Package ‘nmslibR’

September 11, 2021

Type  Package
Title  Non Metric Space (Approximate) Library
Version  1.0.6
Date  2021-09-11

BugReports  https://github.com/mlampros/nmslibR/issues
URL  https://github.com/mlampros/nmslibR

Description  A Non-Metric Space Library (‘NM-SLIB’ <https://github.com/nmslib/nmslib>) wrapper, which according to the authors ``is an efficient cross-platform similarity search library and a toolkit for evaluation of similarity search methods. The goal of the 'NMSLIB' <https://github.com/nmslib/nmslib> Library is to create an effective and comprehensive toolkit for searching in generic non-metric spaces. Being comprehensive is important, because no single method is likely to be sufficient in all cases. Also note that exact solutions are hardly efficient in high dimensions and/or non-metric spaces. Hence, the main focus is on approximate methods". The wrapper also includes Approximate Kernel k-Nearest-Neighbor functions based on the 'NM-SLIB' <https://github.com/nmslib/nmslib> 'Python' Library.

License  Apache License (>= 2)

SystemRequirements  python3-dev: apt-get install -y python3-dev (deb), python3-pip: apt-get install -y python3-pip (deb), numpy: pip3 install numpy (deb), scipy: pip3 install scipy (deb), nmslib: pip3 install --no-binary :all: nmslib (deb)

Encoding  UTF-8

Depends  R(>= 3.2.3)
Imports  Rcpp (>= 0.12.7), reticulate, R6, Matrix, KernelKnn, utils
LinkingTo  Rcpp, RcppArmadillo (>= 0.8.0)
Suggests  testthat, covr, knitr, rmarkdown
VignetteBuilder  knitr
RoxygenNote  7.1.1

NeedsCompilation  yes
**KernelKnnCV_nmslib**

**Author** Lampros Mouselimis [aut, cre] (<https://orcid.org/0000-0002-8024-1546>),
B. Naidan [cph] (Author of the Non-Metric Space Library (NMSLIB)),
L. Boytsov [cph] (Author of the Non-Metric Space Library (NMSLIB)),
Yu. Malkov [cph] (Author of the Non-Metric Space Library (NMSLIB)),
B. Frederickson [cph] (Author of the Non-Metric Space Library (NMSLIB)),
D. Novak [cph] (Author of the Non-Metric Space Library (NMSLIB))

**Maintainer** Lampros Mouselimis <mouselimislampros@gmail.com>

**Repository** CRAN

**Date/Publication** 2021-09-11 15:00:02 UTC

---

### R topics documented:

- `KernelKnnCV_nmslib` ................................................................. 2
- `KernelKnn_nmslib` ................................................................. 4
- `mat_2scipy_sparse` .............................................................. 6
- `NMSlib` .................................................................................. 7
- `TO_scipy_sparse` ................................................................. 10

---

Index 12

---

**KernelKnnCV_nmslib**

Approximate Kernel k nearest neighbors (cross-validated) using the nmslib library

---

**Description**

Approximate Kernel k nearest neighbors (cross-validated) using the nmslib library

**Usage**

```r
KernelKnnCV_nmslib(
  data,
  y,
  k = 5,
  folds = 5,
  h = 1,
  weights_function = NULL,
  Levels = NULL,
  Index_Params = NULL,
  Time_Params = NULL,
  space = "l1",
  space_params = NULL,
  method = "hnsw",
  data_type = "DENSE_VECTOR",
  dtype = "FLOAT",
  index_filepath = NULL,
)```

---
print_progress = FALSE,
num_threads = 1,
seed_num = 1
)

Arguments

data a numeric matrix

y a numeric vector specifying the response variable (in classification the labels
must be numeric from 1:Inf). The length of y must equal the rows of the data
parameter

k an integer. The number of neighbours to return

folds the number of cross validation folds (must be greater than 1)

h the bandwidth (applicable if the weights_function is not NULL, defaults to 1.0)

weights_function there are various ways of specifying the kernel function. See the details section.

Levels a numeric vector. In case of classification the unique levels of the response
variable are necessary

Index_Params a list of (optional) parameters to use in indexing (when creating the index)

Time_Params a list of parameters to use in querying. Setting Time_Params to NULL will reset

space a character string (optional). The metric space to create for this index. Page 31
of the manual (see references) explains all available inputs

space_params a list of (optional) parameters for configuring the space. See the references
manual for more details.

method a character string specifying the index method to use

data_type a character string. One of 'DENSE_UINT8_VECTOR', 'DENSE_VECTOR',
'OBJECT_AS_STRING' or 'SPARSE_VECTOR'

dtype a character string. Either 'FLOAT' or 'INT'

index_filepath a character string specifying the path to a file, where an existing index is saved

print_progress a boolean (either TRUE or FALSE). Whether or not to display progress bar

num_threads an integer. The number of threads to use

seed_num a numeric value specifying the seed of the random number generator

Details

There are three possible ways to specify the weights function. 1st option: if the weights_function
is NULL then a simple k-nearest-neighbor is performed. 2nd option: the weights_function is one
of 'uniform', 'triangular', 'epanechnikov', 'biweight', 'triweight', 'tricube', 'gaussian', 'cosine',
'logistic', 'gaussianSimple', 'silverman', 'inverse', 'exponential'. The 2nd option can be extended
by combining kernels from the existing ones (adding or multiplying). For instance, I can multiply
the tricube with the gaussian kernel by giving 'tricube_gaussian_MULT' or I can add the previously
mentioned kernels by giving 'tricube_gaussian_ADD'. 3rd option: a user defined kernel function
## Not run:

```r
x = matrix(runif(1000), nrow = 100, ncol = 10)
y = runif(100)
out = KernelKnnCV_nmslib(x, y, k = 5, folds = 5)
```

## End(Not run)

### Description

Approximate Kernel k nearest neighbors using the nmslib library

### Usage

```r
KernelKnn_nmslib(
  data,
  TEST_data = NULL,
  y,
  k = 5,
  h = 1,
  weights_function = NULL,
  Levels = NULL,
  Index_Params = NULL,
  Time_Params = NULL,
  space = "l1",
  space_params = NULL,
  method = "hnsw",
  data_type = "DENSE_VECTOR",
  dtype = "FLOAT",
  index_filepath = NULL,
  print_progress = FALSE,
  num_threads = 1
)
```

### Arguments

- **data**: either a matrix or a scipy sparse matrix
- **TEST_data**: a test dataset (in case of a matrix the **TEST_data** should have equal number of columns with the **data**). It is assumed that the **TEST_data** is an unlabeled dataset
y a numeric vector specifying the response variable (in classification the labels must be numeric from 1:Inf). The length of y must equal the rows of the data parameter

k an integer. The number of neighbours to return

h the bandwidth (applicable if the weights_function is not NULL, defaults to 1.0)

weights_function there are various ways of specifying the kernel function. See the details section.

Levels a numeric vector. In case of classification the unique levels of the response variable are necessary

Index_Params a list of (optional) parameters to use in indexing (when creating the index)

Time_Params a list of parameters to use in querying. Setting Time_Params to NULL will reset

space a character string (optional). The metric space to create for this index. Page 31 of the manual (see references) explains all available inputs

space_params a list of (optional) parameters for configuring the space. See the references manual for more details.

method a character string specifying the index method to use

data_type a character string. One of 'DENSE_UINT8_VECTOR', 'DENSE_VECTOR', 'OBJECT_AS_STRING' or 'SPARSE_VECTOR'

dtype a character string. Either 'FLOAT' or 'INT'

index_filepath a character string specifying the path to a file, where an existing index is saved

print_progress a boolean (either TRUE or FALSE). Whether or not to display progress bar

num_threads an integer. The number of threads to use

Details

There are three possible ways to specify the weights function, 1st option: if the weights_function is NULL then a simple k-nearest-neighbor is performed. 2nd option: the weights_function is one of 'uniform', 'triangular', 'epanechnikov', 'biweight', 'triweight', 'tricube', 'gaussian', 'cosine', 'logistic', 'gaussianSimple', 'silverman', 'inverse', 'exponential'. The 2nd option can be extended by combining kernels from the existing ones (adding or multiplying). For instance, I can multiply the tricube with the gaussian kernel by giving 'tricube_gaussian_MULT' or I can add the previously mentioned kernels by giving 'tricube_gaussian_ADD'. 3rd option: a user defined kernel function

Examples

```r
try({
  if (reticulate::py_available(initialize = FALSE)) {
    if (reticulate::py_module_available("nmslib")) {
      library(nmslibR)

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

      y = runif(100)
    }
  }
})
```
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 nmslibR package accepts only python sparse matrices as input.

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

Examples

try({
  if (reticulate::py_available(initialize = FALSE)) {
    if (reticulate::py_module_available("scipy")) {
      library(nmslibR)
      set.seed(1)
      x = matrix(runif(1000), nrow = 100, ncol = 10)
      res = mat_2scipy_sparse(x)
      print(dim(x))
      print(res$shape)
    }
  }
}, silent=TRUE)
Non metric space library

Usage

```r
# init <- NMSlib$new(input_data, Index_Params = NULL, Time_Params = NULL,
#                     space='l1', space_params = NULL, method = 'hnsw',
#                     data_type = 'DENSE_VECTOR', dtype = 'FLOAT',
#                     index_filepath = NULL, print_progress = FALSE)
```

Details

- **input_data** parameter: In case of numeric data the **input_data** parameter should be either an R matrix object or a scipy sparse matrix. Additionally, the **input_data** parameter can be a list including more than one matrices / sparse-matrices having the same number of columns (this is ideal for instance if the user wants to include both a train and a test dataset in the created index)

- The **Knn_Query** function finds the approximate K nearest neighbours of a vector in the index

- The **knn_Query_Batch** function performs multiple queries on the index, distributing the work over a thread pool

- The **save_Index** function saves the index to disk

If the **index_filepath** parameter is not NULL then an existing index will be loaded

Methods

```r
NMSlib$new(input_data, Index_Params = NULL, Time_Params = NULL, space='l1', space_params = NULL, method = 'hnsw',
           data_type = 'DENSE_VECTOR', dtype = 'FLOAT', index_filepath = NULL, print_progress = FALSE)
```

```r
Knn_Query(query_data_row, k = 5)
```

```r
knn_Query_Batch(query_data, k = 5, num_threads = 1)
```

```r
save_Index(filename)
```

Public methods:

- **NMSlib$new()**
- **NMSlib$Knn_Query()**
• NMSlib\$knn\_Query\_Batch()
• NMSlib\$save\_Index()
• NMSlib\$clone()

**Method** `new()`:

**Usage:**

```r
NMSlib\$new(
  input_data,
  Index_Params = NULL,
  Time_Params = NULL,
  space = "l1",
  space_params = NULL,
  method = "hnsw",
  data_type = "DENSE\_VECTOR",
  dtype = "FLOAT",
  index_filepath = NULL,
  print_progress = FALSE
)
```

**Arguments:**

- `input_data` the input data. See details for more information
- `Index_Params` a list of (optional) parameters to use in indexing (when creating the index)
- `Time_Params` a list of parameters to use in querying. Setting `Time_Params` to `NULL` will reset
- `space` a character string (optional). The metric space to create for this index. Page 31 of the manual (see references) explains all available inputs
- `space_params` a list of (optional) parameters for configuring the space. See the references manual for more details.
- `method` a character string specifying the index method to use
- `data_type` a character string. One of 'DENSE\_UINT8\_VECTOR', 'DENSE\_VECTOR', 'OBJECT\_AS\_STRING' or 'SPARSE\_VECTOR'
- `dtype` a character string. Either 'FLOAT' or 'INT'
- `index_filepath` a character string specifying the path to a file, where an existing index is saved
- `print_progress` a boolean (either TRUE or FALSE). Whether or not to display progress bar

**Method** `Knn\_Query()`:

**Usage:**

```r
NMSlib\$Knn\_Query(query_data_row, k = 5)
```

**Arguments:**

- `query_data_row` a vector to query for
- `k` an integer. The number of neighbours to return

**Method** `knn\_Query\_Batch()`:

**Usage:**

```r
NMSlib\$knn\_Query\_Batch(query_data, k = 5, num_threads = 1)
```
Arguments:
query_data  the query_data parameter should be of the same type with the input_data parameter. Queries to query for
k  an integer. The number of neighbours to return
num_threads  an integer. The number of threads to use

Method save_Index():
Usage:
NMSlib$save_Index(filename)
Arguments:
filename  a character string specifying the path. The filename to save ( in case of the save_Index method ) or the filename to load ( in case of the load_Index method )

Method clone(): The objects of this class are cloneable with this method.
Usage:
NMSlib$clone(deep = FALSE)
Arguments:
deep  Whether to make a deep clone.

References

Examples

try({
  if (reticulate::py_available(initialize = FALSE)) {
    if (reticulate::py_module_available("nmslib")) {

      library(nmslibR)

      set.seed(1)
      x = matrix(runif(1000), nrow = 100, ncol = 10)

      init_nms = NMSlib$new(input_data = x)

      # returns a 1-dimensional vector (index, distance)
      #-----------------------------------------------
      init_nms$Knn_Query(query_data_row = x[1, ], k = 5)

      # returns knn's for all data
      #---------------------------
      all_dat = init_nms$knn_Query_Batch(x, k = 5, num_threads = 1)
    }
  }
})
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 \textit{dgCMatrix} or a \textit{dgRMatrix}.

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

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

References

Examples
```
try({
  if (reticulate::py_available(initialize = FALSE)) {
    if (reticulate::py_module_available("scipy")) {
      if (Sys.info()["sysname"] != 'Darwin') {
        library(nmslibR)

        # '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)
Index

KernelKnn_nmslib, 4
KernelKnnCV_nmslib, 2
mat_2scipy_sparse, 6
NMSlib, 7
TO_scipy_sparse, 10