Package ‘TileDBArray’

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Title Using TileDB as a DelayedArray Backend
Description Implements a DelayedArray backend for reading and writing dense or sparse arrays in the TileDB format. The resulting TileDBArrays are compatible with all Bioconductor pipelines that can accept DelayedArray instances.
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Description

The TileDBArray class provides a DelayedArray backend for TileDB arrays (sparse and dense).

Constructing a TileDBArray

TileDBArray(\textit{x}, \textit{attr}) returns a TileDBArray object given:
\begin{itemize}
  \item \textit{x}, a string containing a URI to a TileDB backend, most typically a path to a directory.
  \item \textit{attr}, a string specifying the attribute to represent in the array. Defaults to the first attribute.
\end{itemize}

Alternatively, \textit{x} can be a TileDBArraySeed object, in which case \textit{attr} is ignored.

TileDBArraySeed(\textit{x}, \textit{attr}) returns a TileDBArraySeed with the same arguments as described for TileDBArray. If \textit{x} is already a TileDBArraySeed, it is returned directly without further modification.

DelayedArray(\textit{x}) returns a TileDBArray object given \textit{x}, a TileDBArraySeed.

In all cases, two-dimensional arrays will automatically generate a TileDBMatrix, a subclass of the TileDBArray.

Available operations

\texttt{extract\_array(\textit{x}, \textit{index})} will return an ordinary array containing values from the TileDBArraySeed \textit{x}, subsetted to the indices specified in \textit{index}. The latter should be a list of length equal to the number of dimensions in \textit{x}, where each entry is an integer vector or NULL (in which case the entirety of the dimension is used).

\texttt{OLD\_extract\_sparse\_array(\textit{x}, \textit{index})} will return a SparseArraySeed containing the indices of non-zero entries in \textit{x}, subsetted to the indices in \textit{index}. The latter should be a list of the same structure as described for extract_array.

\texttt{type(\textit{x})} will return a string containing the type of the TileDBArraySeed object \textit{x}. Currently, only "integer", "logical" and "double"-precision is supported.

\texttt{is\_sparse(\textit{x})} will return a logical scalar indicating whether the TileDBArraySeed \textit{x} uses a sparse format in the TileDB backend.

\texttt{path(\textit{x})} will return a string containing the path to the TileDB backend directory.
chunkdim(x) will return an integer vector containing the tile extent in each dimension. This will be used as the chunk dimensions in methods like chunkGrid.

All of the operations described above are also equally applicable to TileDBArray objects, as their methods simply delegate to those of the TileDBArraySeed.

All operations supported by DelayedArray objects are also available for TileDBArray objects.

Author(s)
Aaron Lun

Examples

data <- matrix(rpois(10000, 5), nrow=100, ncol=100)
B <- as(data, "TileDBArray")
B

# Apply typical DelayedArray operations:
as.matrix(B[1:10,1:10])
B %*% runif(ncol(B))

# This also works for sparse arrays:
sdata <- Matrix::rsparsematrix(nrow=100, ncol=100, density=0.1)
C <- as(sdata, "TileDBArray")
C

TileDBArray-globals  

TileDBArray global options

Description
Global options for writing TileDBArray backends, intended for parameters that cannot be automatically derived from the data.

Usage

getTileDBPath()

setTileDBPath(path = NULL)

getTileDBAttr()

setTileDBAttr(attr = NULL)

getTileDBExtent()

setTileDBExtent(extent = NULL)
getTileDBContext()

setTileDBContext(context = NULL)

getTileDBCellOrder()

setTileDBCellOrder(cellorder = NULL)

getTileDBTileOrder()

setTileDBTileOrder(tileorder = NULL)

getTileDBCapacity()

setTileDBCapacity(capacity = NULL)

Arguments

path String containing a path to a TileDB backend.

attr String containing the name of a TileDB attribute.

extent Integer scalar specifying the tile extent for all dimensions. Alternatively, an integer vector of length equal to the number of dimensions, specifying a different extent for each dimension in the array to be created.

context A TileDB context object, see tiledb_ctx for an example.

cellorder String specifying the desired cell order.

tileorder String specifying the desired tile order.

capacity Integer scalar specifying the data tile capacity for sparse arrays.

Value

All of the getter functions return the current global value, or a default value if the former is NULL:

- path defaults to a temporary file in tempdir.
- attr defaults to "x".
- extent defaults to 100L.
- cellorder defaults to "COL_MAJOR".
- tileorder defaults to "COL_MAJOR".
- capacity defaults to 10000L.
- context defaults to the value of tiledb_ctx().

All setter functions change the global value and return NULL invisibly.

Author(s)

Aaron Lun
Description

Implements the TileDB framework as a DelayedArray backend, with read and write functionality for both dense and sparse arrays. Currently only integer, logical and double-precision values are supported.

Author(s)

Aaron Lun

Writing a TileDBArray

TileDBRealizationSink(
  dim,
  dimnames=NULL,
  type="double",
  path=getTileDBPath(),
  attr=getTileDBAttr(),
  sparse=FALSE,
  extent=getTileDBExtent(),
  cellorder=getTileDBCellOrder(),
  tileorder=getTileDBTileOrder(),
  capacity=getTileDBCapacity(),
  context=getTileDBContext()
returns a TileDBRealizationSink object that can be used to write content to a TileDB backend. It accepts the following arguments:

- **dim**, an integer vector (usually of length 2) to specify the array dimensions.
- **dimnames**, a list of length equal to **dim**, containing character vectors with names for each dimension. Defaults to NULL, i.e., no dimnames.
- **type**, a string specifying the data type. Currently only numeric, logical and integer arrays are supported.
- **path**, a string specifying the location of the new TileDB backend.
- **attr**, a string containing the location of the new TileDB backend.
- **sparse**, a logical scalar indicating whether the array should be stored in sparse form.
- **extent**, an integer scalar (or vector of length equal to **dim**) specifying the tile extent for each dimension. Larger values improve compression at the cost of unnecessary data extraction during reads.
- **cellorder**, a string specifying the ordering of cells within each tile.
- **tileorder**, a string specifying the ordering of tiles across the array.
- **capacity**, an integer scalar specifying the size of each data tile in the sparse case.
- **context** is the TileDB context, defaulting to the output of `tiledb_ctx()`.

`writeTileDBArray(x, sparse=is_sparse(x), ...)` writes the matrix-like object `x` to a TileDB backend, returning a `TileDBArray` object referring to that backend. Appropriate values for **dim**, **dimnames** and **type** are determined automatically from `x` itself. All other arguments described for `TileDBRealizationSink` can be passed into `...` to configure the representation.

### Coercing to a TileDBArray

`as(x, "TileDBArray")` will coerce a matrix-like object `x` to a `TileDBArray` object.

`as(x, "TileDBArraySeed")` will coerce a matrix-like object `x` to a `TileDBArraySeed` object.

`as(x, "TileDBMatrix")` will coerce a matrix-like object `x` to a `TileDBArraySeed` object.

`as(x, "TileDBArraySeed")` will coerce a `TileDBRealizationSink` `x` to a `TileDBArray` object.

`as(x, "TileDBArraySeed")` will coerce a `TileDBRealizationSink` `x` to a `TileDBArraySeed` object.

`as(x, "DelayedArray")` will coerce a `TileDBRealizationSink` `x` to a `TileDBArray` object.

### Sink internals

`write_block(sink, viewport, block)` will write the subarray `block` to the `TileDBRealizationSink` `sink` at the specified `viewport`, returning `sink` upon completion. See `write_block` in `DelayedArray` for more details.

`type(x)` will return a string specifying the type of the `TileDBRealizationSink` `x`. 


Examples

```r
X <- matrix(rnorm(100000), ncol=200)
path <- tempfile()
out <- writeTileDBArray(X, path=path)

# Works for integer matrices.
Xi <- matrix(rpois(100000, 2), ncol=200)
pathi <- tempfile()
outi <- writeTileDBArray(Xi, path=pathi)

# Works for logical matrices.
Xl <- matrix(rpois(100000, 0.5) > 0, ncol=200)
pathl <- tempfile()
outl <- writeTileDBArray(Xl, path=pathl)

# Works for sparse numeric matrices.
Y <- Matrix::rsparsematrix(1000, 1000, density=0.01)
path2 <- tempfile()
out2 <- writeTileDBArray(Y, path=path2)

# And for sparse logical matrices.
path2l <- tempfile()
out2l <- writeTileDBArray(Y > 0, path=path2l)

# Works for dimnames.
rownames(X) <- sprintf("GENE_%i", seq_len(nrow(X)))
path3 <- tempfile()
out3 <- writeTileDBArray(X, path=path3)
```
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