Package ‘RGF’

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Type Package
Title Regularized Greedy Forest
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BugReports https://github.com/RGF-team/rgf/issues
URL https://github.com/RGF-team/rgf/tree/master/R-package

Description

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SystemRequirements Python (2.7 or >= 3.4), rgf_python, scikit-learn
(>= 0.18.0), scipy, numpy. Detailed installation instructions for each operating system can be found in the README file.

Depends R(>= 3.2.0)
Imports reticulate, R6, Matrix
Suggests testthat, covr, knitr, rmarkdown

Encoding UTF-8

LazyData true
RoxygenNote 6.1.0

VignetteBuilder knitr

NeedsCompilation no

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A Fast Regularized Greedy Forest classifier

Description

A Fast Regularized Greedy Forest classifier

Usage

```r
# init <- FastRGF_Classifier$new(n_estimators = 500, max_depth = 6,
#     max_leaf = 50, tree_gain_ratio = 1.0,
#     min_samples_leaf = 5, loss = "LS", l1 = 1.0,
#     l2 = 1000.0, opt_algorithm = "rgf",
#     learning_rate = 0.001, max_bin = NULL,
#     min_child_weight = 5.0, data_l2 = 2.0,
#     sparse_max_features = 80000,
#     sparse_min_occurences = 5,
#     calc_prob="sigmoid", n_jobs = 1,
#     verbose = 0)
```

Arguments

- **x**: an R matrix (object) or a Python sparse matrix (object) of shape (n_samples, n_features). The training input samples. The sparse matrix should be a Python sparse matrix. The helper functions `mat_2scipy_sparse` and `TO_scipy_sparse` allow the user to convert an R dense or sparse matrix to a scipy sparse matrix.

- **y**: a vector of shape (n_samples). The target values (real numbers in regression).

- **n_estimators**: an integer. The number of trees in the forest (Original name: forest.ntrees.)
**FastRGF_Classifier**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_depth</td>
<td>an integer. Maximum tree depth (Original name: dtree.max_level.)</td>
</tr>
<tr>
<td>max_leaf</td>
<td>an integer. Maximum number of leaf nodes in best-first search (Original name: dtree.max_nodes.)</td>
</tr>
<tr>
<td>tree_gain_ratio</td>
<td>a float. New tree is created when leaf-nodes gain &lt; this value * estimated gain of creating new tree (Original name: dtree.new_tree_gain_ratio.)</td>
</tr>
<tr>
<td>min_samples_leaf</td>
<td>an integer or float. Minimum number of training data points in each leaf node. If an integer, then consider min_samples_leaf as the minimum number. If a float, then min_samples_leaf is a percentage and ceil(min_samples_leaf * n_samples) are the minimum number of samples for each node (Original name: dtree.min_samples_leaf.)</td>
</tr>
<tr>
<td>loss</td>
<td>a character string. One of &quot;LS&quot; (Least squares loss), &quot;MODLS&quot; (Modified least squares loss) or &quot;LOGISTIC&quot; (Logistic loss) (Original name: dtree.loss.)</td>
</tr>
<tr>
<td>l1</td>
<td>a float. Used to control the degree of L1 regularization (Original name: dtree.lamL1.)</td>
</tr>
<tr>
<td>l2</td>
<td>a float. Used to control the degree of L2 regularization (Original name: dtree.lamL2.)</td>
</tr>
<tr>
<td>opt_algorithm</td>
<td>a character string. Either &quot;rgf&quot; or &quot;epsilon-greedy&quot;. Optimization method for training forest (Original name: forest.opt.)</td>
</tr>
<tr>
<td>learning_rate</td>
<td>a float. Step size of epsilon-greedy boosting. Meant for being used with opt_algorithm = &quot;epsilon-greedy&quot; (Original name: forest.stepsize.)</td>
</tr>
<tr>
<td>max_bin</td>
<td>an integer or NULL. Maximum number of discretized values (bins). If NULL, 65000 is used for dense data and 200 for sparse data (Original name: discretize.(sparse/dense).max_buckets.)</td>
</tr>
<tr>
<td>min_child_weight</td>
<td>a float. Minimum sum of data weights for each discretized value (bin) (Original name: discretize.(sparse/dense).min_bucket_weights.)</td>
</tr>
<tr>
<td>data_l2</td>
<td>a float. Used to control the degree of L2 regularization for discretization (Original name: discretize.(sparse/dense).lamL2.)</td>
</tr>
<tr>
<td>sparse_max_features</td>
<td>an integer. Maximum number of selected features. Meant for being used with sparse data (Original name: discretize.sparse.max_features.)</td>
</tr>
<tr>
<td>sparse_min_occurrences</td>
<td>an integer. Minimum number of occurrences for a feature to be selected. Meant for being used with sparse data (Original name: discretize.sparse.min_occurrences.)</td>
</tr>
<tr>
<td>calc_prob</td>
<td>a character string. Either &quot;sigmoid&quot; or &quot;softmax&quot;. Method of probability calculation</td>
</tr>
<tr>
<td>n_jobs</td>
<td>an integer. The number of jobs to run in parallel for both fit and predict. If -1, all CPUs are used. If -2, all CPUs but one are used. If &lt; -1, (n_cpus + 1 + n_jobs) are used (Original name: set.nthreads.)</td>
</tr>
<tr>
<td>verbose</td>
<td>an integer. Controls the verbosity of the tree building process (Original name: set.verbose.)</td>
</tr>
</tbody>
</table>

**Format**

An object of class R6ClassGenerator of length 24.
Details

the `fit` function builds a classifier from the training set \((x, y)\).

the `predict` function predicts the class for \(x\).

the `predict_proba` function predicts class probabilities for \(x\).

the `cleanup` function removes tempfiles used by this model. See the issue [https://github.com/rgf-team/rgf/issues/75](https://github.com/rgf-team/rgf/issues/75), which explains in which cases the `cleanup` function applies.

the `get_params` function returns the parameters of the model.

the `score` function returns the mean accuracy on the given test data and labels.

Methods

```r
FastRGF_Classifier$new(n_estimators = 500, max_depth = 6, max_leaf = 50, tree_gain_ratio = 1.0, min_samples_leaf = 10, min_samples_split = 2, min_weight_fraction_leaf = 0.0, max_features = NULL, sparsity = NULL, sparsity_threshold = NULL, sparse_max_features = 80000L, sparse_min_occurences = 5L, calc_prob = TRUE, n_jobs = 1L, verbose = 0L)
```

```r
fit(x, y, sample_weight = NULL)
```

```r
predict(x)
```

```r
predict_proba(x)
```

```r
cleanup()
```

```r
get_params(deep = TRUE)
```

```r
score(x, y, sample_weight = NULL)
```

References


Examples

```r
if (reticulate::py_available() & reticulate::py_module_available("rgf.sklearn"); {

library(RGF)

set.seed(1)
x = matrix(runif(100000), nrow = 100, ncol = 1000)
y = sample(1:2, 100, replace = TRUE)
```
FastRGF_Regressor

```r
fast_RGF_class = FastRGF_Classifier$new(max_leaf = 50)

fast_RGF_class$fit(x, y)

preds = fast_RGF_class$predict_proba(x)
```

---

**Description**

A Fast Regularized Greedy Forest regressor

**Usage**

```r
# init <- FastRGF_Regressor$new(n_estimators = 500, max_depth = 6,
# max_leaf = 50, tree_gain_ratio = 1.0,
# min_samples_leaf = 5, l1 = 1.0,
# l2 = 1000.0, opt_algorithm = "rgf",
# learning_rate = 0.001, max_bin = NULL,
# min_child_weight = 5.0, data_l2 = 2.0,
# sparse_max_features = 80000,
# sparse_min_occurences = 5,
# n_jobs = 1, verbose = 0)
```

**Arguments**

- **x**: an R matrix (object) or a Python sparse matrix (object) of shape \( (n_{\text{samples}}, n_{\text{features}}) \). The training input samples. The sparse matrix should be a Python sparse matrix. The helper functions `mat_2scipy_sparse` and `TO_scipy_sparse` allow the user to convert an R dense or sparse matrix to a scipy sparse matrix.

- **y**: a vector of shape \( (n_{\text{samples}}) \). The target values (real numbers in regression).

- **n_estimators**: an integer. The number of trees in the forest (Original name: forest.ntrees.)

- **max_depth**: an integer. Maximum tree depth (Original name: dtree.max_level.)

- **max_leaf**: an integer. Maximum number of leaf nodes in best-first search (Original name: dtree.max_nodes.)

- **tree_gain_ratio**: a float. New tree is created when leaf-nodes gain < this value * estimated gain of creating new tree (Original name: dtree.new_tree_gain_ratio.)

- **min_samples_leaf**: an integer or float. Minimum number of training data points in each leaf node. If an integer, then consider min_samples_leaf as the minimum number. If a float, then min_samples_leaf is a percentage and ceil(min_samples_leaf * n_samples) are the minimum number of samples for each node (Original name: dtree.min_sample.)

- **l1**: a float. Used to control the degree of L1 regularization (Original name: dtree.lamL1.)
FastRGF_Regressor

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a float. Used to control the degree of L2 regularization (Original name: dtree.lamL2.)

opt_algorithm

a character string. Either "rgf" or "epsilon-greedy". Optimization method for training forest (Original name: forest.opt.)

learning_rate

a float. Step size of epsilon-greedy boosting. Meant for being used with opt_algorithm = "epsilon-greedy" (Original name: forest.stepsize.)

max_bin

an integer or NULL. Maximum number of discretized values (bins). If NULL, 65000 is used for dense data and 200 for sparse data (Original name: discretize.(sparse/dense).max_buckets.)

min_child_weight

a float. Minimum sum of data weights for each discretized value (bin) (Original name: discretize.(sparse/dense).min_bucket_weights.)

data_lR

a float. Used to control the degree of L2 regularization for discretization (Original name: discretize.(sparse/dense).lamL2.)

sparse_max_features

an integer. Maximum number of selected features. Meant for being used with sparse data (Original name: discretize.sparse.max_features.)

sparse_min_occurences

an integer. Minimum number of occurrences for a feature to be selected. Meant for being used with sparse data (Original name: discretize.sparse.min_occurrences.)

n_jobs

an integer. The number of jobs to run in parallel for both fit and predict. If -1, all CPUs are used. If -2, all CPUs but one are used. If < -1, (n_cpus + 1 + n_jobs) are used (Original name: set.nthreads.)

verbose

an integer. Controls the verbosity of the tree building process (Original name: set.verbose.)

Format

An object of class R6ClassGenerator of length 24.

Details

the fit function builds a regressor from the training set (x, y).

the predict function predicts the regression target for x.

the cleanup function removes tempfiles used by this model. See the issue https://github.com/rgf-team/rgf/issues/75, which explains in which cases the cleanup function applies.

the get_params function returns the parameters of the model.

the score function returns the coefficient of determination (\( R^2 \)) for the predictions.

Methods

FastRGF_Regressor$new(n_estimators = 500, max_depth = 6, max_leaf = 50, tree_gain_ratio = 1.0, min...

--------------

fit(x, y, sample_weight = NULL)

--------------
predict(x)
--------------
cleanup()
------------
get_params(deep = TRUE)
-------------
score(x, y, sample_weight = NULL)
----------

References


Examples

if (reticulate::py_available() && reticulate::py_module_available("rgf.sklearn")) {

  library(RGF)

  set.seed(1)
  x = matrix(runif(100000), nrow = 100, ncol = 100)

  y = runif(100)

  fast_RGF_regr = FastRGF_Regressor$new(max_leaf = 50)

  fast_RGF_regr$fit(x, y)

  preds = fast_RGF_regr$predict(x)
}

mat_2scipy_sparse  conversion of an R matrix to a scipy sparse matrix

Description

conversion of an R matrix to a scipy sparse matrix

Usage

mat_2scipy_sparse(x, format = "sparse_row_matrix")

Arguments

x a data matrix
format a character string. Either "sparse_row_matrix" or "sparse_column_matrix"
Details

This function allows the user to convert an R matrix to a scipy sparse matrix. This is useful because the Regularized Greedy Forest algorithm accepts only python sparse matrices as input.

References

https://docs.scipy.org/doc/scipy/reference/sparse.html

Examples

```r
if (reticulate::py_available() && reticulate::py_module_available("scipy")) {

  library(RGF)
  set.seed(1)
  x = matrix(runif(1000), nrow = 100, ncol = 10)
  res = mat_2scipy_sparse(x)
  print(dim(x))
  print(res$shape)
}
```

RGF_Classifier  

Regularized Greedy Forest classifier

Description

Regularized Greedy Forest classifier

Usage

```r
# init <- RGF_Classifier$new(max_leaf = 1000, test_interval = 100,
#   algorithm = "RGF", loss = "Log", reg_depth = 1.0,
#   l2 = 0.1, sl2 = NULL, normalize = FALSE,
#   min_samples_leaf = 10, n_iter = NULL,
#   n_tree_search = 1, opt_interval = 100,
#   learning_rate = 0.5, calc_prob = "sigmoid",
#   n_jobs = 1, memory_policy = "generous",
#   verbose = 0, init_model = NULL)
```
**Arguments**

- **x**: an R matrix (object) or a Python sparse matrix (object) of shape c(n_samples, n_features). The training input samples. The sparse matrix should be a Python sparse matrix. The helper functions `mat_2scipy_sparse` and `TO_scipy_sparse` allow the user to convert an R dense or sparse matrix to a scipy sparse matrix.

- **y**: a vector of shape c(n_samples). The target values (class labels in classification).

- **sample_weight**: a vector of shape c(n_samples) or NULL. Individual weights for each sample.

- **max_leaf**: an integer. Training will be terminated when the number of leaf nodes in the forest reaches this value.

- **test_interval**: an integer. Test interval in terms of the number of leaf nodes.

- **algorithm**: a character string specifying the **Regularization algorithm**. One of "RGF" (RGF with L2 regularization on leaf-only models), "RGF_Opt" (RGF with min-penalty regularization) or "RGF_Sib" (RGF with min-penalty regularization with the sum-to-zero sibling constraints).

- **loss**: a character string specifying the **Loss function**. One of "LS" (Square loss), "Expo" (Exponential loss) or "Log" (Logistic loss).

- **reg_depth**: a float. Must be no smaller than 1.0. Meant for being used with the algorithm RGF Opt or RGF Sib. A larger value penalizes deeper nodes more severely.

- **l2**: a float. Used to control the degree of L2 regularization.

- **s12**: a float or NULL. Override L2 regularization parameter l2 for the process of growing the forest. That is, if specified, the weight correction process uses l2 and the forest growing process uses s12. If NULL, no override takes place and l2 is used throughout training.

- **normalize**: a boolean. If True, training targets are normalized so that the average becomes zero.

- **min_samples_leaf**: an integer or a float. Minimum number of training data points in each leaf node. If an integer, then consider min_samples_leaf as the minimum number. If a float, then min_samples_leaf is a percentage and ceil(min_samples_leaf * n_samples) are the minimum number of samples for each node.

- **n_iter**: an integer or NULL. The number of iterations of coordinate descent to optimize weights. If NULL, 10 is used for loss = "LS" and 5 for loss = "Expo" or "Log".

- **n_tree_search**: an integer. The number of trees to be searched for the nodes to split. The most recently grown trees are searched first.

- **opt_interval**: an integer. Weight optimization interval in terms of the number of leaf nodes. For example, by default, weight optimization is performed every time approximately 100 leaf nodes are newly added to the forest.

- **learning_rate**: a float. Step size of Newton updates used in coordinate descent to optimize weights.

- **calc_prob**: a character string. One of "sigmoid" or "softmax". Method of probability calculation.
 RGFC2R class
generator

Format
An object of class R6ClassGenerator of length 24.

details

the fit function builds a classifier from the training set (x, y).
the predict function predicts the class for x.
the predict_proba function predicts class probabilities for x.
the cleanup function removes tempfiles used by this model. See the issue https://github.com/RGF-
team/rgf/issues/75, which explains in which cases the cleanup function applies.
the get_params function returns the parameters of the model.
the score function returns the mean accuracy on the given test data and labels.
the feature_importances function returns the feature importances for the data.
the dump_model function currently prints information about the fitted model in the console.
the save_model function saves a model to a file from which training can do warm-start in the future.

methods

RGFC2R$new(max_leaf = 1000, test_interval = 100, algorithm = "RGF", loss = "Log", reg_depth

--------------

fit(x, y, sample_weight = NULL)
predict(x)

predict_proba(x)

cleanup()

get_params(deep = TRUE)

score(x, y, sample_weight = NULL)

feature_importances()

dump_model()

save_model(filename)

References

https://github.com/RGF-team/rgf/tree/master/python-package, Rie Johnson and Tong Zhang, Learning Nonlinear Functions Using Regularized Greedy Forest

Examples

if (reticulate::py_available() && reticulate::py_module_available("rgf.sklearn")) {

library(RGF)

set.seed(1)

x = matrix(runif(1000), nrow = 100, ncol = 10)

y = sample(1:2, 100, replace = TRUE)

RGF_class = RGF_Classifier$new(max_leaf = 50)

RGF_class$fit(x, y)

preds = RGF_class$predict_proba(x)
}
RGF_cleanup_temp_files

Delete all temporary files of the created RGF estimators

Description

Delete all temporary files of the created RGF estimators

Usage

RGF_cleanup_temp_files()

Details

This function deletes all temporary files of the created RGF estimators. See the issue https://github.com/rgf-team/rgf/issues/75 for more details.

References

https://github.com/rgf-team/rgf/tree/master/python-package

Examples

```r
## Not run:
library(rgf)

RGF_cleanup_temp_files()

## End(Not run)
```

RGF_Regressor

Regularized Greedy Forest regressor

Description

Regularized Greedy Forest regressor

Usage

```r
# init <- RGF_Regressor$new(max_leaf = 500, test_interval = 100,
#   algorithm = "RGF", loss = "LS", reg_depth = 1.0,
#   l2 = 0.1, sl2 = NULL, normalize = TRUE,
#   min_samples_leaf = 10, n_iter = NULL,
#   n_tree_search = 1, opt_interval = 100,
#   learning_rate = 0.5, memory_policy = "generous",
#   verbose = 0, init_model = NULL)
```
**Arguments**

- **x**
  - an R matrix (object) or a Python sparse matrix (object) of shape $c(n_{\text{samples}}, n_{\text{features}})$. The training input samples. The sparse matrix should be a Python sparse matrix. The helper functions `mat_2scipy_sparse` and `TO_scipy_sparse` allow the user to convert an R dense or sparse matrix to a scipy sparse matrix.

- **y**
  - a vector of shape $c(n_{\text{samples}})$. The target values (real numbers in regression).

- **sample_weight**
  - a vector of shape $c(n_{\text{samples}})$ or NULL. Individual weights for each sample.

- **max_leaf**
  - an integer. Training will be terminated when the number of leaf nodes in the forest reaches this value.

- **test_interval**
  - an integer. Test interval in terms of the number of leaf nodes.

- **algorithm**
  - a character string specifying the **Regularization algorithm**. One of "RGF" (RGF with L2 regularization on leaf-only models), "RGF_Opt" (RGF with min-penalty regularization) or "RGF_Sib" (RGF with min-penalty regularization with the sum-to-zero sibling constraints).

- **loss**
  - a character string specifying the **Loss function**. One of "LS" (Square loss), "Expo" (Exponential loss) or "Log" (Logistic loss).

- **reg_depth**
  - a float. Must be no smaller than 1.0. Meant for being used with the algorithm RGF Opt or RGF Sib. A larger value penalizes deeper nodes more severely.

- **l2**
  - a float. Used to control the degree of L2 regularization.

- **sl2**
  - a float or NULL. Override L2 regularization parameter l2 for the process of growing the forest. That is, if specified, the weight correction process uses l2 and the forest growing process uses sl2. If NULL, no override takes place and l2 is used throughout training.

- **normalize**
  - a boolean. If True, training targets are normalized so that the average becomes zero.

- **min_samples_leaf**
  - an integer or a float. Minimum number of training data points in each leaf node. If an integer, then consider min_samples_leaf as the minimum number. If a float, then min_samples_leaf is a percentage and ceil(min_samples_leaf * n_samples) are the minimum number of samples for each node.

- **n_iter**
  - an integer or NULL. The number of iterations of coordinate descent to optimize weights. If NULL, 10 is used for loss = "LS" and 5 for loss = "Expo" or "Log".

- **n_tree_search**
  - an integer. The number of trees to be searched for the nodes to split. The most recently grown trees are searched first.

- **opt_interval**
  - an integer. Weight optimization interval in terms of the number of leaf nodes. For example, by default, weight optimization is performed every time approximately 100 leaf nodes are newly added to the forest.

- **learning_rate**
  - a float. Step size of Newton updates used in coordinate descent to optimize weights.

- **memory_policy**
  - a character string. One of "conservative" (it uses less memory at the expense of longer runtime. Try only when with default value it uses too much memory) or "generous" (it runs faster using more memory by keeping the sorted orders of the features on memory for reuse). Memory using policy.
verbose an integer. Controls the verbosity of the tree building process.

init_model either NULL or a character string, optional (default=NULL). Filename of a previously saved model from which training should do warm-start. If model has been saved into multiple files, do not include numerical suffixes in the filename. **NOTE:** Make sure you haven’t forgotten to increase the value of the max_leaf parameter regarding to the specified warm-start model because warm-start model trees are counted in the overall number of trees.

filename a character string specifying a valid path to a file where the fitted model should be saved

Format

An object of class `R6ClassGenerator` of length 24.

Details

the `fit` function builds a regressor from the training set `(x, y)`.

the `predict` function predicts the regression target for `x`.

the `cleanup` function removes tempfiles used by this model. See the issue https://github.com/rgf-team/rgf/issues/75, which explains in which cases the `cleanup` function applies.

the `get_params` function returns the parameters of the model.

the `score` function returns the coefficient of determination (R²) for the predictions.

the `feature_importances` function returns the feature importances for the data.

the `dump_model` function currently prints information about the fitted model in the console

the `save_model` function saves a model to a file from which training can do warm-start in the future.

Methods

```r
RGF_Regressor$new(max_leaf = 500, test_interval = 100, algorithm = "RGF", loss = "LS", reg_depth =

fit(x, y, sample_weight = NULL)

predict(x)

cleanup()

get_params(deep = TRUE)

score(x, y, sample_weight = NULL)

feature_importances()
```
**TO_scipy_sparse**

--------------
dump_model()
--------------
save_model(filename)
--------------

References

https://github.com/RGF-team/rgf/tree/master/python-package, Rie Johnson and Tong Zhang, Learning Nonlinear Functions Using Regularized Greedy Forest

Examples

```r
if (reticulate::py_available() & reticulate::py_module_available("rgf.sklearn")) {
  library(RGF)
  set.seed(1)
  x = matrix(runif(1000), nrow = 100, ncol = 10)
  y = runif(100)
  RGF_regr = RGF_Regressor$new(max_leaf = 50)
  RGF_regr$fit(x, y)
  preds = RGF_regr$predict(x)
}
```

**TO_scipy_sparse**

conversion of an R sparse matrix to a scipy sparse matrix

Description

conversion of an R sparse matrix to a scipy sparse matrix

Usage

`TO_scipy_sparse(R_sparse_matrix)`

Arguments

- `R_sparse_matrix`:
an R sparse matrix. Acceptable input objects are either a `dgCMatrix` or a `dgRMatrix`.

Details
This function allows the user to convert either an R \emph{dgCMatrix} or a \emph{dgRMatrix} to a scipy sparse matrix (\emph{scipy.sparse.csc_matrix} or \emph{scipy.sparse.csr_matrix}). This is useful because the RGF package accepts besides an R dense matrix also python sparse matrices as input.

The \emph{dgCMatrix} class is a class of sparse numeric matrices in the compressed, sparse, column-oriented format. The \emph{dgRMatrix} class is a class of sparse numeric matrices in the compressed, sparse, row-oriented format.

References

Examples

```r
if (reticulate::py_available() && reticulate::py_module_available("scipy")) {
  if (Sys.info()["sysname"] != 'Darwin') {

    library(RGF)

    # 'dgCMatrix' sparse matrix
    #-----------------------------
    data = c(1, 0, 2, 0, 0, 3, 4, 5, 6)
    dgcm = Matrix::Matrix(
      data = data
      , nrow = 3
      , ncol = 3
      , byrow = TRUE
      , sparse = TRUE
    )

    print(dim(dgcm))
    res = TO_scipy_sparse(dgcm)
    print(res$shape)

    # 'dgRMatrix' sparse matrix
    #-----------------------------
    dgrm = as(dgcm, "RsparseMatrix")
    print(dim(dgrm))
    res_dgr = TO_scipy_sparse(dgrm)
  }
}
```
print(res_dgr$shape)
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