Package ‘Prize’

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Description The high throughput studies often produce large amounts of numerous genes and proteins of interest. While it is difficult to study and validate all of them. Analytic Hierarchy Process (AHP) offers a novel approach to narrowing down long lists of candidates by prioritizing them based on how well they meet the research goal. AHP is a mathematical technique for organizing and analyzing complex decisions where multiple criteria are involved. The technique structures problems into a hierarchy of elements, and helps to specify numerical weights representing the relative importance of each element. Numerical weight or priority derived from each element allows users to find alternatives that best suit their goal and their understanding of the problem.

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Imports diagram, stringr, ggplot2, reshape2, grDevices, matrixcalc, stats, gplots, methods, utils, graphics

Suggests RUnit, BiocGenerics

biocViews Software, MultipleComparison, GeneExpression, CellBiology, RNASeq

NeedsCompilation no

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Prize-package

Prize: an R package for prioritization estimation based on analytic hierarchy process

Description

The Prize package is a decision analysis tool based on Analytic Hierarchy Process (AHP), which provides a logical framework to rank and prioritize a group of alternatives. Once the decision makers have their list of available options (alternatives) and defined their criteria for prioritization, the Prize package allows aggregation of individual judgements against each criterion into a group judgement, then use these judgements to calculate final ahp weight for ranking. The Prize package also provides visualization tools to illustrate the problem hierarchy, the criteria weights and final ranking.

Author(s)

Daryanaz Dargahi <daryanazdargahi@gmail.com>

References


Examples

# aggregation of individual opinions
mat = matrix(nrow = 4, ncol = 1, data = NA)
rownames(mat) = c('ind1', 'ind2', 'ind3', 'ind4')
colnames(mat) = c('individual_judgement')

# non-weighted AIJ
res = gaggregate(srcfile = mat, method = 'geometric', simulation = 500)

# Estimating idealised prioritise
# Rating AHP

category_pcm = read.delim(system.file('extdata','number.tsv', package = 'Prize'),
sep = '\t', header = TRUE, row.names = 1)
alt_mat = read.delim(system.file('extdata','numEpitope_alternative_category.tsv',
sep = '\t', header = TRUE, row.names = 1)

system.file('extdata','ind1.tsv',package = 'Prize'),
system.file('extdata','ind2.tsv',package = 'Prize'),
system.file('extdata','ind3.tsv',package = 'Prize'),
system.file('extdata','ind4.tsv',package = 'Prize'))
package = 'Prize'), sep = '\t', header = FALSE)
rate = rating(category_pcm, alt_mat, simulation = 500)

########################################
## Prioritization estimation using AHP
########################################
mat <- matrix(nrow = 7, ncol = 3, data = NA)
mat[,1] <- c('0', '1', '2', '3', '4', '4.1', '4.2')
mat[,3] <- c(system.file('extdata', 'aggreg.judgement.tsv',package = 'Prize'),
 system.file('extdata', 'tumor.PCM.tsv',package = 'Prize'),
 system.file('extdata', 'normal.PCM.tsv',package = 'Prize'),
 system.file('extdata', 'freq.PCM.tsv',package = 'Prize'),
 system.file('extdata', 'epitope.PCM.tsv',package = 'Prize'),
 system.file('extdata', 'epitopeNum.PCM.tsv',package = 'Prize'),
 system.file('extdata', 'epitopeLength.PCM.tsv',package = 'Prize'))

# prioritization pipeline
prioritization <- pipeline(mat, model = 'relative', simulation = 500)

########################################
## visualizaion
########################################
# visualizing individal opinion consistency ratio
crplot(ICR(res), angle = 45)

# visualizing the distance among individual opinion and aggregated group judgment
dplot(IP(res))

# visualizing problem hierarchy
ahplot(ahp_plot(prioritization), fontsize = 0.7, cradx = 0.11 ,sradx = 0.12,
 cirx= 0.18, ciry = 0.07, dist = 0.06)

# visualizing prioritized alternatives
rainbowplot(rainbow_plot(prioritization)$criteria_rainbowplot, xcex = 3)
rainbowplot(rainbow_plot(prioritization)$subcriteria_rainbowplot, xcex = 3)

# visualizing criteria/subcriteria score
wplot(weight_plot(prioritization)$criteria_wplot, type = 'pie',
 fontsize = 7, pcex = 3)
wplot(weight_plot(prioritization)$criteria_wplot, type = 'bar',
 fontsize = 7, pcex = 3, xlab = 'Weight', ylab = 'Criteria')
**Description**

Converting a triangular matrix into a square pairwise comparison matrix (PCM) where the diagonal values are equal to 1 and $a[i,j] = 1/a[j,i]$.

**Usage**

```r
ahmatrix(x)
```

**Arguments**

- `x` a numeric triangular matrix, where empty elements are specified with NA.

**Value**

An S4 object including a PCM.

**Author(s)**

Daryanaz Dargahi

**Examples**

```r
mat <- matrix(nrow = 3, ncol = 3, data = NA)
mat[1,2] <- 5
mat[1,3] <- 2
mat[2,3] <- 7
res <- ahmatrix(mat)
```
ahmatrixObj-class  Class ahmatrixObj

Description
An object that stores a pairwise comparison matrix.

Objects from the Class
Objects can be created by calls of the form new("ahmatrixObj", ...).

Slots
ahp_matrix: A pairwise comparison matrix.

Author(s)
Daryanaz Dargahi <daryanazdargahi@gmail.com>

ahp

Description
Computing AHP weights as well as Satty’s inconsistency.

Usage
ahp(x, simulation = 500)

Arguments
x a pairwise comparison matrix (PCM) with diagonal values equal 1 and a[i,j] = 1/a[j,i].
simulation the simulation size in order to compute Satty’s inconsistency. The default value is 500.

Value
An S4 object including a numeric vector of AHP weights and Satty’s inconsistency.

Author(s)
Daryanaz Dargahi

References
Examples

```r
mat <- matrix(c(1,2,5, 1/2,1,3, 1/5,1/3,1), nrow = 3, ncol = 3, byrow = TRUE)
res <- ahp(mat, simulation = 500)
```

Description

Plotting the problem hierarchy, showing the relationships between goal, criteria, and subcriteria.

Usage

```r
ahplot(srcfile, fontsize = 0.5, cradx = 0.07, crady = 0.05, sradx = 0.05, srady = 0.05, cirx = 0.1, ciry = 0.05, gcol = "green", ccol = "yellow", scol = "orange", lcol = "black", dist = 0.05, digit = 3, main = NULL)
```

Arguments

- `srcfile` a character matrix, where the first column specifies the hierarchy order. The second and third columns include the ID of decision elements and AHP weights (optional), respectively (See the example below).
- `fontsize` the font size of characters.
- `cradx, crady` the horizontal and vertical radius of the criteria box, respectively.
- `sradx, srady` the horizontal and vertical radius of the subcriteria box, respectively.
- `cirx, ciry` the horizontal and vertical radius of the goal.
- `gcol, ccol, scol` the filling color of the goal, criteria, and subcriteria boxes, respectively.
- `lcol` the line color surrounding the goal, criteria, and subcriteria boxes.
- `dist` the distance between the weights and the tree edges.
- `digit` the number of digits after decimal point to be shown on the arrows.
- `main` a character string as the plot title.

Value

An object created by 'diagram'.

Author(s)

Daryanaz Dargahi
Examples

```r
mat <- matrix(nrow = 7, ncol = 2, data = NA)
mat[,1] <- c("0", "1", "2", "3", "4", "4.1", "4.2")
mat[,2] <- c("Prioritization of DE genes", "Tumor_expression", "Normal_expression", "Frequency", "Epitopes", "Number of epitopes", "Size of epitopes")

# plotting a problem hierarchy
ahplot(mat, fontsize = 0.7, cradx = 0.11, sradx = 0.12, cirx = 0.18, ciry = 0.07)

# plotting a problem hierarchy with AHP weights shown on the edges of the graph
mat <- cbind(mat, c(1, 0.470, 0.341, 0.117, 0.073, 0.009, 0.064))
ahplot(mat, fontsize = 0.7, cradx = 0.11, sradx = 0.12, cirx = 0.18, ciry = 0.07)
```

### Description
An object that stores AHP priorities and consistency ratio.

### Objects from the Class
Objects can be created by calls of the form `new("ahpObj", ...)`. 

### Slots
- **weight**: A vector of AHP priorities.
- **saaty_inconsistency**: The consistency ratio.

### Author(s)
Daryanaz Dargahi <daryanazdargahi@gmail.com>

### Examples
```r
mat <- matrix(nrow = 3, ncol = 3, data = NA)
mat[1,2] <- 5
mat[1,3] <- 2
mat[2,3] <- 7
res <- ahmatrix(mat)
ahp_matrix(res)
```
ahp_plot

**Description**

ahp_plot is a slot of pipelineObj class. It consists of a matrix of problem hierarchy.

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>

**Examples**

```r
mat <- matrix(nrow = 7, ncol = 3, data = NA)
mat[,1] <- c('0', '1', '2', '3', '4', '4.1', '4.2')
mat[,2] <- c('Prioritization_of_DE_genes', 'Tumor_expression', 'Normal_expression',
             'Frequency', 'Epitopes', 'Number_of_epitopes', 'Size_of_epitopes')
mat[,3] <- c(system.file('extdata', 'aggreg.judgement.tsv', package = 'Prize'),
             system.file('extdata', 'tumor.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'normal.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'freq.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'epitope.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'epitopeNum.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'epitopeLength.PCM.tsv', package = 'Prize'))

result <- pipeline(mat, model = 'relative', simulation = 500)
ahp_plot(result)
```

ahp_weights

**Description**

ahp_weights is a slot of pipelineObj class. It consists of a list of matrices representing AHP priorities for all decision elements.

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>

**Examples**

```r
mat <- matrix(nrow = 7, ncol = 3, data = NA)
mat[,1] <- c('0', '1', '2', '3', '4', '4.1', '4.2')
mat[,2] <- c('Prioritization_of_DE_genes', 'Tumor_expression', 'Normal_expression',
             'Frequency', 'Epitopes', 'Number_of_epitopes', 'Size_of_epitopes')
mat[,3] <- c(system.file('extdata', 'aggreg.judgement.tsv', package = 'Prize'),
             system.file('extdata', 'tumor.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'normal.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'freq.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'epitope.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'epitopeNum.PCM.tsv', package = 'Prize'),
             system.file('extdata', 'epitopeLength.PCM.tsv', package = 'Prize'),
```
result <- pipeline(mat, model = 'relative', simulation = 500)
ahp_weights(result)

### AIJ

**Aggregated individual judgements (AIJ) slot**

**Description**

AIJ (Aggregated individual judgements) is a slot of geoAggreg class. It consists of a matrix of aggregated group judgements (a pairwise comparison matrix).

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>

**Examples**

mat <- matrix(nrow = 4, ncol = 1, data = NA)
mat[,1] <- c(system.file('extdata','ind1.tsv',package = 'Prize'),
            system.file('extdata','ind2.tsv',package = 'Prize'),
            system.file('extdata','ind3.tsv',package = 'Prize'),
            system.file('extdata','ind4.tsv',package = 'Prize'))
rownames(mat) <- c('ind1','ind2','ind3','ind4')
colnames(mat) <- c('individual_judgement')

# non-weighted aggregation
res <- gaggregate(srcfile = mat, method = 'geometric', simulation = 500)
AIP(res)

### AIP

**Aggregated individual priorities (AIP) slot**

**Description**

AIP (Aggregated individual priorities) is a slot of ariAggreg class. It consists of a vector of aggregated group priorities.

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>
Examples

```r
mat <- matrix(nrow = 4, ncol = 1, data = NA)
mat[,1] <- c(system.file("extdata","ind1.tsv",package = "Prize"),
            system.file("extdata","ind2.tsv",package = "Prize"),
            system.file("extdata","ind3.tsv",package = "Prize"),
            system.file("extdata","ind4.tsv",package = "Prize"))
rownames(mat) <- c("ind1","ind2","ind3","ind4")
colnames(mat) <- c("individual_judgement")

# non-weighted aggregation
res <- gaggregate(srcfile = mat, method = 'arithmetic', simulation = 500)
AIP(res)
```

ariAggreg-class

Class ariAggreg

Description

An object that stores the aggregated group priorities as well as consistency ratio of the individual judgements.

Objects from the Class

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

Slots

AIP: A vector of aggregated group priorities.
ICR: A vector of individuals judgements consistency ratio.
IP: A matrix of individual and aggregated group AHP priorities.

Author(s)

Daryanaz Dargahi <daryanazdargahi@gmail.com>

Consistency index (CI) slot

Description

CI (Consistency index) is a slot of geoAggreg class. It consists of a vector of the individuals consistency index.

Author(s)

Daryanaz Dargahi <daryanazdargahi@gmail.com>
Examples

mat <- matrix(nrow = 4, ncol = 1, data = NA)
mat[,1] <- c(system.file('extdata','ind1.tsv',package = 'Prize'),
            system.file('extdata','ind2.tsv',package = 'Prize'),
            system.file('extdata','ind3.tsv',package = 'Prize'),
            system.file('extdata','ind4.tsv',package = 'Prize'))
rownames(mat) <- c('ind1','ind2','ind3', 'ind4')
colnames(mat) <- c('individual_judgement')

# non-weighted aggregation
res <- gaggregate(srcfile = mat, method = 'geometric', simulation = 500)
CI(res)

data <- c(0.1132, 0.0142, 0.0324, 0.10075, 0.0883)
names(data) <- c('individual_1','individual_2','individual_3','individual_4','individual_5')
crplot(data, fontsize = 15, xcex = 10, ycex = 10, xlab = "ID", ylab = "ICR", main = NULL)

Description

Plotting the consistency ratio (CR) of individual judgements. According to Satty, a pairwise comparison matrix is considered to be consistent if CR is equal or less than 0.1. Therefore, CRs equal to or less than 0.1 are colored in green (Pass) and CRs greater than 0.1 are colored in red (Failed).

Usage

```r
crplot(srcfile, fontsize = 15, xcex = 10, ycex = 10, angle = 90,
       xlab = "ID", ylab = "ICR", main = NULL)
```

Arguments

- `srcfile` a numeric vector of individual CR
- `fontsize` the font size of plot title, x and y axis labels. The default value is 15.
- `xcex,ycex` the font size of x and y axis, respectively. The default values is 10.
- `angle` the angle of the labels on x axis
- `xlab,ylab` the label to be shown on the x and y axis, respectively.
- `main` the plot title

Value

An object created by `ggplot`.

Author(s)

Daryanaz Dargahi

Examples

data <- c(0.1132, 0.0142, 0.0324, 0.10075, 0.0883)
names(data) <- c('individual_1','individual_2','individual_3','individual_4','individual_5')
crplot(data, fontsize = 15, xcex = 10, yex = 10, xlab = 'ID', ylab = 'ICR', main = 'Individuals consistency ratio')
Description

Computing and plotting the distance between individuals and group judgement. Distances are computed using classical multidimensional scaling (MDS) approach.

Usage

dplot(srcfile, fontsize = 15, xcex = 10, ycex = 10, lcex = 5, hjust = 0.5, vjust = 1, xlab = "Coordinate 1", ylab = "Coordinate 2", main = NULL)

Arguments

- srcfile: a numeric matrix of individual and group priorities.
- fontsize: the font size of the plot title, and x and y axis labels. The default value is 15.
- xcex, ycex: the font size of the x and y axis, respectively. The default values is 10.
- lcex: the font size of point labels in dplot
- hjust, vjust: the horizontal and vertical justification of point labels, respectively.
- xlab, ylab: the label of the x and y axis, respectively.
- main: the plot title

Value

An object created by 'ggplot'.

Author(s)

Daryanaz Dargahi

References


Examples

```r
mat <- matrix(nrow = 5, ncol = 4, data = NA)
rownames(mat) <- c("Ind1", "Ind2", "Ind3", "Ind4", "Group judgement")
colnames(mat) <- c("Tumor_expression", "Normal_expression", "Frequency", "Epitopes")
mat[1,] <- c(0.4915181, 0.3058879, 0.12487821, 0.07771583)
mat[2,] <- c(0.3060687, 0.4949012, 0.12868606, 0.07034399)
mat[3,] <- c(0.4627138, 0.3271881, 0.13574662, 0.07435149)
mat[4,] <- c(0.6208484, 0.2414021, 0.07368481, 0.06406465)
mat[5,] <- c(0.4697298, 0.3406738, 0.11600194, 0.07359445)

dplot(mat, xlab = "Coordinate 1", ylab = "Coordinate 2", main = "Distance plot")
```
Description

epitope.PCM is a criteria with two subcriteria in the prioritization of a set of genes of interest. This file includes a PCM of the two subcriteria including number of epitopes and size of epitopes. The pairwise comparisons are performed according to the Saaty’s fundamental scale.

Author(s)

Daryanaz Dargahi

References


Description

EpitopeLength.PCM is a subcriteria (of the Epitope criterion) in the prioritization of a set of genes of interest. This file includes a PCM of the genes with respect to size (length) of epitopes according to the UniProt annotation (uniprot.org). The pairwise comparisons are performed according to the Saaty’s fundamental scale.

Author(s)

Daryanaz Dargahi

References

**Description**

The rating categories and computed idealised priorities of alternatives (genes) with respect to their number of epitopes. This matrix is computed by the rating() function.

**Author(s)**

Daryanaz Dargahi

---

**Description**

The rating categories and computed idealised priorities of alternatives (genes) with respect to their epitope size. This matrix is computed by the rating() function.

**Author(s)**

Daryanaz Dargahi

---

**Description**

Freq.PCM is a criteria (with no subcriteria) in the prioritization of a set of genes of interest. This file includes a PCM of the genes with respect to their expression frequency in tumor tissue. The pairwise comparisons are performed according to the Saaty's fundamental scale.

**Author(s)**

Daryanaz Dargahi

**References**

freq_exp_rating-data  Rating categories and idealised priorities

Description
The rating categories and computed idealised priorities of alternatives (genes) with respect to their expression frequency in tumor tissue. This matrix is computed by the rating() function.

Author(s)
Daryanaz Dargahi

gaggregate  gaggregate

Description
Aggregating individual judgments (pairwise comparison matrices - PCMs) into a group judgement or group priority.

Usage
gaggregate(srcfile, method = "geometric", simulation = 500)

Arguments

srcfile  a matrix with one or two columns. Column one (required) includes the path (location) to each individual pairwise comparison matrix and column two (optional) includes the individual weights. The matrix rowname is individuals identifier.

method  two methods are available for aggregation of individual opinions, (1) arithmetic, which compute the arithmetic mean of individual priorities, (2) geometric, which computes the geometric mean of individual PCMs. If individuals are assigned with a weight, the weighted arithmetic/geometric mean will be computed. The default method is ‘geometric’.

simulation  simulation size for computation of Satty’s inconsistency. The default value is 500.

Value
An S4 object including group PCM/prioritise;
If geometric mean is used, the returning object includes: aggregated group PCM (AIJ), group consistency ratio (GCR), individual consistency ratios (ICR), consensus index (CI), and priority matrix (IP).
If arithmetic mean is used, the returning object includes: aggregated group priority (AIP), individual consistency ratios (ICR), and priority matrix (IP).
References


Examples

mat <- matrix(nrow = 4, ncol = 1, data = NA)
mat[,1] <- c(system.file('extdata','ind1.tsv',package = 'Prize'),
           system.file('extdata','ind2.tsv',package = 'Prize'),
           system.file('extdata','ind3.tsv',package = 'Prize'),
           system.file('extdata','ind4.tsv',package = 'Prize'))
rownames(mat) <- c('ind1','ind2','ind3', 'ind4')
colnames(mat) <- c('individual_judgement')

# non-weighted aggregation
res <- gaggregate(srcfile = mat, method = 'geometric', simulation = 500)

# weighted aggregation
# Decision makers are assigned with a priority value based on their specialization and perspectives.
mat <- cbind(mat, c(0.35,0.25,0.15,0.25))
colnames(mat)[2] <- 'individual_weight'
res <- gaggregate(srcfile = mat, method = 'geometric', simulation = 500)

---

Description

GCR (Group consistency ratio) is a slot of geoAggreg class. It consists of the consistency ratio of the aggregated group judgement.

Author(s)

Daryanaz Dargahi <daryanazdargahi@gmail.com>

Examples

mat <- matrix(nrow = 4, ncol = 1, data = NA)
mat[,1] <- c(system.file('extdata','ind1.tsv',package = 'Prize'),
           system.file('extdata','ind2.tsv',package = 'Prize'),
           system.file('extdata','ind3.tsv',package = 'Prize'),
           system.file('extdata','ind4.tsv',package = 'Prize'))
rownames(mat) <- c('ind1','ind2','ind3', 'ind4')
colnames(mat) <- c('individual_judgement')

# non-weighted aggregation
res <- gaggregate(srcfile = mat, method = 'geometric', simulation = 500)
GCR(res)
### Description

A pairwise comparison matrix (PCM)

A matrix of genes to prioritize based on their tumor and normal expression, frequency of expression in tumor tissue, and number and size of epitopes.

### Author(s)

Daryanaz Dargahi

---

### Description

An object that stores the aggregated group judgements as well as consistency ratio of the individuals and group judgements.

### Objects from the Class

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

### Slots

- **AIJ**: A matrix of aggregated group judgements (a pairwise comparison matrix).
- **GCR**: The consistency ratio of the aggregated group judgement.
- **CI**: A vector of the individuals consistency index.
- **ICR**: A vector of individuals judgements consistency ratio.
- **IP**: A matrix of individual and aggregated group AHP priorities.

### Author(s)

Daryanaz Dargahi <daryanazdargahi@gmail.com>
**Individual consistency ratio (ICR) slot**

**Description**

Individual consistency ratio (ICR) is a slot of geoAggreg and ariAggreg classes. It consists of a vector of individuals judgements consistency ratio.

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>

**Examples**

```r
mat <- matrix(nrow = 4, ncol = 1, data = NA)
mat[,1] <- c(system.file("extdata","ind1.tsv",package = "Prize"),
           system.file("extdata","ind2.tsv",package = "Prize"),
           system.file("extdata","ind3.tsv",package = "Prize"),
           system.file("extdata","ind4.tsv",package = "Prize"))
rownames(mat) <- c('ind1','ind2','ind3','ind4')
colnames(mat) <- c('individual_judgement')

# Aggregation of individual judgements
res <- gaggregate(srcfile = mat, method = 'geometric', simulation = 500)
ICR(res)

# Aggregation of individual priorities
res <- gaggregate(srcfile = mat, method = 'arithmetic', simulation = 500)
ICR(res)
```

**ind1-data**

*An individual judgement matrix*

**Description**

A numeric square matrix generated based on Saaty’s fundamental scale. This matrix includes judgements of a decision maker.

**Author(s)**

Daryanaz Dargahi

**References**

An individual judgement matrix

Description
A numeric square matrix generated based on Saaty’s fundamental scale. This matrix includes judgements of a decision maker.

Author(s)
Daryanaz Dargahi

References

An individual judgement matrix

Description
A numeric square matrix generated based on Saaty’s fundamental scale. This matrix includes judgements of a decision maker.

Author(s)
Daryanaz Dargahi

References

An individual judgement matrix

Description
A numeric square matrix generated based on Saaty’s fundamental scale. This matrix includes judgements of a decision maker.

Author(s)
Daryanaz Dargahi

References
**IP**

*Individual priority (IP) slot*

**Description**

IP (Individual priority) is a slot of geoAggreg and ariAggreg classes. It consists of a matrix of individual and aggregated group AHP priorities.

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>

**Examples**

```r
mat <- matrix(nrow = 4, ncol = 1, data = NA)
mat[,1] <- c(system.file('extdata','ind1.tsv',package = 'Prize'),
            system.file('extdata','ind2.tsv',package = 'Prize'),
            system.file('extdata','ind3.tsv',package = 'Prize'),
            system.file('extdata','ind4.tsv',package = 'Prize'))
rownames(mat) <- c('ind1','ind2','ind3','ind4')
colnames(mat) <- c('individual_judgement')

# Aggregation of individual judgements
res <- gaggregate(srcfile = mat, method = 'geometric', simulation = 500)
IP(res)

# Aggregation of individual priorities
res <- gaggregate(srcfile = mat, method = 'arithmetic', simulation = 500)
IP(res)
```

**normal.PCM-data**

*A pairwise comparison matrix (PCM)*

**Description**

Normal.PCM is a criteria (with no subcriteria) in the prioritization of a set of genes of interest. This file includes a PCM of the genes with respect to their expression level in healthy (normal) tissues. The pairwise comparisons are performed according to the Saaty's fundamental scale.

**Author(s)**

Daryanaz Dargahi

**References**

Rating categories and idealised priorities

Description
The rating categories and computed idealised priorities of alternatives (genes) with respect to their expression in healthy (normal) tissues. This matrix is computed by the rating() function.

Author(s)
Daryanaz Dargahi

A pairwise comparison matrix (PCM)

Description
Number is a PCM of the categories defined for the number of epitopes subcriteria. The categories include: Single and Multiple. The pairwise comparisons are performed according to the Saaty’s fundamental scale.

Author(s)
Daryanaz Dargahi

References

A pairwise comparison matrix (PCM)

Description
A matrix assigning each alternative (gene) to a category with respect to their number of epitopes. The categories include: Single and Multiple.

Author(s)
Daryanaz Dargahi
Description

A pipeline for prioritization estimation using analytic hierarchy process (AHP), which supports both relative and rating AHP models.

Usage

pipeline(srcfile, model, simulation = 500)

Arguments

- **srcfile**: a character matrix, where the first column specifies the hierarchy order, the second column includes elements IDs, and the third column includes the path to the PCM/priority matrices (See the example below).

- **model**: the AHP computation model. Choose from relative and rating models. If using the relative model pairwise comparison matrices must be provided for the evaluation of alternatives. However, if using the rating model, rating matrices must be provided for the evaluation of alternatives.

- **simulation**: simulation size for computation of Saaty’s inconsistency

Value

An S4 object including the ahp wight and consistancy measures, and data structures to visualize with ahplot(), rainbowplot(), and wplot().

Author(s)

Daryanaz Dargahi

Examples

```R
mat <- matrix(nrow = 7, ncol = 3, data = NA)
mat[,1] <- c('0', '1', '2', '3', '4', '4.1', '4.2')
mat[,2] <- c('Prioritization_of_DE_genes', 'Tumor_expression', 'Normal_expression',
'Frequency', 'Epitopes', 'Number_of_epitopes', 'Size_of_epitopes')
mat[,3] <- c(system.file('extdata','aggreg.judgement.tsv', package = 'Prize'),
system.file('extdata','tumor.PCM.tsv',package = 'Prize'),
system.file('extdata','normal.PCM.tsv',package = 'Prize'),
system.file('extdata','freq.PCM.tsv',package = 'Prize'),
system.file('extdata','epitope.PCM.tsv',package = 'Prize'),
system.file('extdata','epitopeNum.PCM.tsv',package = 'Prize'),
system.file('extdata','epitopeLength.PCM.tsv',package = 'Prize'))
result <- pipeline(mat, model = 'relative', simulation = 500)
```
pipelineObj-class  

Class pipelineObj

Description
An object that stores the problem hierarchy as well as AHP priorities.

Objects from the Class
Objects can be created by calls of the form new("pipelineObj", ...).

Slots
ahp_plot: A matrix of problem hierarchy.
weight_plot: A list of matrices representing AHP priorities at the criteria and subcriteria level.
rainbow_plot: A list of matrices representing final AHP ranking of alternatives at the criteria and subcriteria level.
ahp_weights: A list of matrices representing AHP priorities for all decision elements.
simulation: A numeric value of the simulation size.
saaty_inconsistency: A list of Saaty inconsistency ratios.

Author(s)
Daryanaz Dargahi <daryanazdargahi@gmail.com>

Description
Plotting prioritized alternatives in a color-coded barplot, where a color is assigned to each criteria/subcriteria.

Usage
rainbowplot(srcfile, range = NULL, fontsize = 10, xcex = 4, ycex = 8, color = "rainbow", xlab = "Total priority score", ylab = "Alternative", digit = 3, dist = 0.02, main = NULL)

Arguments
srcfile: a numeric matrix with alternatives on the rows and criteria/subcriteria on the columns. alternative’s AHP weights for each criteria, and the sum of each row on the last column (see example below).
range: specifies which alternatives to plot. Either provide a range (e.g. 1:5) or a vector of numbers (e.g. c(2.5,12,20)). if range is NULL then all alternatives will be plotted. The default value is NULL.
fontsize  the font size of the plot title, x and y axis labels, and legend. The default value is 10.
xsize  the font size of the labels on the bars. The default values is 4.
ysize  the font size of the y axis. The default values is 8.
color  the color palette to fill bars. Either provide a vector of n colors, where n is the number of criteria/subcriteria, or choose from the following palettes 'rainbow, heat, terrain, topo, cm'. The default value is rainbow.
xlab,ylab  the label of the x and y axis, respectively.
digit  the number of digits after decimal point to be shown on the bars. The default value is 3.
dist  the distance between the bar and its label. The default value is 0.02.
main  the plot title

Value
An object created by 'ggplot'.

Author(s)
Daryanaz Dargahi

Examples
mat <- matrix(c(0.007,0.289,0.033,0.118,0.447, 0.015,0.155,0.015,0.088,0.275, 0.048,0.078,0.007,0.044,0.177, 0.039,0.042,0.003,0.017,0.101),
nrow = 4, ncol = 5, byrow = TRUE, dimnames = list(c('CA9','MUC16','CD70','MUC1'),
c('Tumor_expression','Normal_expression','Style','Frequency','Epitopes'),
colnames = c('Prioritization of DE genes','Tumor_expression','Normal_expression','Frequency','Epitopes','Number of epitopes','Size of epitopes'))

rainbowplot(mat, range = NULL, xlab = 'Total priority score', ylab = 'Alternative', dist = 0.04)

Description
rainbow_plot is a slot of pipelineObj class. It consists of a list of matrices representing final AHP ranking of alternatives at the criteria and subcriteria level.

Author(s)
Daryanaz Dargahi <daryanazdargahi@gmail.com>

Examples
mat <- matrix(nrow = 7, ncol = 3, data = NA)
mat[,1] <- c(0, 1, 2, 3, 4, 4.1, 4.2)
mat[,2] <- c('Prioritization of DE genes', 'Tumor_expression', 'Normal_expression', 'Frequency', 'Epitopes', 'Number of epitopes', 'Size of epitopes')
mat[,3] <- c(system.file('extdata','aggreg.judgement.tsv',package = 'Prize'),
 system.file('extdata','tumor.PCM.tsv',package = 'Prize'),
 system.file('extdata','normal.PCM.tsv',package = 'Prize'),
 system.file('extdata','freq.PCM.tsv',package = 'Prize'),
 system.file('extdata','epitope.PCM.tsv',package = 'Prize'),
 system.file('extdata','epitopeNum.PCM.tsv',package = 'Prize'),
 system.file('extdata','epitopeNum.PCM.tsv',package = 'Prize'),

system.file('extdata','epitopeLength.PCM.tsv',package = 'Prize'))

result <- pipeline(mat, model = 'relative', simulation = 500)
rainbow_plot(result)

---

### Description

Estimates idealised priorities of alternatives (the rating AHP model).

### Usage

```r
rating(scale, alternative, NA_category = NULL, simulation = 500)
```

### Arguments

- **scale**: a pairwise comparison matrix (PCM) of rating categories.
- **alternative**: a N by 2 character matrix, where N is the number of alternatives. The matrix includes alternatives on column #1 and the rating category they belong to on column #2.
- **NA_category**: a character string or vector which specifies categories with the value of zero. Since zero is not achievable by PCM matrix.
- **simulation**: simulation size for computation of Saaty’s inconsistency

### Value

An S4 object including the raw and normalized ahp priorities, Satty’s inconsistency, and rating matrix.

### Author(s)

Daryanaz Dargahi

### References


### Examples

```r
mat <- matrix(nrow = 4, ncol = 4, data = NA)

# The category PCM matrix
rownames(mat) <- c('excellent','good','fair','poor')
colnames(mat) <- c('excellent','good','fair','poor')
mat[1,] <- c(1,2,4,6)
mat[2,] <- c(NA,1,2,4)
mat[3,] <- c(NA,NA,1,2)
```
mat[4,] <- c(NA, NA, NA, 1)

# The alternative matrix
alt <- matrix(nrow = 5, ncol = 2, data = NA)
alt[1,1] <- c("Andy", "Emily", "Nina", "Alex", "Jack")
alt[1,2] <- c("good", "poor", "good", "fair", "excellent")

result <- rating(mat, alt, simulation = 500)

# Specifying a category with value of zero
alt <- rbind(alt, c("shannon", "Not_available"))

result <- rating(mat, alt, NA_category = 'Not_available', simulation = 500)

---

**ratingObj-class**

*Class ratingObj*

**Description**

An object that stores the idealised priorities of alternatives (The rating AHP model).

**Objects from the Class**

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

**Slots**

- `weight`: A matrix of rating categories and their AHP and idealised prioritise.
- `saaty_inconsistency`: The consistency ratio of the categories pairwise comparison matrix.
- `RM`: A matrix of alternatives with their scale category and idealised prioritise.

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>

---

**RM**

*Rating matrix (RM) slot*

**Description**

RM (Rating matrix) is a slot of ratingObj class. It consists of a matrix of alternatives with their scale category and idealised prioritise.

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>
Examples

```r
mat <- matrix(nrow = 4, ncol = 4, data = NA)

# Category PCM matrix
rownames(mat) <- c('excellent', 'good', 'fair', 'poor')
colnames(mat) <- c('excellent', 'good', 'fair', 'poor')
mat[1,] <- c(1, 2, 4, 6)
mat[2,] <- c(NA, 1, 2, 4)
mat[3,] <- c(NA, NA, 1, 2)
mat[4,] <- c(NA, NA, NA, 1)

# Alternative matrix
alt <- matrix(nrow = 5, ncol = 2, data = NA)
alt[,1] <- c("Andy", "Emily", "Nina", "Alex", "Jack")
alt[,2] <- c("good", "poor", "good", "fair", "excellent")

result <- rating(mat, alt, simulation = 500)
RM(result)
```

saaty_inconsistency

Saaty inconsistency slot

Description

saaty_inconsistency is a slot of ahpObj, pipelineObj, and ratingObj classes. It consists of Saaty’s consistency ratio of a pairwise comparison matrix.

Author(s)

Daryanaz Dargahi <daryanazdargahi@gmail.com>

Examples

```r
# ahp()
mat <- matrix(c(1,2,5, 1/2,1,3, 1/5,1/3,1), nrow = 3, ncol = 3, byrow = TRUE)
res <- ahp(mat, simulation = 500)
saaty_inconsistency(res)

# pipeline()
mat <- matrix(nrow = 7, ncol = 3, data = NA)
mat[,2] <- c(system.file("extdata", "agreg.judgement.tsv", package = 'Prize'),
 system.file("extdata", "tumor.PCM.tsv", package = 'Prize'),
 system.file("extdata", "normal.PCM.tsv", package = 'Prize'),
 system.file("extdata", "freq.PCM.tsv", package = 'Prize'),
 system.file("extdata", "epitope.PCM.tsv", package = 'Prize'),
 system.file("extdata", "epitopeNum.PCM.tsv", package = 'Prize'),
 system.file("extdata", "epitopeLength.PCM.tsv", package = 'Prize'))

result <- pipeline(mat, model = 'relative', simulation = 500)
saaty_inconsistency(result)
```
# rating()
mat <- matrix(nrow = 4, ncol = 4, data = NA)
## Category PCM matrix
rownames(mat) <- c('excellent', 'good', 'fair', 'poor')
colnames(mat) <- c('excellent', 'good', 'fair', 'poor')
mat[1,] <- c(1, 2, 4, 6)
mat[2,] <- c(NA, 1, 2, 4)
mat[3,] <- c(NA, NA, 1, 2)
mat[4,] <- c(NA, NA, NA, 1)
## Alternative matrix
alt <- matrix(nrow = 5, ncol = 2, data = NA)
alt[,1] <- c("Andy", "Emily", "Nina", "Alex", "Jack")
alt[,2] <- c("good", "poor", "good", "fair", "excellent")
result <- rating(mat, alt, simulation = 500)
saaty_inconsistency(result)

---

### Simulation

**Simulation slot**

**Description**

simulation is a slot of pipelineObj class. It consists of a numeric value of the simulation size (used in order to estimate Saaty’s consistency ratio).

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>

**Examples**

mat <- matrix(nrow = 7, ncol = 3, data = NA)
mat[,1] <- c('0', '1', '2', '3', '4', '4.1', '4.2')
mat[,3] <- c(system.file('extdata', 'agreg_judgement.tsv', package = 'Prize'),
            system.file('extdata', 'tumor.PCM.tsv', package = 'Prize'),
            system.file('extdata', 'normal.PCM.tsv', package = 'Prize'),
            system.file('extdata', 'freq.PCM.tsv', package = 'Prize'),
            system.file('extdata', 'epitope.PCM.tsv', package = 'Prize'),
            system.file('extdata', 'epitopeNum.PCM.tsv', package = 'Prize'),
            system.file('extdata', 'epitopeLength.PCM.tsv', package = 'Prize'))
result <- pipeline(mat, model = 'relative', simulation = 500)
simulation(result)
**tumor.PCM-data**  
A pairwise comparison matrix (PCM)

**Description**

Tumor.PCM is a criteria (with no subcriteria) in the prioritization of a set of genes of interest. This file includes a PCM of the genes with respect to their expression level in tumor tissue. The pairwise comparisons are performed according to the Saaty’s fundamental scale.

**Author(s)**

Daryanaz Dargahi

**References**


**tumor_exp_rating-data**  Rating categories and idealised priorities

**Description**

The rating categories and computed idealised priorities of alternatives (genes) with respect to their expression in tumor tissue. This matrix is computed by the rating() function.

**Author(s)**

Daryanaz Dargahi

**weight**  
Weight slot

**Description**

weight is a slot of ahpObj and ratingObj classes. It consists of computed AHP weights from a pairwise comparison matrix.

**Author(s)**

Daryanaz Dargahi <daryanazdargahi@gmail.com>
### Examples

```r
# ahp()
mat <- matrix(c(1,2,5, 1/2,1,3, 1/5,1/3,1), nrow = 3, ncol = 3, byrow = TRUE)
res <- ahp(mat, simulation = 500)
weight(res)

# rating()
mat <- matrix(nrow = 4, ncol = 4, data = NA)
## Category PCM matrix
rownames(mat) <- c('excellent','good','fair','poor')
colnames(mat) <- c('excellent','good','fair','poor')
mat[1,] <- c(1,2,4,6)
mat[2,] <- c(NA,1,2,4)
mat[3,] <- c(NA,NA,1,2)
mat[4,] <- c(NA,NA,NA,1)
## Alternative matrix
alt <- matrix(nrow = 5, ncol = 2, data = NA)
alt[,1] <- c("Andy", "Emily", "Nina", "Alex", "Jack")
alt[,2] <- c("good", "poor", "good", "fair", "excellent")
result <- rating(mat, alt, simulation = 500)
weight(result)
```

---

### Description

`weight_plot` is a slot of `pipelineObj` class. It consists of a list of matrices representing AHP priorities at the criteria and subcriteria level.

### Author(s)

Daryanaz Dargahi <daryanazdargahi@gmail.com>

### Examples

```r
mat <- matrix(nrow = 7, ncol = 3, data = NA)
mat[,1] <- c('0', '1', '2', '3', '4', '4.1', '4.2')
mat[,2] <- c('Prioritization_of_DE_genes', 'Tumor_expression', 'Normal_expression',
             'Frequency', 'Epitopes', 'Number_of_epitopes', 'Size_of_epitopes')
mat[,3] <- c(system.file('extdata', 'aggreg.judgement.tsv',package = 'Prize'),
             system.file('extdata', 'tumor.PCM.tsv',package = 'Prize'),
             system.file('extdata', 'normal.PCM.tsv',package = 'Prize'),
             system.file('extdata', 'freq.PCM.tsv',package = 'Prize'),
             system.file('extdata', 'epitope.PCM.tsv',package = 'Prize'),
             system.file('extdata', 'epitopeNum.PCM.tsv',package = 'Prize'),
             system.file('extdata', 'epitopeLength.PCM.tsv',package = 'Prize'))
result <- pipeline(mat, model = 'relative', simulation = 500)
weight_plot(result)
```
Description

Plotting the criteria/subcriteria ahp weights in a bar/pie plot.

Usage

```r
wplot(srcfile, color = "rainbow", fontsize = 15, xcex = 10, ycex = 10,
     pcex = 5, digit = 2, xlab = NULL, ylab = NULL, type = "bar",
     main = NULL)
```

Arguments

- `srcfile`: a matrix, where the first column includes criteria/subcriteria ID and the second includes the ahp weights.
- `color`: the color palette to fill bars. Either provide a vector of n colors, where n is the number of criteria, or choose from the following palettes 'rainbow, heat, terrain, topo, cm'. The default value is rainbow.
- `fontsize`: the font size of the plot title, and x and y axis labels. The default value is 15.
- `xcex,ycex`: the font size of the x and y axis, respectively. The default values is 10.
- `pcex`: the font size of the labels inside pie chart
- `digit`: the number of digits after decimal point to be shown on the x axis.
- `xlab,ylab`: the label of the x and y axis, respectively.
- `type`: wplot offers two plot types; bar and pie plots. Default value is bar.
- `main`: the plot title

Value

An object created by 'ggplot'.

Author(s)

Daryanaz Dargahi

Examples

```r
mat <- matrix(nrow = 4, ncol = 2, data = NA)
mat[,1] <- c("Tumor_expression","Normal_expression","Frequency","Epitope")
mat[,2] <- c(0.470, 0.341, 0.116, 0.073)

wplot(mat, xlab = 'Weight', ylab = 'Criteria', type = 'bar')
wplot(mat, type = 'pie')
```
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