
asp argument of the plot.igraph function, see igraph.plotting for details.
... additional plotting parameters, see igraph.plotting for details.
equispaced logical, if TRUE the nodes on the same level of the Hasse diagram are horizontally equispaced.
show logical, if TRUE (default) the Hasse diagram is plotted.
Details

`plot.poset` computes the cover relation and produces the corresponding Directed Acyclic Graph (DAG), as an `igraph` object, returned as invisible output. Function `layout_with_sugiyama` generates the DAG layout with edges oriented from top to bottom. When `equispaced=TRUE`, nodes on the same Hasse diagram level are horizontally equispaced.

The Hasse diagram is displayed by a call to `plot.igraph` (some default argument values are set to get a cleaner plot, by exploiting Hasse diagram properties.

Setting `show = FALSE` produces the `igraph` object, without showing the Hasse diagram.

Note that

Value

an `igraph` object.

See Also

`poset`, `igraph`, `igraph.plotting`

Examples

```r
dom <- matrix(c("a", "b", "c", "b", "b", "d"), ncol = 2, byrow = TRUE)
p <- poset(x = dom)
hasse <- plot(p)
class(hasse)
```

---

poset

Generates a Partially Ordered SET from the list of dominances

Description

Function `poset` creates a poset from a dominance list. `x` argument is a two-column matrix, each row defines a pair of comparable elements, where the element in the first column is dominated by or coincide with the element in the second column. If the elements of `x` are numeric, they are first coerced to character and used as elements labels.

Usage

```r
poset(x = NULL, elements = unique(as.character(x)))
```

Arguments

- `x` an object of class `matrix` with two columns, listing the dominances, by rows.
- `elements` a vector of characters listing all the labels of the elements.
Details

A partial order relation is reflexive, transitive and anti-symmetric. Given the dominance list provided by the user, the function produces the smallest poset comprising them (reflexive and transitive closure); in case the dominances provided by the user imply non-trivial cycles, violating anti-symmetry, the function returns an error.

By default elements is equal to all the different labels available in x. If some elements are incomparable, list all of the elements in elements or include self-comparabilities in x. Notice that antichains can be created in a simpler way, by function antiChain.

Value

an environment of class poset; this class contains a pointer with different C++ methods used by other functions of the package.

See Also

in the package are available functions that simply the creation of particular posets: antiChain to create a poset without comparabilities, chain to create a complete order, poset_from_dataframe to create a poset from a statistical population.

Examples

dom <- matrix(c(  
  "a", "b",  
  "c", "b",  
  "b", "d"  
), ncol = 2, byrow = TRUE)  
poset(x = dom)  
poset(x = dom, elements = letters[1:5])
poset_from_igraph

Generates a Partially Ordered SET from a Directed Acyclic Graph (DAG)

Description

This function generates a poset from an object. The function checks if the graph is directed and cyclic in order it represent the cover-relation.

Arguments

x  an object of class data.frame.
collapse an object of class character that defines the separator between observations with the same profile, by default ",". For more information see the details section.

Details

The poset is generated through the component-wise comparability relation (Davey and Priestley 2002). Note that some observations may have the same profile (i.e. the same values for all the variables) therefore they have to be included into the same element of the poset, than the label of such element correspond to the labels of the statistical units separated by the collapse character.

Value

an S4 object of class Rcpp_P0Set; this class contains different C++ methods used by other functions of the package.

References


See Also

poset.

Examples

set <- ordered(letters[1:5])
set.seed(0)
n <- 30
x <- data.frame(
  A = sample(set, n, replace = TRUE),
  B = sample(set, n, replace = TRUE),
  C = sample(set, n, replace = TRUE)
)
p <- poset_from_dataframe(x, collapse = ",")
plot(p, equispaced = TRUE, vertex.frame.color = "lightgray", vertex.color = "lightgray")
**poset_from_incidence**

Usage

```
poset_from_igraph(g)
```

Arguments

- **g**: an igraph object

Details

Note that the Hasse diagram represents the cover relation from the top to the bottom, therefore its representation is the opposite of the plot of the graph with Sugiyama layout.

Value

an environment of class poset.

References


See Also

`poset`.

Examples

```r
library(igraph)
g <- make_tree(10)
ly <- igraph::layout_with_sugiyama(g)$layout
g$layout <- ly
plot(g)
p <- poset_from_igraph(g)
plot(p)
```

---

**poset_from_incidence**

*Generates a Partially Ordered SET from an incidence matrix*

Description

This function generates a poset from an incidence matrix `x`. Such matrix is a named and logical that is TRUE if the row element is dominated by the column one, FALSE otherwise. Such incidence relation should be reflexive, anti-symmetric, and transitive.

Usage

```
poset_from_incidence(x)
```
print.poset

Arguments

x a logical matrix.

Value

an environment of class poset.

References


See Also

poset.

Examples

```r
x <- c(
  TRUE, FALSE, FALSE, FALSE, FALSE, FALSE,
  TRUE, TRUE, FALSE, FALSE, FALSE, FALSE,
  TRUE, TRUE, TRUE, FALSE, FALSE, FALSE,
  TRUE, FALSE, FALSE, TRUE, FALSE, FALSE,
  TRUE, TRUE, FALSE, TRUE, TRUE, FALSE,
  TRUE, TRUE, TRUE, TRUE, TRUE, TRUE
)

x <- matrix(x, nrow = 6, ncol = 6)
rownames(x) <- colnames(x) <- LETTERS[1:6]
p <- poset_from_incidence(x)
plot(p)
```

print.poset

Method for the print function that shows the poset elements and comparabilities

Description

print prints the list of poset elements and all of the strict dominances in it.

Usage

```r
## S3 method for class 'poset'
print(x, max = NULL, ...)
```

Arguments

x an object of class Rcpp_POSet.

max a non-null value for max specifies the approximate maximum number of entries to be printed. The default, NULL, uses `getOption("max.print")`: see that help page for more details.

... further arguments passed to or from other methods.
Value

nothing

Examples

dom <- matrix(c(
    "a", "b",
    "c", "b",
    "b", "d"
), ncol = 2, byrow = TRUE)
p <- poset(x = dom)
print(p)

print.summary_poset    Method for the print function that shows the poset summary

Description

print prints the poset summary.

Usage

## S3 method for class 'summary_poset'
print(x, ...)

Arguments

x an object of class summary_poset.

... further arguments passed to or from other methods.

Value

nothing

See Also

summary.poset

Examples

dom <- matrix(c(
    "a", "b",
    "c", "b",
    "b", "d"
), ncol = 2, byrow = TRUE)
p <- poset(x = dom)
summary(p)

summary(chain(1:4))
summary(antiChain(LETTERS[1:5]))
productOrder

Product order between two posets

Description
The function returns the product poset of two posets X and Y.

Usage
productOrder(x, y, sep = "-")

Arguments
x an S4 object of class poset, see poset for details.
y an S4 object of class poset, see poset for details.
sep a character object indicating the separator to be used to paste profiles names.

Value
an environment of class poset, see poset for details

References

See Also
poset

Examples

dom <- matrix(c(
  "a", "b",
  "c", "b",
  "b", "d"
), ncol = 2, byrow = TRUE)
p <- poset(x = dom)
q <- chain(1:3)
plot(p %po% q)
Summary

Poset summary

Description

Method of the summary function for objects of class poset.

Usage

## S3 method for class 'poset'
summary(object, ...)

Arguments

object an object of class poset.
...

further arguments passed to or from other methods.

Value

An S3 object of class summary_poset listing and counting the poset elements, their strict dominances and their incomparabilities.

Examples

dom <- matrix(c("a", "b",
"c", "b",
"b", "d"), ncol = 2, byrow = TRUE)
p <- poset(x = dom)
summary(p)

summary(chain(1:4))
summary(antiChain(LETTERS[1:5]))
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