

# WhiBoClustering

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**Type** Package

**Title** White Box Clustering Algorithm Design

**Version** 0.1.2

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**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.

For more information see Delibasic et al. (2009) <doi:10.1007/s10462-009-9133-

6>, Vukicevic et al. (2011) <doi:10.1109/BIBM.2011.97>,

Delibasic et al. (2012) <doi:10.1016/j.datak.2012.03.005>, Vukice-

vic et al. (2013) <doi:10.1007/s10115-012-0542-5> and

Vukicevic et al. (2016) <doi:10.1504/IJDMB.2016.074682>.

**License** GPL-3

**Depends** graphics, stats, clusterCrit, cluster

**Suggests** methods, testthat

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.0.1

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---

plot.whibo_cluster	<i>Plot WhiBo Cluster Representatives</i>
--------------------	---

---

## Description

Plot WhiBo Cluster Representatives

## Usage

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

## Arguments

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

## 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)
```

---

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**

Plotting 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) #Plotting Cluster Representatives only

plot_pairs(model, data) #Plotting Cluster Representatives and Data
```

---

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)
```

---

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 <sandro.radovanovic@gmail.com>

**See Also**

print.whibo\_cluster

**Examples**

```
data <- iris[, 1:4] #Numerical data only

model <- whibo_clustering(data = data, k = 3)
summary(model)
```

---

wc_assignment	<i>General Component for Assignment of data points to Cluster Representatives.</i>
---------------	--

---

**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 <code>wc_assign_types</code> for possible values.

**Value**

A vector of assignments.

**Author(s)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_assign_bhattacharyya_numerical	<i>Assign data points using Bhattacharyya distance.</i>
-----------------------------------	---

---

**Description**

Assign data points using Bhattacharyya distance.

**Usage**

```
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	<i>Assign data points using Canberra distance.</i>
--------------------	--

---

**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	<i>Assign data points using Chebyshev distance.</i>
---------------------	---

---

**Description**

Assign data points using Chebyshev distance.

**Usage**

```
wc_assign_chebyshev(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\_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.

**Usage**

```
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	<i>Assign data points using Euclidean distance.</i>
---------------------	---

---

**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	<i>Assign data points using Fidelity (numerical version) distance.</i>
------------------------------	--

---

**Description**

Assign data points using Fidelity (numerical version) distance.

**Usage**

```
wc_assign_fidelity_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_gower	<i>Assign data points using Gower distance.</i>
-----------------	---

---

**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	<i>Assign data points using Hellinger (numerical version) distance.</i>
-------------------------------	---

---

**Description**

Assign data points using Hellinger (numerical version) distance.

**Usage**

```
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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

`wc_assign_intersection`*Assign data points using intersection distance.*

---

**Description**

Assign data points using intersection distance.

**Usage**

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

**Arguments**

<code>data</code>	A dataset for which data points needs to be assigned to Cluster Representatives.
<code>centroids</code>	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**

<code>data</code>	A dataset for which data points needs to be assigned to Cluster Representatives.
<code>centroids</code>	Cluster representatives.

**Value**

A vector of assignments.

**Author(s)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc\_assign\_lorentzian    *Assign data points using Lorentzian distance.*

---

**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>

---

wc\_assign\_manhattan    *Assign data points using Manhattan distance.*

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_assign_sorensen	<i>Assign data points using Sorensen distance.</i>
--------------------	--

---

**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	<i>Assign data points using squared Euclidean distance.</i>
-----------------------------	---

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_assign_tanimoto	<i>Assign data points using Tanimoto distance.</i>
--------------------	--

---

**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	<i>Data frame for possible values of assignment types.</i>
-----------------	--

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>



---

wc_assign_whittaker	<i>Assign data points using Whittaker distance.</i>
---------------------	---

---

**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	<i>Calculate Ball-Hall internal Cluster evaluation measure</i>
-------------------	--

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

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>

---

wc\_eval\_between\_sum\_of\_squares

*Calculate between (Clusters) sum of squares*


---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

`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**

<code>data</code>	A dataset for which internal cluster quality should be calculated.
<code>assignment</code>	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**

<code>data</code>	A dataset for which internal cluster quality should be calculated.
<code>assignment</code>	Vector of assignments.

**Value**

A value of internal cluster quality evaluation measure.

**Author(s)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

`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**

<code>data</code>	A dataset for which internal cluster quality should be calculated.
<code>assignment</code>	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**

<code>data</code>	A dataset for which internal cluster quality should be calculated.
<code>assignment</code>	Vector of assignments.

**Value**

A value of internal cluster quality evaluation measure.

**Author(s)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

`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**

<code>data</code>	A dataset for which internal cluster quality should be calculated.
<code>assignment</code>	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**

<code>data</code>	A dataset for which internal cluster quality should be calculated.
<code>assignment</code>	Vector of assignments.

**Value**

A value of internal cluster quality evaluation measure.

**Author(s)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_eval_g_plus	<i>Calculate G+ index internal Cluster evaluation measure</i>
----------------	---

---

**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	<i>Calculate Silhouette score internal Cluster evaluation measure</i>
--------------------	---

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_eval_xie_beni	<i>Calculate Xie-Beni internal Cluster evaluation measure</i>
------------------	---

---

**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	<i>General Component for Initialization of Cluster Representatives.</i>
---------------	---

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>



---

wc_init_agnes	<i>AGNES Cluster Representatives initialization.</i>
---------------	--

---

**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	<i>CCIA Cluster Representatives initialization.</i>
--------------	---

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_init_diana	<i>DIANA Cluster Representatives initialization.</i>
---------------	--

---

**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	<i>Forgy algorithm Cluster Representatives initialization.</i>
---------------	--

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_init_kkz	<i>KKZ Cluster Representatives initialization.</i>
-------------	--

---

**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	<i>K-Means++ Cluster Representatives initialization.</i>
------------------------	--

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_init_pca	<i>PCA Cluster Representatives initialization.</i>
-------------	--

---

**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	<i>Quantile Cluster Representatives initialization.</i>
------------------	---

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_init_random	<i>Random Cluster Representatives initialization.</i>
----------------	---

---

**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	<i>Data frame for possible values of initialization types.</i>
---------------	--

---

**Description**

Data frame for possible values of initialization types.

**Usage**

```
wc_init_types
```

**Format**

An object of class data.frame with 10 rows and 2 columns.

**Author(s)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_init_ward	<i>Ward algorithm Cluster Representatives initialization.</i>
--------------	---

---

**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	<i>General (Optional) Component for Normalization of data.</i>
--------------	--

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

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 normalization 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 normalization 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_l1	<i>l<sub>1</sub> normalization of data.</i>
------------	---

---

**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 normalization 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_l2	<i>l<sub>2</sub> normalization of data.</i>
------------	---

---

**Description**

$l_2$  normalization of data.

**Usage**

```
wc_norm_l2(data, model = NULL)
```

**Arguments**

data	A dataset which needs to be normalized.
model	Additional data needed for future data to be normalized using same normalization 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_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 normalization 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 normalization 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_max_min	<i>Max-Min normalization of data.</i>
-----------------	---------------------------------------

---

**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 normalization 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	<i>Mean (Max-Min like) normalization of data.</i>
--------------	---

---

**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 normalization 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_no	<i>Ignore normalization of data.</i>
------------	--------------------------------------

---

**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 normalization 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	<i>Non-monotonic normalization of data.</i>
-----------------------	---

---

**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 normalization 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_sigmoid	<i>Sigmoid normalization of data.</i>
-----------------	---------------------------------------

---

**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 normalization 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	<i>Softmax normalization of data.</i>
-----------------	---------------------------------------

---

**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 normalization 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_types	<i>Data frame for possible values of normalization types.</i>
---------------	---

---

**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	<i>Z transformation of data.</i>
-----------	----------------------------------

---

**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 normalization technique.

**Value**

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

**Author(s)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

wc_recalculate	<i>General Component for Cluster Representative update.</i>
----------------	---

---

**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 <code>wc_recalculate_types</code> 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	<i>Data frame for possible values of recalculate types.</i>
----------------------	---

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

`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**

<code>data</code>	A dataset for which Cluster Representatives needs to be updated.
<code>assignment</code>	Vector of Cluster assignments.
<code>old_centroids</code>	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**

<code>data</code>	A dataset for which Cluster Representatives needs to be updated.
<code>assignment</code>	Vector of Cluster assignments.
<code>old_centroids</code>	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\_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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>



---

wc_recalc_midhinge	<i>Solution for Cluster Representative update which uses Midhinge.</i>
--------------------	--

---

**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	<i>Solution for Cluster Representative update which uses Midrange.</i>
--------------------	--

---

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

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.
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\_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 Midhinge.*

---

**Description**

Solution for Cluster Representative update which uses Online Midhinge.

**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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

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.
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\_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)**

Sandro Radovanovic <sandro.radovanovic@gmail.com>

---

`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**

<code>data</code>	A dataset for which Cluster Representatives needs to be updated.
<code>assignment</code>	Vector of Cluster assignments.
<code>assignment_type</code>	Assignment type to be used.
<code>old_centroids</code>	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**

<code>data</code>	A dataset for which Cluster Representatives needs to be updated.
<code>assignment</code>	Vector of Cluster assignments.
<code>old_centroids</code>	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\_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.
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>

---

whibo_cluster-class	<i>As S4 class to represent WhiBo Cluster model</i>
---------------------	---

---

**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	<i>Find Cluster model using White-Box Cluster Algorithm Design.</i>
------------------	---

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**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.

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`)

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### See Also

`plot.whibo_cluster`, `predict.whibo_cluster`

### Examples

```
data <- iris[, 1:4] #Take only numerical columns

#Perform k-means clustering
model <- whibo_clustering(data = data, k = 3)
model

#Perform some unorthodox clustering
model <- whibo_clustering(data = data, k = 3,
  normalization_type = 'Z', cluster_initialization_type = 'Ward',
  assignment_type = 'Correlation', recalculation_type = 'Trimean')
```

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