

# Package ‘SQLDataFrame’

January 21, 2025

**Title** Representation of SQL tables in DataFrame metaphor

**Version** 1.21.0

**Description** Implements bindings for SQL tables that are compatible with Bioconductor S4 data structures, namely the DataFrame and DelayedArray. This allows SQL-derived data to be easily used inside other Bioconductor objects (e.g., SummarizedExperiments) while keeping everything on disk.

**License** LGPL (>= 3); File LICENSE

**Depends** DelayedArray, S4Vectors

**Imports** stats, utils, methods, BiocGenerics, RSQLite, duckdb, DBI

**Suggests** knitr, rmarkdown, BiocStyle, testthat

**biocViews** DataRepresentation, Infrastructure, Software

**VignetteBuilder** knitr

**URL** <https://github.com/Bioconductor/SQLDataFrame>

**BugReports** <https://github.com/Bioconductor/SQLDataFrame/issues>

**RoxygenNote** 7.2.3

**Encoding** UTF-8

**git\_url** <https://git.bioconductor.org/packages/SQLDataFrame>

**git\_branch** devel

**git\_last\_commit** 909e7f6

**git\_last\_commit\_date** 2024-10-29

**Repository** Bioconductor 3.21

**Date/Publication** 2025-01-20

**Author** Qian Liu [aut, cre] (ORCID: <<https://orcid.org/0000-0003-1456-5099>>),  
Aaron Lun [aut],  
Martin Morgan [aut]

**Maintainer** Qian Liu <[Qian.Liu@RoswellPark.org](mailto:Qian.Liu@RoswellPark.org)>

## Contents

acquireConn . . . . .	2
SQLColumnSeed . . . . .	3
SQLDataFrame . . . . .	4
SQLiteColumnSeed-class . . . . .	6
<b>Index</b>	<b>9</b>

---

acquireConn	<i>Acquire the SQL file connection</i>
-------------	--

---

### Description

Acquire a (possibly cached) SQL file connection given it's path.

### Usage

```
acquireConn(path, dbtype = NULL)
```

```
releaseConn(path)
```

### Arguments

path	String containing a path to a SQL file.
dbtype	String containing the SQL database type (case insensitive). Supported types are "SQLite" and "DuckDB".

### Details

acquireConn will cache the DBIConnection object in the current R session to avoid repeated initialization. This improves efficiency for repeated calls, e.g., when creating a [DataFrame](#) with multiple columns from the same SQL table. The cached DBIConnection for any given path can be deleted by calling releaseConn for the same path.

### Value

For acquireConn, a DBIConnection with backends of SQLite or DuckDB, which are identical to that returned by `DBI::dbConnect(RSQLite::SQLite(), path)` or `DBI::dbConnect(duckdb::duckdb(), path)`.

For releaseConn, any existing DBIConnection for the path is disconnected and cleared from cache, and NULL is invisibly returned. If path=NULL, all cached connections are removed.

### Author(s)

Qian Liu

**Examples**

```
#####
## SQLite
#####

## Mocking up a file
tf <- tempfile()
on.exit(unlink(tf))
con <- DBI::dbConnect(RSQLite::SQLite(), tf)
DBI::dbWriteTable(con, "mtcars", mtcars)
DBI::dbDisconnect(con)

## Acquire or release connection
con <- acquireConn(tf, dbtype = "SQLite")
acquireConn(tf, dbtype = "SQLite") # just re-uses the cache
releaseConn(tf) # clears the cache

#####
## DuckDB
#####

tf1 <- tempfile()
on.exit(unlist(tf1))
con <- DBI::dbConnect(duckdb::duckdb(), tf1)
DBI::dbWriteTable(con, "mtcars", mtcars)
DBI::dbDisconnect(con)
con <- acquireConn(tf1, dbtype = "DuckDB")
releaseConn(tf1)
```

---

SQLColumnSeed

*Column of a SQL table*


---

**Description**

Represent a column of a SQL table as a 1-dimensional [DelayedArray](#). This allows us to use SQL data inside [DataFrames](#) without loading them into memory.

**Usage**

```
SQLColumnSeed(path, dbtype, table, column, length = NULL, type = NULL)
```

```
SQLColumnVector(x, ...)
```

**Arguments**

**path** String containing a path to a SQL file.

**dbtype** String containing the SQL database type (case insensitive). Supported types are "SQLite" and "DuckDB".

table	String containing the name of the table in SQL file.
column	String containing the name of the column inside the table.
length	Integer containing the number of rows. If NULL, this is determined by inspecting the SQL table. This should only be supplied for efficiency purposes, to avoid a file look-up on construction.
type	String specifying the type of the data. If NULL, this is determined by inspecting the file. Users may specify this to avoid a look-up, or to coerce the output into a different type.
x	A SQLColumnSeed object.
...	Further arguments to be passed to the SQLColumnSeed constructor. #'

**Value**

For SQLColumnSeed: a SQLColumnSeed. For SQLColumnVector: a SQLColumnVector. #'

**Author(s)**

Qian Liu

**Examples**

```
# Mocking up a file:
tf <- tempfile()
on.exit(unlink(tf))
con <- DBI::dbConnect(RSQLite::SQLite(), tf)
DBI::dbWriteTable(con, "mtcars", mtcars)
DBI::dbDisconnect(con)

# Creating a vector:
SQLColumnVector(tf, dbtype = "SQLite", "mtcars", column="gear")

# This happily lives inside DataFrames:
collected <- list()
for (x in colnames(mtcars)) {
  collected[[x]] <- SQLColumnVector(tf, dbtype = "SQLite", "mtcars", column=x)
}
DataFrame(collected)
#'
```

---

SQLDataFrame

*SQL-backed DataFrame*


---

**Description**

Create a SQL-backed [DataFrame](#), where the data are kept on disk until requested. Direct extension classes are `SQLiteDataFrame` and `DuckDBDataFrame`.

## Usage

```
SQLDataFrame(path, dbtype = NULL, table = NULL, columns = NULL, nrows = NULL)
```

## Arguments

path	String containing a path to a SQL file.
dbtype	String containing the SQL database type (case insensitive). Supported types are "SQLite" and "DuckDB".
table	String containing the name of SQL table.
columns	Character vector containing the names of columns in a SQL table. If NULL, this is determined from path.
nrows	Integer scalar specifying the number of rows in a SQL table. If NULL, this is determined from path.

## Details

The `SQLDataFrame` is essentially just a `DataFrame` of `SQLColumnVector` objects. It is primarily useful for indicating that the in-memory representation is consistent with the underlying SQL file (e.g., no delayed filter/mutate operations have been applied, no data has been added from other files). Thus, users can specialize code paths for a `SQLDataFrame` to operate directly on the underlying SQL table.

In that vein, operations on a `SQLDataFrame` may return another `SQLDataFrame` if the operation does not introduce inconsistencies with the file-backed data. For example, slicing or combining by column will return a `SQLDataFrame` as the contents of the retained columns are unchanged. In other cases, the `SQLDataFrame` will collapse to a regular `DFrame` of `SQLColumnVector` objects before applying the operation; these are still file-backed but lack the guarantee of file consistency.

## Value

A `SQLDataFrame` where each column is a `SQLColumnVector`.

## Author(s)

Qian Liu

## Examples

```
## Mocking up a file:

### SQLite
tf <- tempfile()
on.exit(unlink(tf))
con <- DBI::dbConnect(RSQLite::SQLite(), tf)
DBI::dbWriteTable(con, "mtcars", mtcars)
DBI::dbDisconnect(con)

### DuckDB
tf1 <- tempfile()
```

```
on.exit(unlist(tf1))
con <- DBI::dbConnect(duckdb::duckdb(), tf1)
DBI::dbWriteTable(con, "mtcars", mtcars)
DBI::dbDisconnect(con)

## Creating a SQLite-backed data frame:

df <- SQLDataFrame(tf, dbtype = "SQLite", table = "mtcars")
df1 <- SQLiteDataFrame(tf, "mtcars")
identical(df, df1)

## DuckDB-backed data frame:
df2 <- SQLDataFrame(tf1, dbtype = "duckdb", table = "mtcars")
df3 <- DuckDBDataFrame(tf1, "mtcars")
identical(df2, df3)
## Extraction yields a SQLiteColumnVector:
df$carb

## Some operations preserve the SQLDataFrame:
df[,1:5]
combined <- cbind(df, df)
class(combined)

## ... but most operations collapse to a regular DFrame:
df[1:5,]
combined2 <- cbind(df, some_new_name=df[,1])
class(combined2)

df1 <- df
rownames(df1) <- paste0("row", seq_len(nrow(df1)))
class(df1)

df2 <- df
colnames(df2) <- letters[1:ncol(df2)]
class(df2)

df3 <- df
df3$carb <- mtcars$carb
class(df3)

## Utility functions
path(df)
dbtype(df)
sqltable(df)
dim(df)
names(df)

as.data.frame(df)
```

---

SQLiteColumnSeed-class

*SQL extensions***Description**

Extensions of SQLDataFrame, SQLColumnVector, SQLColumnSeed with different SQL backends. Currently supporting SQLite and DuckDB, with which the definition coding can be followed for added extension of other SQL backends.

**Arguments**

path	String containing a path to a SQL file.
table	String containing the name of the table in SQL file.
column	String containing the name of the column inside the table.
length	Integer containing the number of rows. If NULL, this is determined by inspecting the SQL table. This should only be supplied for efficiency purposes, to avoid a file look-up on construction.
type	String specifying the type of the data. If NULL, this is determined by inspecting the file. Users may specify this to avoid a look-up, or to coerce the output into a different type.

**Examples**

```
## Mocking up a file:

### SQLite
tf <- tempfile()
on.exit(unlink(tf))
con <- DBI::dbConnect(RSQLite::SQLite(), tf)
DBI::dbWriteTable(con, "mtcars", mtcars)
DBI::dbDisconnect(con)

### DuckDB
tf1 <- tempfile()
on.exit(unlist(tf1))
con <- DBI::dbConnect(duckdb::duckdb(), tf1)
DBI::dbWriteTable(con, "mtcars", mtcars)
DBI::dbDisconnect(con)

## Constructor of xxColumnSeed and xxColumnVector

sd <- SQLiteColumnSeed(tf, "mtcars", "gear")
scv <- SQLiteColumnVector(sd)
scv1 <- SQLiteColumnVector(tf, "mtcars", "gear")
identical(scv, scv1)

DuckDBColumnSeed(tf1, "mtcars", "mpg")
DuckDBColumnVector(tf1, "mtcars", "mpg")
```

```
## Constructor of xxDataFrame  
  
SQLiteDataFrame(tf, "mtcars")  
DuckDBDataFrame(tf1, "mtcars")
```



# Index

`[[`, `SQLDataFrame`-method (`SQLDataFrame`), 4  
`[[<-`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4

`acquireConn`, 2  
`as.data.frame`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4

`cbind`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`cbind.SQLDataFrame` (`SQLDataFrame`), 4  
`coerce`, `SQLDataFrame`, `DFrame`-method  
    (`SQLDataFrame`), 4

`DataFrame`, 2–5  
`DelayedArray`, 3  
`DelayedArray`, `DuckDBColumnSeed`-method  
    (`SQLiteColumnSeed`-class), 7  
`DelayedArray`, `SQLColumnSeed`-method  
    (`SQLColumnSeed`), 3  
`DelayedArray`, `SQLiteColumnSeed`-method  
    (`SQLiteColumnSeed`-class), 7  
`DFrame`, 5  
`dim`, `SQLColumnSeed`-method  
    (`SQLColumnSeed`), 3  
`DuckDBColumnSeed`-class  
    (`SQLiteColumnSeed`-class), 7  
`DuckDBColumnVector`-class  
    (`SQLiteColumnSeed`-class), 7  
`DuckDBDataFrame`-class  
    (`SQLiteColumnSeed`-class), 7

`extract_array`, `SQLColumnSeed`-method  
    (`SQLColumnSeed`), 3  
`extractCOLS`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`extractROWS`, `SQLDataFrame`, `ANY`-method  
    (`SQLDataFrame`), 4

`length`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4

`names`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`names<-`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`ncol`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`normalizeSingleBracketReplacementValue`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`nrow`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4

`path`, `SQLColumnSeed`-method  
    (`SQLColumnSeed`), 3  
`path`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4

`releaseConn` (`acquireConn`), 2  
`replaceCOLS`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`replaceROWS`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`rownames`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4  
`rownames<-`, `SQLDataFrame`-method  
    (`SQLDataFrame`), 4

`SQLColumnSeed`, 3  
`SQLColumnSeed`-class (`SQLColumnSeed`), 3  
`SQLColumnVector`, 5  
`SQLColumnVector` (`SQLColumnSeed`), 3  
`SQLColumnVector`-class (`SQLColumnSeed`), 3  
`SQLDataFrame`, 4  
`SQLDataFrame`-class (`SQLDataFrame`), 4  
`SQLiteColumnSeed`-class, 6  
`SQLiteColumnVector`-class  
    (`SQLiteColumnSeed`-class), 7  
`SQLiteDataFrame`-class  
    (`SQLiteColumnSeed`-class), 7  
`sqltable`, `SQLColumnSeed`-method  
    (`SQLColumnSeed`), 3

type, [SQLColumnSeed-method](#)  
([SQLColumnSeed](#)), [3](#)