# WhiBoClustering

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Type Package

Title White Box Clustering Algorithm Design
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Maintainer Sandro Radovanovic <sandro.radovanovic@gmail.com>, Milan Vukice-vic <vucko83@gmail.com></vucko83@gmail.com></sandro.radovanovic@gmail.com>
Description White Box Cluster Algorithm Design allows you to create Representative based cluster algorithm by using reusable components.  This way one can recreate already available cluster algorithms (i.e. K-Means, K-Means++, PAM but also create new cluster algorithms not available in the literature or any other software. Interested readers are reffered to following papers.  Delibasic, B., Kirchner, K., Ruhland, J., Jovanovic, M., Vukicevic, M. (2009) <doi: 10.1007="" dx.doi.org="" https:="" s10462-009-9133-6="">.  Vukicevic, M., Delibasic, B., Jovanovic, M., Suknovic, M., &amp; Obradovic, Z. (2011, November) <doi: 10.1109="" bibm.2011.97="" dx.doi.org="" https:="">.  Delibasic, B., Vukicevic, M., Jovanovic, M., Kirchner, K., Ruhland, J., &amp; Suknovic, M. (2012) <doi: 10.1016="" dx.doi.org="" https:="" j.datak.2012.03.005="">.  Vukicevic, M., Kirchner, K., Delibasic, B., Jovanovic, M., Ruhland, J., &amp; Suknovic, M. (2013) <doi: 10.1007="" dx.doi.org="" https:="" s10115-012-0542-5="">.  Vukicevic, M., Radovanovic, S., Delibasic, B., &amp; Suknovic, M. (2016) <doi: 10.1504="" dx.doi.org="" https:="" ijdmb.2016.074682="">.</doi:></doi:></doi:></doi:></doi:>
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Depends graphics, stats, clusterCrit, cluster
Suggests methods, testthat
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LazyData true
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R topics documented:
plot.whibo_cluster

wc_assignment	7
wc_assign_bhattacharyya_numerical	7
wc_assign_canberra	8
wc_assign_chebyshev	8
wc_assign_correlation	9
wc_assign_cosine	9
wc_assign_euclidean	10
wc_assign_fidelity_numerical	10
wc_assign_gower	11
wc_assign_hellinger_numerical	11
wc_assign_inner_product	12
wc_assign_intersection	13
wc_assign_kulczynski	13
wc_assign_lorentzian	14
wc_assign_manhattan	14
wc_assign_sorensen	15
wc_assign_squared_euclidean	15
wc_assign_tanimoto	16
wc_assign_types	16
wc_assign_whittaker	17
wc_eval_ball_hall	17
wc_eval_banfeld_raftery	18
wc_eval_between_sum_of_squares	18
wc_eval_calinski_harabasz	19
wc_eval_c_index	19
wc_eval_davies_bouldin	20
wc_eval_det_ratio	
wc_eval_dunn	
wc_eval_gamma	
wc_eval_g_plus	
wc_eval_silhouette	
wc_eval_total_sum_of_squares	
wc_eval_within_sum_of_squares	
wc_eval_xie_beni	
wc_initialize	
wc_init_agnes	25
we init ccia	25
we init diana	26
wc_init_forgy	26
wc_init_kkz	27
wc_init_kmeansplusplus	27
wc_init_pca	28
wc_init_quantile	28
wc_init_random	29
wc_init_types	29
we init ward	30
wc_nnt_watu	30
wc_norm_comprehensive	31
wc_norm_decimal_scaling	31
wc_norm_11	32
wc_norm_12	
wc_norm_linf	
<del>"</del>	55

plot.whibo\_cluster 3

	wc_norm_log	33
	wc_norm_max_min	34
	wc_norm_mean	
	wc_norm_no	35
	wc_norm_non_monotonic	35
	wc_norm_sigmoid	36
	wc_norm_softmax	36
	wc_norm_types	37
	wc_norm_z	37
	wc_recalculate	38
	wc_recalculate_types	38
		39
	wc_recalc_harmonic_mean	39
	wc_recalc_mean	40
	wc_recalc_median	40
	wc_recalc_midhinge	41
	wc_recalc_midrange	41
	wc_recalc_online_geometric_mean	42
	wc_recalc_online_harmonic_mean	42
	wc_recalc_online_mean	43
	wc_recalc_online_median	43
	wc_recalc_online_midhinge	44
	wc_recalc_online_midrange	45
	wc_recalc_online_quadratic_mean	45
	wc_recalc_online_trimean	46
	wc_recalc_online_trimmed_mean	47
	wc_recalc_quadratic_mean	47
	wc_recalc_trimean	48
	wc_recalc_trimmed_mean	48
	whibo_cluster-class	49
	whibo_clustering	49
Index		51

plot.whibo\_cluster

Plot WhiBo Cluster Representatives

# Description

Plot WhiBo Cluster Representatives

# Usage

```
## S3 method for class 'whibo_cluster' plot(x, ...)
```

# Arguments

WhiBo Cluster model.

... None of those will be used.

plot\_pairs

#### Value

Line plot with Cluster representatives

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

# **Examples**

```
data <- iris[, 1:4] #Numerical data only
model <- whibo_clustering(data = data, k = 3)
plot(model)</pre>
```

plot\_pairs

Plot WhiBo Cluster Representatives

## Description

Plot WhiBo Cluster Representatives

## Usage

```
plot_pairs(model, data)
```

## **Arguments**

model WhiBo Cluster model.

data Data used for clustering (optional).

# Value

Ploting pairs plot where Cluster representatives are presented with data (if provided).

# Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

## **Examples**

```
data <- iris[, 1:4] #Numerical data only
model <- whibo_clustering(data = data, k = 3)
plot_pairs(model) #Ploting Cluster Representatives only
plot_pairs(model, data) #Ploting Cluster Representatives and Data</pre>
```

predict.whibo\_cluster 5

predict.whibo\_cluster Predict to which Cluster new data belongs

## **Description**

Predict to which Cluster new data belongs

## Usage

```
## S3 method for class 'whibo_cluster'
predict(object, data, ...)
```

## **Arguments**

object WhiBo Cluster model.

data Data for which Cluster should be obtained.

... None of those will be used.

#### Value

Vector of assignments.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

## **Examples**

```
data <- iris[1:100, 1:4] #Numerical data only and first 100 rows model <- whibo_clustering(data = data, k = 3) predict(object = model, data = iris[101:150, 1:4])
```

print.whibo\_cluster

Show White-Box Cluster Algorithm model

## **Description**

Show White-Box Cluster Algorithm model

## Usage

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

## **Arguments**

x WhiBo Cluster model.

... None of those will be used.

#### Value

Summary text about Cluster model.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

#### See Also

```
summary.whibo_cluster
```

# **Examples**

```
data <- iris[, 1:4] #Numerical data only
model <- whibo_clustering(data = data, k = 3)
print(model)</pre>
```

summary.whibo\_cluster Show White-Box Cluster Algorithm model

## **Description**

Show White-Box Cluster Algorithm model

# Usage

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

## **Arguments**

object WhiBo Cluster model.
... None of those will be used.

#### Value

Summary text about Cluster model.

## Author(s)

 $Sandro\ Radovanovic < \verb|sandro.radovanovic@gmail.com|| > \\$ 

## See Also

```
print.whibo_cluster
```

wc\_assignment 7

## **Examples**

```
data <- iris[, 1:4] #Numerical data only
model <- whibo_clustering(data = data, k = 3)
summary(model)</pre>
```

wc\_assignment

General Component for Assignment of data points to Cluster Representatives.

## **Description**

General Component for Assignment of data points to Cluster Representatives.

# Usage

```
wc_assignment(data, centroids, assignment_type)
```

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

assignment\_type

String which signal which assignment type to be used. Check wc\_assign\_types for possible values.

#### Value

A vector of assignments.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_assign_bhattacharyya_numerical
```

Assign data points using Bhattacharyya distance.

# Description

Assign data points using Bhattacharyya distance.

```
wc_assign_bhattacharyya_numerical(data, centroids)
```

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

## Value

A vector of assignments.

# Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_canberra

Assign data points using Canberra distance.

## **Description**

Assign data points using Canberra distance.

# Usage

```
wc_assign_canberra(data, centroids)
```

# **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

# Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_chebyshev

Assign data points using Chebyshev distance.

## **Description**

Assign data points using Chebyshev distance.

```
wc_assign_chebyshev(data, centroids)
```

wc\_assign\_correlation 9

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

## Value

A vector of assignments.

# Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_correlation Assign data points using Correlation distance.

## **Description**

Assign data points using Correlation distance.

# Usage

```
wc_assign_correlation(data, centroids)
```

# **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

# Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_cosine

Assign data points using Cosine distance.

# Description

Assign data points using Cosine distance.

```
wc_assign_cosine(data, centroids)
```

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

## Value

A vector of assignments.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_euclidean

Assign data points using Euclidean distance.

# **Description**

Assign data points using Euclidean distance.

# Usage

```
wc_assign_euclidean(data, centroids)
```

# **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

## Value

A vector of assignments.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

 $wc_assign_fidelity_numerical$ 

Assign data points using Fidelity (numerical version) distance.

# Description

Assign data points using Fidelity (numerical version) distance.

```
wc_assign_fidelity_numerical(data, centroids)
```

wc\_assign\_gower 11

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

## Value

A vector of assignments.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_gower

Assign data points using Gower distance.

# **Description**

Assign data points using Gower distance.

# Usage

```
wc_assign_gower(data, centroids)
```

# **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

## Value

A vector of assignments.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_assign_hellinger_numerical
```

Assign data points using Hellinger (numerical version) distance.

# Description

Assign data points using Hellinger (numerical version) distance.

```
wc_assign_hellinger_numerical(data, centroids)
```

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

# Value

A vector of assignments.

# Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_inner\_product

Assign data points using Inner product distance.

# **Description**

Assign data points using Inner product distance.

# Usage

wc\_assign\_inner\_product(data, centroids)

# Arguments

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

## Author(s)

wc\_assign\_intersection 13

wc\_assign\_intersection

Assign data points using intersection distance.

# Description

Assign data points using intersection distance.

# Usage

```
wc_assign_intersection(data, centroids)
```

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_kulczynski Assign data points using Kulczynski distance.

## **Description**

Assign data points using Kulczynski distance.

## Usage

```
wc_assign_kulczynski(data, centroids)
```

# Arguments

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

#### Author(s)

14 wc\_assign\_manhattan

# Description

Assign data points using Lorentzian distance.

## Usage

```
wc_assign_lorentzian(data, centroids)
```

# Arguments

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

## **Description**

Assign data points using Manhattan distance.

# Usage

```
wc_assign_manhattan(data, centroids)
```

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

## Author(s)

wc\_assign\_sorensen 15

wc\_assign\_sorensen

Assign data points using Sorensen distance.

#### **Description**

Assign data points using Sorensen distance.

# Usage

```
wc_assign_sorensen(data, centroids)
```

# Arguments

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_squared\_euclidean

Assign data points using squared Euclidean distance.

## **Description**

Assign data points using squared Euclidean distance.

## Usage

```
wc_assign_squared_euclidean(data, centroids)
```

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

#### Author(s)

16 wc\_assign\_types

wc\_assign\_tanimoto

Assign data points using Tanimoto distance.

# Description

Assign data points using Tanimoto distance.

# Usage

```
wc_assign_tanimoto(data, centroids)
```

## **Arguments**

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

#### Value

A vector of assignments.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_assign\_types

Data frame for possible values of assignment types.

# Description

Data frame for possible values of assignment types.

# Usage

```
wc_assign_types
```

## **Format**

An object of class data. frame with  $18\ rows$  and  $2\ columns$ .

# Author(s)

wc\_assign\_whittaker 17

wc\_assign\_whittaker

Assign data points using Whittaker distance.

# Description

Assign data points using Whittaker distance.

## Usage

```
wc_assign_whittaker(data, centroids)
```

# Arguments

data A dataset for which data points needs to be assigned to Cluster Representatives.

centroids Cluster representatives.

## Value

A vector of assignments.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_eval\_ball\_hall

Calculate Ball-Hall internal Cluster evaluation measure

# **Description**

Calculate Ball-Hall internal Cluster evaluation measure

#### Usage

```
wc_eval_ball_hall(data, assignment)
```

## **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

#### Author(s)

wc\_eval\_banfeld\_raftery

Calculate Banfeld-Raftery internal Cluster evaluation measure

## **Description**

Calculate Banfeld-Raftery internal Cluster evaluation measure

#### Usage

```
wc_eval_banfeld_raftery(data, assignment)
```

## **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

# Description

Calculate between (Clusters) sum of squares

#### Usage

```
wc_eval_between_sum_of_squares(data, centroids, assignment)
```

## **Arguments**

data A dataset for which between sum of squared should be calculated.

centroids A data frame of cluster representatives.

assignment Vector of assignments.

#### Value

A vector of number which shows between (clusters) sum of squares.

## Author(s)

wc\_eval\_calinski\_harabasz

Calculate Calinski-Harabasz internal Cluster evaluation measure

# Description

Calculate Calinski-Harabasz internal Cluster evaluation measure

# Usage

```
wc_eval_calinski_harabasz(data, assignment)
```

# **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

## Value

A value of internal cluster quality evaluation measure.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_eval\_c\_index

Calculate C index internal Cluster evaluation measure

# Description

Calculate C index internal Cluster evaluation measure

# Usage

```
wc_eval_c_index(data, assignment)
```

#### **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

#### Author(s)

20 wc\_eval\_det\_ratio

```
wc_eval_davies_bouldin
```

Calculate Davies-Bouldin internal Cluster evaluation measure

# Description

Calculate Davies-Bouldin internal Cluster evaluation measure

## Usage

```
wc_eval_davies_bouldin(data, assignment)
```

## **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_eval\_det\_ratio

Calculate Det ratio internal Cluster evaluation measure

# Description

Calculate Det ratio internal Cluster evaluation measure

## Usage

```
wc_eval_det_ratio(data, assignment)
```

# Arguments

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

#### Author(s)

wc\_eval\_dunn 21

wc\_eval\_dunn

Calculate Dunn index internal Cluster evaluation measure

## **Description**

Calculate Dunn index internal Cluster evaluation measure

## Usage

```
wc_eval_dunn(data, assignment)
```

## **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_eval\_gamma

Calculate Gamma index internal Cluster evaluation measure

## **Description**

Calculate Gamma index internal Cluster evaluation measure

#### Usage

```
wc_eval_gamma(data, assignment)
```

## **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

#### Author(s)

22 wc\_eval\_silhouette

wc\_eval\_g\_plus

Calculate G+ index internal Cluster evaluation measure

## **Description**

Calculate G+ index internal Cluster evaluation measure

## Usage

```
wc_eval_g_plus(data, assignment)
```

# Arguments

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_eval\_silhouette

Calculate Silhouette score internal Cluster evaluation measure

## **Description**

Calculate Silhouette score internal Cluster evaluation measure

#### Usage

```
wc_eval_silhouette(data, assignment)
```

## **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

#### Author(s)

wc\_eval\_total\_sum\_of\_squares

Calculate total sum of squares

## **Description**

Calculate total sum of squares

## Usage

```
wc_eval_total_sum_of_squares(data)
```

## **Arguments**

data

A dataset for which total sum of squared should be calculated.

#### Value

A number which shows total sum of squares.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_eval\_within\_sum\_of\_squares

Calculate within (Cluster) sum of squares

# Description

Calculate within (Cluster) sum of squares

## Usage

```
wc_eval_within_sum_of_squares(data, centroids, assignment)
```

# **Arguments**

data A dataset for which within sum of squared should be calculated.

centroids A data frame of cluster representatives.

assignment Vector of assignments.

## Value

A vector of number which shows within (cluster) sum of squares.

# Author(s)

24 wc\_initialize

wc\_eval\_xie\_beni

Calculate Xie-Beni internal Cluster evaluation measure

# Description

Calculate Xie-Beni internal Cluster evaluation measure

## Usage

```
wc_eval_xie_beni(data, assignment)
```

## **Arguments**

data A dataset for which internal cluster quality should be calculated.

assignment Vector of assignments.

#### Value

A value of internal cluster quality evaluation measure.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_initialize

General Component for Initialization of Cluster Representatives.

## **Description**

General Component for Initialization of Cluster Representatives.

## Usage

```
wc_initialize(data, k = 3, initialization_type)
```

# Arguments

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives.

initialization\_type

String which signal which initialization type to be used. Check wc\_init\_types

for possible values.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

wc\_init\_agnes 25

wc\_init\_agnes

AGNES Cluster Representatives initialization.

# Description

AGNES Cluster Representatives initialization.

#### Usage

```
wc_init_agnes(data, k)
```

# Arguments

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_init\_ccia

CCIA Cluster Representatives initialization.

#### **Description**

CCIA Cluster Representatives initialization.

## Usage

```
wc_init_ccia(data, k)
```

# Arguments

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

26 wc\_init\_forgy

wc\_init\_diana

DIANA Cluster Representatives initialization.

# **Description**

DIANA Cluster Representatives initialization.

#### Usage

```
wc_init_diana(data, k)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_init\_forgy

Forgy algorithm Cluster Representatives initialization.

#### **Description**

Forgy algorithm Cluster Representatives initialization.

# Usage

```
wc_init_forgy(data, k = 3)
```

# Arguments

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

wc\_init\_kkz 27

wc\_init\_kkz

KKZ Cluster Representatives initialization.

#### **Description**

KKZ Cluster Representatives initialization.

#### Usage

```
wc_init_kkz(data, k)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_init_kmeansplusplus
```

*K-Means++ Cluster Representatives initialization.* 

## **Description**

K-Means++ Cluster Representatives initialization.

## Usage

```
wc_init_kmeansplusplus(data, k = 3)
```

# Arguments

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

# Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

28 wc\_init\_quantile

wc\_init\_pca

PCA Cluster Representatives initialization.

# Description

PCA Cluster Representatives initialization.

#### Usage

```
wc_init_pca(data, k)
```

# Arguments

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_init\_quantile

Quantile Cluster Representatives initialization.

#### **Description**

Quantile Cluster Representatives initialization.

## Usage

```
wc_init_quantile(data, k)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

wc\_init\_random 29

wc\_init\_random

Random Cluster Representatives initialization.

# Description

Random Cluster Representatives initialization.

# Usage

```
wc_init_random(data, k = 3)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

#### Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_init\_types

Data frame for possible values of initialization types.

# Description

Data frame for possible values of initialization types.

# Usage

```
wc_init_types
```

## **Format**

An object of class data. frame with  $10 \ \text{rows}$  and  $2 \ \text{columns}$ .

# Author(s)

30 wc\_normalize

wc\_init\_ward

Ward algorithm Cluster Representatives initialization.

## **Description**

Ward algorithm Cluster Representatives initialization.

#### Usage

```
wc_init_ward(data, k)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be initialized.

k A number of Cluster Representatives to be initialized.

## Value

As a result initial Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_normalize

General (Optional) Component for Normalization of data.

## **Description**

General (Optional) Component for Normalization of data.

## Usage

```
wc_normalize(data, normalization_type)
```

## **Arguments**

data A dataset which needs to be normalized.

 $normalization\_type$ 

String which signal which normalization type to be used. Check wc\_norm\_types for possible values.

## Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

wc\_norm\_comprehensive Comprehensive normalization of data.

## **Description**

Comprehensive normalization of data.

## Usage

```
wc_norm_comprehensive(data, model = NULL)
```

#### **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

#### Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_norm_decimal_scaling
```

Decimal scaling of data.

#### **Description**

Decimal scaling of data.

## Usage

```
wc_norm_decimal_scaling(data, model = NULL)
```

# **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

#### Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

32 wc\_norm\_12

wc\_norm\_11

 $l\_1$  normalization of data.

## **Description**

 $l_1$  normalization of data.

#### Usage

```
wc_norm_l1(data, model = NULL)
```

## **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

#### Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_norm\_12

 $l\_2$  normalization of data.

## **Description**

 $l_2$  normalization of data.

#### Usage

```
wc_norm_12(data, model = NULL)
```

# **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

# Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

# Author(s)

wc\_norm\_linf 33

wc\_norm\_linf

 $l\_\infty$  normalization of data.

## **Description**

 $l_{\infty}$  normalization of data.

#### Usage

```
wc_norm_linf(data, model = NULL)
```

## **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

#### Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_norm\_log

Logarithmic normalization of data.

## **Description**

Logarithmic normalization of data.

## Usage

```
wc_norm_log(data, model = NULL)
```

# **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

## Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

# Author(s)

34 wc\_norm\_mean

wc\_norm\_max\_min

Max-Min normalization of data.

## **Description**

Max-Min normalization of data.

#### Usage

```
wc_norm_max_min(data, model = NULL)
```

## **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

#### Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_norm\_mean

Mean (Max-Min like) normalization of data.

## **Description**

Mean (Max-Min like) normalization of data.

## Usage

```
wc_norm_mean(data, model = NULL)
```

# **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

## Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

# Author(s)

wc\_norm\_no 35

wc\_norm\_no

Ignore normalization of data.

## **Description**

Ignore normalization of data.

# Usage

```
wc_norm_no(data, model = NULL)
```

## **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

#### Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_norm\_non\_monotonic Non-monotonic normalization of data.

## **Description**

Non-monotonic normalization of data.

## Usage

```
wc_norm_non_monotonic(data, model = NULL)
```

# **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

## Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

# Author(s)

36 wc\_norm\_softmax

wc\_norm\_sigmoid

Sigmoid normalization of data.

## **Description**

Sigmoid normalization of data.

# Usage

```
wc_norm_sigmoid(data, model = NULL)
```

## **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

#### Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_norm\_softmax

Softmax normalization of data.

## **Description**

Softmax normalization of data.

## Usage

```
wc_norm_softmax(data, model = NULL)
```

# **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

## Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

# Author(s)

wc\_norm\_types 37

wc\_norm\_types

Data frame for possible values of normalization types.

## Description

Data frame for possible values of normalization types.

## Usage

```
wc_norm_types
```

## **Format**

An object of class data. frame with 13 rows and 2 columns.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_norm\_z

Z transformation of data.

# Description

Z transformation of data.

# Usage

```
wc_norm_z(data, model = NULL)
```

## **Arguments**

data A dataset which needs to be normalized.

model Additional data needed for future data to be normalized using same normaliza-

tion technique.

#### Value

As a result normalized data are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

 $Sandro\ Radovanovic < \verb|sandro.radovanovic@gmail.com|| > \\$ 

38 wc\_recalculate\_types

wc\_recalculate

General Component for Cluster Representative update.

#### **Description**

General Component for Cluster Representative update.

#### Usage

```
wc_recalculate(data, assignment, recalculate_type, assignment_type = NULL,
   old_centroids = NULL)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

recalculate\_type

String which signal which update type to be used. Check wc\_recalculate\_types

for possible values.

assignment\_type

Assignment type (Optional).

old\_centroids Old centroids (Optional).

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

 $wc\_recalculate\_types \quad \textit{Data frame for possible values of recalculate types}.$ 

## **Description**

Data frame for possible values of recalculate types.

# Usage

```
wc_recalculate_types
```

#### **Format**

An object of class data. frame with 18 rows and 2 columns.

## Author(s)

wc\_recalc\_geometric\_mean

Solution for Cluster Representative update which uses Geometric mean.

#### **Description**

Solution for Cluster Representative update which uses Geometric mean.

#### Usage

```
wc_recalc_geometric_mean(data, assignment, old_centroids = NULL)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_recalc_harmonic_mean
```

Solution for Cluster Representative update which uses Harmonic mean.

## Description

Solution for Cluster Representative update which uses Harmonic mean.

## Usage

```
wc_recalc_harmonic_mean(data, assignment, old_centroids = NULL)
```

# **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

old\_centroids Old centroids.

# Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

40 wc\_recalc\_median

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_recalc\_mean

Solution for Cluster Representative update which uses Mean.

## **Description**

Solution for Cluster Representative update which uses Mean.

#### Usage

```
wc_recalc_mean(data, assignment, old_centroids = NULL)
```

#### **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_recalc\_median

Solution for Cluster Representative update which uses Median.

## **Description**

Solution for Cluster Representative update which uses Median.

#### Usage

```
wc_recalc_median(data, assignment, old_centroids = NULL)
```

#### **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

wc\_recalc\_midhinge 41

wc\_recalc\_midhinge

Solution for Cluster Representative update which uses Midhinge.

#### **Description**

Solution for Cluster Representative update which uses Midhinge.

#### Usage

```
wc_recalc_midhinge(data, assignment, old_centroids = NULL)
```

#### **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_recalc\_midrange

Solution for Cluster Representative update which uses Midrange.

# Description

Solution for Cluster Representative update which uses Midrange.

## Usage

```
wc_recalc_midrange(data, assignment, old_centroids = NULL)
```

#### **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

```
wc_recalc_online_geometric_mean
```

Solution for Cluster Representative update which uses Online Geometric mean.

## Description

Solution for Cluster Representative update which uses Online Geometric mean.

## Usage

```
wc_recalc_online_geometric_mean(data, assignment, assignment_type,
  old_centroids = NULL)
```

#### **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

assignment\_type

Assignment type to be used.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_recalc_online_harmonic_mean
```

Solution for Cluster Representative update which uses Online Harmonic mean.

## **Description**

Solution for Cluster Representative update which uses Online Harmonic mean.

## Usage

```
wc_recalc_online_harmonic_mean(data, assignment, assignment_type,
  old_centroids = NULL)
```

# Arguments

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

 ${\tt assignment\_type}$ 

Assignment type to be used.

wc\_recalc\_online\_mean

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

43

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_recalc\_online\_mean Solution for Cluster Representative update which uses Online mean.

#### **Description**

Solution for Cluster Representative update which uses Online mean.

## Usage

```
wc_recalc_online_mean(data, assignment, assignment_type, old_centroids = NULL)
```

#### **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

assignment\_type

Assignment type to be used.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_recalc_online_median
```

 $Solution\ for\ Cluster\ Representative\ update\ which\ uses\ Online\ median.$ 

#### **Description**

Solution for Cluster Representative update which uses Online median.

## Usage

```
wc_recalc_online_median(data, assignment, assignment_type,
  old_centroids = NULL)
```

#### **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

assignment\_type

Assignment type to be used.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_recalc\_online\_midhinge

Solution for Cluster Representative update which uses Online Midhindge.

## **Description**

Solution for Cluster Representative update which uses Online Midhindge.

## Usage

```
wc_recalc_online_midhinge(data, assignment, assignment_type,
  old_centroids = NULL)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

assignment\_type

Assignment type to be used.

old\_centroids Old centroids.

## Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

```
wc_recalc_online_midrange
```

Solution for Cluster Representative update which uses Online Midrange.

## **Description**

Solution for Cluster Representative update which uses Online Midrange.

## Usage

```
wc_recalc_online_midrange(data, assignment, assignment_type,
  old_centroids = NULL)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

assignment\_type

Assignment type to be used.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_recalc_online_quadratic_mean
```

Solution for Cluster Representative update which uses Online Quadratic mean.

## **Description**

Solution for Cluster Representative update which uses Online Quadratic mean.

## Usage

```
wc_recalc_online_quadratic_mean(data, assignment, assignment_type,
  old_centroids = NULL)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

assignment\_type

Assignment type to be used.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_recalc_online_trimean
```

Solution for Cluster Representative update which uses Online Trimean.

## **Description**

Solution for Cluster Representative update which uses Online Trimean.

## Usage

```
wc_recalc_online_trimean(data, assignment, assignment_type,
  old_centroids = NULL)
```

# Arguments

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

assignment\_type

Assignment type to be used.

old\_centroids Old centroids.

# Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

```
wc_recalc_online_trimmed_mean
```

Solution for Cluster Representative update which uses Online Trimmed mean.

#### **Description**

Solution for Cluster Representative update which uses Online Trimmed mean.

#### Usage

```
wc_recalc_online_trimmed_mean(data, assignment, assignment_type,
  old_centroids = NULL)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

assignment\_type

Assignment type to be used.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

## Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_recalc_quadratic_mean
```

Solution for Cluster Representative update which uses Quadratic mean.

## Description

Solution for Cluster Representative update which uses Quadratic mean.

## Usage

```
wc_recalc_quadratic_mean(data, assignment, old_centroids = NULL)
```

# Arguments

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

wc\_recalc\_trimean

Solution for Cluster Representative update which uses Trimean.

# Description

Solution for Cluster Representative update which uses Trimean.

# Usage

```
wc_recalc_trimean(data, assignment, old_centroids = NULL)
```

## **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

old\_centroids Old centroids.

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

```
wc_recalc_trimmed_mean
```

Solution for Cluster Representative update which uses Trimmed mean.

## **Description**

Solution for Cluster Representative update which uses Trimmed mean.

## Usage

```
wc_recalc_trimmed_mean(data, assignment, old_centroids = NULL)
```

# **Arguments**

data A dataset for which Cluster Representatives needs to be updated.

assignment Vector of Cluster assignments.

whibo\_cluster-class 49

#### Value

As a result new Cluster Representatives are obtained. Result is in for of data.frame or data.matrix.

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

whibo\_cluster-class

As S4 class to represent WhiBo Cluster model

#### **Description**

As S4 class to represent WhiBo Cluster model

#### **Slots**

whibo\_cluster Whibo Clustering object - list of objects for White-Box Clustering

#### Author(s)

Sandro Radovanovic

whibo\_clustering

Find Cluster model using White-Box Cluster Algorithm Design.

#### **Description**

Find Cluster model using White-Box Cluster Algorithm Design.

#### Usage

```
whibo_clustering(data, k = 3, normalization_type = "No",
  cluster_initialization_type = "Random", assignment_type = "Euclidean",
  recalculation_type = "Mean", max_iteration = 20, no_of_restarts = 1)
```

#### **Arguments**

data Data on which clustering should be performed.

k Number of Cluster Representatives.

normalization\_type

Which normalization should be used (look at wc\_norm\_types for possible values). Default value is No.

cluster\_initialization\_type

Which initialization of Cluster Representatives should be used (look at wc\_init\_types for possible values). Default value is Random.

assignment\_type

Which assignment function should be used (look at wc\_assign\_types for possible values). Default value is Euclidean.

50 whibo\_clustering

```
recalculation_type

Which function for updating Cluster Representatives should be used (look at wc_recalculate_types for possible values). Default value is Mean.

max_iteration Number of iterations. Default value is 20.

no_of_restarts Number of restarts of whole clustering procedure. Default value is 1.
```

#### Value

Object of type whibo\_cluster which include Cluster Representatives (centroids), number of elements per cluster (elements\_per\_cluster), assignments (assignments), measures of cluster quality (within\_sum\_of\_squares, between\_ss\_div\_total\_ss and internal\_measures\_of\_quality), cluster models per iterations (model\_history), iterations (iterations) and parameters used (params)

#### Author(s)

Sandro Radovanovic <sandro.radovanovic@gmail.com>

#### See Also

```
plot.whibo_cluster, predict.whibo_cluster
```

# **Examples**

# Index

*Topic datasets	<pre>wc_eval_total_sum_of_squares, 23</pre>
wc_assign_types, 16	wc_eval_within_sum_of_squares, 23
wc_assign_types, 10 wc_init_types, 29	wc_eval_xie_beni, 24
wc_norm_types, 37	wc_init_agnes, 25
wc_norm_types, 37 wc_recalculate_types, 38	_
wc_recarculate_types, 50	<pre>wc_init_ccia, 25 wc_init_diana, 26</pre>
plot.whibo_cluster, 3	
plot_pairs, 4	wc_init_forgy, 26
predict.whibo_cluster, 5	wc_init_kkz,27
print.whibo_cluster, 5	wc_init_kmeansplusplus, 27
print: miso_cluster, s	wc_init_pca, 28
<pre>summary.whibo_cluster, 6</pre>	wc_init_quantile, 28
	wc_init_random, 29
<pre>wc_assign_bhattacharyya_numerical, 7</pre>	wc_init_types, 29
wc_assign_canberra, 8	wc_init_ward, 30
wc_assign_chebyshev, 8	wc_initialize, 24
wc_assign_correlation, 9	wc_norm_comprehensive, 31
wc_assign_cosine, 9	wc_norm_decimal_scaling, 31
wc_assign_euclidean, 10	wc_norm_11, 32
wc_assign_fidelity_numerical, 10	wc_norm_12, 32
wc_assign_gower, 11	wc_norm_linf, 33
<pre>wc_assign_hellinger_numerical, 11</pre>	wc_norm_log, 33
<pre>wc_assign_inner_product, 12</pre>	wc_norm_max_min, 34
wc_assign_intersection, 13	wc_norm_mean, 34
wc_assign_kulczynski, 13	wc_norm_no, 35
wc_assign_lorentzian, 14	wc_norm_non_monotonic, 35
wc_assign_manhattan, 14	wc_norm_sigmoid, 36
wc_assign_sorensen, 15	wc_norm_softmax, 36
<pre>wc_assign_squared_euclidean, 15</pre>	wc_norm_types, 37
wc_assign_tanimoto, 16	wc_norm_z, 37
<pre>wc_assign_types, 16</pre>	wc_normalize, 30
wc_assign_whittaker, 17	wc_recalc_geometric_mean,39
<pre>wc_assignment, 7</pre>	wc_recalc_harmonic_mean,39
wc_eval_ball_hall, 17	wc_recalc_mean, 40
<pre>wc_eval_banfeld_raftery, 18</pre>	$wc_recalc_median, 40$
<pre>wc_eval_between_sum_of_squares, 18</pre>	wc_recalc_midhinge,41
<pre>wc_eval_c_index, 19</pre>	wc_recalc_midrange,41
wc_eval_calinski_harabasz,19	wc_recalc_online_geometric_mean, 42
<pre>wc_eval_davies_bouldin, 20</pre>	<pre>wc_recalc_online_harmonic_mean, 42</pre>
wc_eval_det_ratio,20	wc_recalc_online_mean,43
wc_eval_dunn, 21	wc_recalc_online_median, 43
<pre>wc_eval_g_plus, 22</pre>	wc_recalc_online_midhinge,44
wc_eval_gamma, 21	wc_recalc_online_midrange, 45
wc_eval_silhouette, 22	wc_recalc_online_quadratic_mean, 45

52 INDEX

```
wc_recalc_online_trimean, 46
wc_recalc_online_trimmed_mean, 47
wc_recalc_quadratic_mean, 47
wc_recalc_trimean, 48
wc_recalc_trimmed_mean, 48
wc_recalculate, 38
wc_recalculate_types, 38
whibo_cluster-class, 49
whibo_clustering, 49
```