

Package ‘ctrdata’

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Type Package

Title Retrieve and Analyze Clinical Trials in Public Registers

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stringi, dplyr, lubridate

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URL <https://cran.r-project.org/package=ctrdata>

BugReports <https://github.com/rfhb/ctrdata/issues>

Description A system for querying, retrieving and analyzing protocol- and results-related information on clinical trials from three public registers, the 'European Union Clinical Trials Register' ('EUCTR', <<https://www.clinicaltrialsregister.eu/>>), 'ClinicalTrials.gov' ('CTGOV', <<https://clinicaltrials.gov/>>) and the 'ISRCTN' (<<http://www.isrctn.com/>>). Trial information is downloaded, converted and stored in a database ('PostgreSQL', 'SQLite' or 'MongoDB'; via package 'nodbi'). Functions are included to identify de-duplicated records, to easily find and extract variables (fields) of interest even from complex nesting as used by the registers, and to update previous queries. The package can be used for meta-analysis and trend-analysis of the design and conduct as well as for results of clinical trials.

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ctrdata-package	<i>ctrdata: get started, connect database and function overview</i>
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Description

A package for aggregating and analysing information on and results from clinical trials, retrieved from public study registers

Database connection

Package `ctrdata` retrieves trial information and stores it in a database collection, which has to be given as a connection object to parameter `con` for several `ctrdata` functions; this connection object is created in slightly different ways for the three supported database backends:

Database	Connection object
MongoDB	<code>dbc <- nodbi::src_mongo(db = "my_db", collection = "my_coll")</code>
SQLite	<code>dbc <- nodbi::src_sqlite(dbname = "my_db", collection = "my_coll")</code>
PostgreSQL	<code>dbc <- nodbi::src_postgres(dbname = "my_db"); dbc[["collection"]] <- "my_coll"</code>

Example of using a `ctrdata` function with any such connection object: `ctrdata::dbQueryHistory(con = dbc)`. Besides `ctrdata` functions below, any such a connection object can equally be used with functions of package `nodbi`, for example `nodbi::docdb_query(src = dbc, key = dbc$collection, fields = '{"_id": 1}', query = '{"sponsors.lead_sponsor.agency_class": "Industry"}')`

Operations on a clinical trial register

[ctrOpenSearchPagesInBrowser](#), [ctrLoadQueryIntoDb](#) (load trial records into database collection), [ctrFindActiveSubstanceSynonyms](#); see [ctrdata-registers](#) for details on registers and how to search

Get a data frame from the database collection

[dbFindFields](#) (find names of fields of interest in trial records in a collection), [dbGetFieldsIntoDf](#) (create a data frame for fields of interest from collection), [dbFindIdsUniqueTrials](#) (de-duplicated identifiers of clinical trial records that can be used to subset a data frame)

Operate on a data frame with trial information

[dfTrials2Long](#) (convert fields with nested elements into long format), [dfName2Value](#) (get values for variable(s) of interest). [dfMergeTwoVariablesRelevel](#)

Author(s)

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ctrdata-registers

ctrdata: detailed information on clinical trial registers

Description

Registers of clinical trials that can be accessed with package [ctrdata-package](#) as of end 2021

Details

- **EUCTR**: The European Union Clinical Trials Register contains more than 40,000 clinical trials (using one or more medicines as investigational medicinal product, IMP; in Europe and beyond)
- **CTGOV**: ClinicalTrials.gov includes almost 400,000 interventional and observational studies
- **ISCRTN**: The ISRCTN Registry includes more than 21,000 interventional or observational health studies

Material	EUCTR	CTGOV	ISRCTN
Home page	link	link	link
About	link	link	link
Terms and conditions, disclaimer	link	link	link
How to search	link	link	link
Search interface	link	link	link
Glossary	link	link	link
FAQ	link	link	link
Expert / advanced search	link	link	link
Example*	link	link	link
Definitions	link	Protocol, results, names, syntax	link

*The example expert search retrieves interventional trials with neonates, investigating infectious conditions: EUCTR retrieves trials with neonates, but not exclusively. The CTGOV expert search retrieves trials exclusively in neonates. ISRCTN retrieves a small number of studies. Thus, after loading trials with `ctrLoadQueryIntoDb` into a database collection, corresponding sets of trials need to be defined, based on values of fields of interest (e.g., `eligibility.maximum_age` from CTGOV and `f115_children_211years` from EUCTR), which can be obtained from the collection using `dbGetFieldsIntoDf`.

Author(s)

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ctrFindActiveSubstanceSynonyms

Find synonyms of an active substance

Description

An active substance can be identified by a recommended international nonproprietary name (INN), a trade or product name, or a company code(s). Retrieves the substances which are searched for by the register 'ClinicalTrials.Gov' for a given active substance.

Usage

```
ctrFindActiveSubstanceSynonyms(activessubstance = "")
```

Arguments

activessubstance

An active substance, in an atomic character vector

Value

A character vector of the active substance (input parameter) and synonyms, or NULL if active substance was not found and may be invalid

Examples

```
## Not run:
```

```
ctrFindActiveSubstanceSynonyms(activessubstance = "imatinib")  
# [1] "imatinib" "gleevec" "sti 571" "glivec" "CGP 57148" "st1571"
```

```
## End(Not run)
```

ctrGetQueryUrl	<i>Get query details</i>
----------------	--------------------------

Description

Extracts query parameters and register name from parameter 'url' or from the clipboard, into which the URL of a register search was copied.

Usage

```
ctrGetQueryUrl(url = "", register = "")
```

Arguments

url	URL such as from the browser address bar. If not specified, clipboard contents will be checked for a suitable URL. Can also contain a query term such as from dbQueryHistory() ["query-term"]
register	Optional name of register (i.e., "EUCTR" or "CTGOV") in case url is a query term

Value

A data frame (or tibble, if dplyr is loaded) with column names 'query-term' and 'query-register'. The data frame (or tibble) can be passed as such as parameter 'query-term' to [ctrLoadQueryIntoDb](#) and as parameter 'url' to [ctrOpenSearchPagesInBrowser](#).

Examples

```
## Not run:

dbc <- nodbi::src_sqlite(collection = "my_collection")

# user now copies into the clipboard the URL from
# the address bar of the browser that shows results
# from a query in one of the trial registers
#
# information about all trials found with this query
# is now loaded into the database collection
ctrLoadQueryIntoDb(
  queryterm = ctrGetQueryUrl(),
  con = dbc
)

## End(Not run)
```

ctrLoadQueryIntoDb *Load and store register trial information*

Description

Retrieves or updates information on clinical trials from registers and stores it in a collection in a database. This is the main function of [ctrdata-package](#) for accessing registers and loading trial information into a database collection, even if from different queries or different registers. The query details are stored in the database collection and can be accessed using [dbQueryHistory](#). A previous query can be re-run, which replaces or adds trial records. However, user annotations of trial records are kept.

Usage

```
ctrLoadQueryIntoDb(
  queryterm = NULL,
  register = "",
  querytoupdate = NULL,
  forcetoupdate = FALSE,
  euctrresults = FALSE,
  euctrresultshistory = FALSE,
  euctrresultsfilepath = euctrresultspdfpath,
  euctrresultspdfpath = NULL,
  annotation.text = "",
  annotation.mode = "append",
  parallelretrievals = 10L,
  only.count = FALSE,
  con = NULL,
  verbose = FALSE
)
```

Arguments

queryterm	Either a string with the full URL of a search in a register, or the data frame returned by the ctrGetQueryUrl or the dbQueryHistory functions, or, together with parameter register, a string with query elements of a search URL. The queryterm is recorded in the collection for later use to update records.
register	String with abbreviation of register to query, either "EUCTR", "CTGOV" or "ISRCTN". Not needed if queryterm provide the information which register to query (see queryterm).
querytoupdate	Either the word "last" or the number of the query (based on dbQueryHistory) that should be run to retrieve any trial records that are new or have been updated since this query was run the last time. This parameter takes precedence over queryterm. For EUCTR, updates are available only for the last seven days; the query is run again if more time has passed since it was run last.

forcetoupdate	If TRUE, run again the query given in querytoupdate, irrespective of when it was run last (default is FALSE).
euctrresults	If TRUE, also download available results when retrieving and loading trials from EUCTR. This slows down this function. (For CTGOV, all available results are always retrieved and loaded.)
euctrresultshistory	If TRUE, also download available history of results publication in EUCTR. This is quite time-consuming (default is FALSE).
euctrresultsfilepath	If this is a relative or absolute path to a directory that exists or can be created, save results files into it, e.g., PDF files of result publications that had been submitted to EUCTR (default is NULL).
euctrresultspdfpath	Deprecated, use euctrresultsfilepath
annotation.text	Text to be including in the records retrieved with the current query, in the field "annotation".
annotation.mode	One of "append" (default), "prepend" or "replace" for new annotation.text with respect to any existing annotation for the records retrieved with the current query.
parallelretrievals	Number of parallel downloads of information from the register, defaults to 10.
only.count	Set to TRUE to return only the number of trial records found in the register for the query. Does not load trial information into the database. Default is FALSE.
con	A connection object, see section 'Databases' in ctrdata-package
verbose	Printing additional information if set to TRUE; default is FALSE.

Value

A list with elements 'n' (number of trial records newly imported or updated), 'success' (a vector of _id's of successfully loaded records), 'failed' (a vector of identifiers of records that failed to load) and 'queryterm' (the query term used). The returned list has several attributes (including database and collection name, as well as the query history of this database collection) to facilitate documentation.

Examples

```
## Not run:
dbc <- nodbi::src_sqlite(collection = "my_collection")

# Retrieve protocol- and results-related information
# on a single trial identified by its EU number
ctrLoadQueryIntoDb(
  queryterm = "2013-001291-38",
  register = "EUCTR",
  euctrresults = TRUE,
```

```

    con = dbc
  )

  # Retrieve all information on about 2,000 ongoing
  # interventional cancer trials involving children
  # into the same collection as used before
  ctrlLoadQueryIntoDb(
    queryterm = "cancer&recr=Open&type=Intr&age=0",
    register = "CTGOV",
    con = dbc
  )

## End(Not run)

```

ctrOpenSearchPagesInBrowser

Open stored query or register search page

Description

Open advanced search pages of register(s), or execute search in browser

Usage

```
ctrOpenSearchPagesInBrowser(url = "", register = "", copyright = FALSE, ...)
```

Arguments

url	of search results page to show in the browser. Can be the return value of ctrGetQueryUrl or dbQueryHistory .
register	Register(s) to open. Either "EUCTR" or "CTGOV" or a vector of both. Default is to open both registers' advanced search pages. To open the browser with a previous search, the output of ctrGetQueryUrl or one row from dbQueryHistory can be used.
copyright	(Optional) If set to TRUE, opens copyright pages of register(s).
...	May include the deprecated input parameter.

Value

Always TRUE, invisibly.

Examples

```
## Not run:

# Check copyrights before using registers
ctrOpenSearchPagesInBrowser(copyright = TRUE)

# open last query loaded into the collection
dbc <- nodbi::src_sqlite(
  collection = "previously_created"
)
ctrOpenSearchPagesInBrowser(
  dbQueryHistory(con = dbc))

## End(Not run)
```

dbFindFields

Find names of fields in the database collection

Description

Given part of the name of a field of interest to the user, this function returns the full field names used in records that were previously loaded into a collection (using [ctrLoadQueryIntoDb](#)). The field names can be fed into function [dbGetFieldsIntoDf](#) to extract the data from the collection into a data frame. In addition to the full names of leaf fields (e.g., `clinical_results.outcome_list.outcome.measure.class_list`) this function also returns names of node fields (e.g., `clinical_results`). Data in node fields is typically complex (multiply nested) and can be converted into individual data elements by function [dfTrials2Long](#), possibly followed by function [dfName2Value](#).

Usage

```
dbFindFields(namepart = "", con, verbose = FALSE)
```

Arguments

namepart	A plain string (can include a regular expression, including Perl-style) to be searched for among all field names (keys) in the collection. Use <code>".*"</code> to find all fields.
con	A connection object, see section ‘Databases’ in ctrdata-package
verbose	If TRUE, prints additional information (default FALSE).

Details

For fields in EUCTR (protocol- and results-related information), <https://eudract.ema.europa.eu/result.html>.

For fields in CTGOV (protocol-related information), see <https://prsinfo.clinicaltrials.gov/definitions.html>.

For fields in ISRCTN (protocol-related information), see <https://www.isrctn.com/page/definitions>.

Note: Only when ‘dbFindFields’ is first called after [ctrLoadQueryIntoDb](#), it will take a moment.

Value

Vector of strings with full names of field(s) found, in alphabetical order by register. This is a named vector where the names of the vector are the register names for the respective fields.

Examples

```
## Not run:  
  
dbc <- nodbi::src_sqlite(collection = "my_collection")  
  
dbFindFields(namepart = "date", con = dbc)  
  
## End(Not run)
```

dbFindIdsUniqueTrials *Get identifiers of deduplicated trial records*

Description

Records for a clinical trial can be loaded from more than one register into a collection. The function returns identifiers of records in the collection that were loaded from the register(s) preferred by the user. All registers are recording identifiers also from other registers, which is used by this function to provide a vector of identifiers of deduplicated trials.

Usage

```
dbFindIdsUniqueTrials(  
  preferregister = c("EUCTR", "CTGOV", "ISRCTN"),  
  prefermemberstate = "DE",  
  include3rdcountrytrials = TRUE,  
  con,  
  verbose = FALSE  
)
```

Arguments

preferregister A vector of the order of preference for registers from which to generate unique `_id`'s, default `c("EUCTR", "CTGOV", "ISRCTN")`

prefermemberstate	Code of single EU Member State for which records should returned. If not available, a record for DE or lacking this, any random Member State's record for the trial will be returned. For a list of codes of EU Member States, please see vector <code>countriesEUCTR</code> . Specifying "3RD" will return the Third Country record of trials, where available.
include3rdcountrytrials	A logical value if trials should be retained that are conducted exclusively in third countries, that is, outside the European Union. Ignored if <code>prefermemberstate</code> is set to "3RD".
con	A connection object, see section 'Databases' in ctrdata-package
verbose	If set to TRUE, prints out which fields of the registers are used to find corresponding trial records

Value

A vector with strings of keys ("`_id`") of records in the collection that represent unique trials.

Examples

```
## Not run:
dbc <- nodbi::src_sqlite(collection = "my_collection")

dbFindIdsUniqueTrials(con = dbc)

## End(Not run)
```

dbGetFieldsIntoDf	<i>Create data frame of specified fields from database collection</i>
-------------------	---

Description

Fields in the collection are retrieved into a data frame (or tibble). Note that fields within the record of a trial can be hierarchical and structured, that is, nested. Names of fields can be found with [dbFindFields](#). The function uses the field names to appropriately type the values that it returns, harmonising original values (e.g. "Information not present in EudraCT" becomes 'NA', "Yes" becomes 'TRUE', "false" becomes 'FALSE', date strings become class Date, number strings become numbers). The function attempts so simplify the structure of some nested data and may concatenate multiple strings in a field using " / " (see below); for complex nested data, use function [dfTrials2Long](#) followed by [dfName2Value](#) to extract the desired nested variable(s).

Usage

```
dbGetFieldsIntoDf(fields = "", con, verbose = FALSE, stopifnodata = TRUE)
```

Arguments

fields	Vector of one or more strings, with names of sought fields. See function dbFind-Fields for how to find names of fields. "item.subitem" notation is supported.
con	A connection object, see section 'Databases' in ctrdata-package
verbose	Printing additional information if set to TRUE; (default FALSE).
stopifnodata	Stops with an error (default TRUE) or with a warning (FALSE) if the sought field is empty in all, or not available in any of the records in the database collection.

Value

A data frame (or tibble, if dplyr is loaded) with columns corresponding to the sought fields. A column for the record '_id' will always be included. Each column can be either a simple data type (numeric, character, date) or a list. For complicated lists, use function [dfTrials2Long](#) followed by function [dfName2Value](#) to extract values for nested variables. The maximum number of rows of the returned data frame is equal to, or less than the number of records of trials in the database collection.

Examples

```
## Not run:

dbc <- nodbi::src_sqlite(collection = "my_collection")

# access fields that are nested within another field
# and can have multiple values with the nested field
dbGetFieldsIntoDf(
  "b1_sponsor.b31_and_b32_status_of_the_sponsor",
  con = dbc
)

# access fields that include a list of values which
# (if they are strings) are concatenated with a slash
dbGetFieldsIntoDf("keyword", con = dbc)[1,]
#       _id                                     keyword
# 1 NCT00129259 T1D / type 1 diabetes / juvenile diabetes

## End(Not run)
```

 dbQueryHistory

Show history of queries loaded into a database collection

Description

Show history of queries loaded into a database collection

Usage

```
dbQueryHistory(con, verbose = FALSE)
```

Arguments

con A connection object, see section ‘Databases’ in [ctrdata-package](#)
 verbose If TRUE, prints additional information (default FALSE).

Value

A data frame (or tibble, if `dplyr` is loaded) with columns: ‘query-timestamp’, ‘query-register’, ‘query-records’ (note: this is the number of records loaded when last executing [ctrLoadQueryIntoDb](#), not the total record number) and ‘query-term’, with one row for each time [ctrLoadQueryIntoDb](#) loaded trial records into this collection.

Examples

```
## Not run:

dbc <- nodbi::src_sqlite(collection = "my_collection")

dbQueryHistory(con = dbc)

## End(Not run)
```

<code>dfListExtractKey</code>	<i>Extract named element(s) from list(s) into long-format data frame</i>
-------------------------------	--

Description

(Deprecated, use [dfTrials2Long](#) and [dfName2Value](#)!) The function uses a name (key) to extract an element from a list in a data.frame such as obtained with [dbGetFieldsIntoDf](#). This helps to simplify working with nested lists and with complex structures.

Usage

```
dfListExtractKey(df, list.key = list(c("endPoints.endPoint", "^title")))
```

Arguments

df A data frame (or tibble)
 list.key A list of pairs of list names and key names, where the list name corresponds to the name of a column in `df` that holds a list and the name of the key identifies the element to be extracted. See example.

Value

A data frame (or tibble, if dplyr is loaded) in long format with columns name (identifying the full path in the data frame, "<list>.<key>"), _id (of the trial record), value (of name per _id), item (number of value of name per _id).

Examples

```
## Not run:

dbc <- nodbi::src_sqlite(collection = "my_collection")

df <- dbGetFieldsIntoDf(
  fields = c(
    "endPoints.endPoint",
    "subjectDisposition.postAssignmentPeriods"),
  con = dbc
)

dfListExtractKey(
  df = df,
  list.key = list(
    c("endPoints.endPoint",
      "^title"),
    c("subjectDisposition.postAssignmentPeriods",
      "arms.arm.type.value")
  )
)

## End(Not run)
```

```
dfMergeTwoVariablesRelevel
      Merge two variables
```

Description

Merge two variables in a data frame such as returned by [dbGetFieldsIntoDf](#) into a new variable, and optionally also map its values to new levels.

Usage

```
dfMergeTwoVariablesRelevel(df = NULL, colnames = "", levelslist = NULL, ...)
```

Arguments

df	A data.frame in which there are two variables (columns) to be merged into one.
colnames	A vector of length two with names of the two columns that hold the variables to be merged. See colnames for how to obtain the names of columns of a data frame.
levelslist	A list with one slice each for a new value to be used for a vector of old values (optional).
...	for deprecated varnames parameter (will be removed)

Value

A vector of strings

Examples

```
## Not run:

statusvalues <- list(
  "ongoing" = c("Recruiting", "Active", "Ongoing",
               "Active, not recruiting", "Enrolling by invitation"),
  "completed" = c("Completed", "Prematurely Ended", "Terminated"),
  "other" = c("Withdrawn", "Suspended",
              "No longer available", "Not yet recruiting"))

dfMergeTwoVariablesRelevel(
  df = df,
  colnames = c("overall_status", "x5_trial_status"),
  levelslist = statusvalues)

## End(Not run)
```

dfName2Value	<i>Get value for variable of interest</i>
--------------	---

Description

Get information of interest (e.g., endpoint) from long data frame of protocol- or result-related trial information as returned by [dfTrials2Long](#). Parameters 'valuenam', 'wherenam' and 'wherevalue' are matched using Perl regular expressions and ignoring case.

Usage

```
dfName2Value(df, valuenam = "", wherenam = "", wherevalue = "")
```

Arguments

df	A data frame (or tibble) with four columns ('_id', 'identifier', 'name', 'value') as returned by dfTrials2Long
valuenam	A character string for the name of the field that holds the value for the variable of interest (e.g., a summary measure such as "endPoints.*tendencyValue.value")
wherenam	A character string to identify the variable of interest (e.g., "endPoints.endPoint.title")
wherevalu	A character string with the value of interest for the variable of interest (e.g., "duration of response")

Value

A data frame (or tibble, if dplyr is loaded) with columns '_id', 'identifier', 'name', 'value' that only includes the values of interest, where values are strings unless all value elements are numbers. The 'identifier' is generated by function [dfTrials2Long](#) to identify matching elements, e.g. endpoint descriptions and measurements.

Examples

```
## Not run:

dbc <- nodbi::src_sqlite(collection = "my_collection")

df <- dbGetFieldsIntoDf(
  fields = c(
    # ctgov - typical results fields
    "clinical_results.baseline.analyzed_list.analyzed.count_list.count",
    "clinical_results.baseline.group_list.group",
    "clinical_results.baseline.analyzed_list.analyzed.units",
    "clinical_results.outcome_list.outcome",
    "study_design_info.allocation",
    # eucr - typical results fields
    "trialInformation.fullTitle",
    "subjectDisposition.recruitmentDetails",
    "baselineCharacteristics.baselineReportingGroups.baselineReportingGroup",
    "endPoints.endPoint",
    "trialChanges.hasGlobalInterruptions",
    "subjectAnalysisSets",
    "adverseEvents.seriousAdverseEvents.seriousAdverseEvent"
  ), con = dbc
)

# convert to long
reslong <- dfTrials2Long(df = df)

# get values for endpoint of interest, e.g. 'response'
dfName2Value(
  df = reslong,
  valuenam = paste0(
    "endPoints.endPoint.*armReportingGroup.tendencyValues.tendencyValue.value|",
    "clinical_results.*category.measurement_list.measurement.value|"
  ),
```



```

      "clinical_results.*outcome.measure.units|endPoints.endPoint.unit"
    ),
    whereName = "clinical_results.*outcome.measure.title|endPoints.endPoint.title",
    whereValue = "response"
  )

## End(Not run)

```

dfTrials2Long *Convert data frame with trial records into long format*

Description

The function works with protocol- and results- related information. It converts lists and other values that are in a data frame returned by [dbGetFieldsIntoDf](#) into individual rows of a long data frame. From the resulting data frame, values of interest can be selected using [dfName2Value](#). The function is intended for fields with complex content, such as node field "clinical_results" from EUCTR, which [dbGetFieldsIntoDf](#) returns as a multiply nested list and for which this function then converts every observation of every (leaf) field into a row of its own.

Usage

```
dfTrials2Long(df)
```

Arguments

df Data frame (or tibble) with columns including the trial identifier (`_id`) and one or more variables as obtained from [dbGetFieldsIntoDf](#)

Value

A data frame (or tibble, if `dplyr` is loaded) with the four columns: `'_id'`, `'identifier'`, `'name'`, `'value'`

Examples

```

## Not run:

dbc <- nodbi::src_sqlite(collection = "my_collection")

df <- dbGetFieldsIntoDf(
  fields = c("clinical_results"),
  con = dbc
)
head(dfTrials2Long(df = df))

## End(Not run)

```

`installCygwinWindowsDoInstall`*Install necessary helper apps (Windows only)*

Description

Convenience function to install a minimal Cygwin environment under MS Windows, including perl, sed and php. Alternatively and in case of difficulties, download and run the cygwin setup yourself as follows: `cygwinsetup.exe --no-admin --quiet-mode --verbose --upgrade-also --root c:/cygwin --site https://www.mirrorservice.org/sites/sourceware.org/pub/cygwin/ --packages perl,php-jsonc,php-simplexml`. These binaries are required only for function [ctrLoadQueryIntoDb](#) but not for any other function in this package.

Usage

```
installCygwinWindowsDoInstall(force = FALSE, proxy = Sys.getenv("https_proxy"))
```

Arguments

<code>force</code>	Set to TRUE to update a Cygwin environment that was previously installed with the function, or to overwrite any existing installation in <code>c:\cygwin</code>
<code>proxy</code>	Specify any proxy to be used for downloading via http, e.g. <code>'host_or_ip:port'</code> ; defaults to the environment variable <code>'https_proxy'</code> . Set to <code>''</code> to not specify or to unset a proxy.

Examples

```
## Not run:  
  
installCygwinWindowsDoInstall()  
  
## End(Not run)
```

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