Package: TileDBArray (via r-universe)

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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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`TileDBArray` *Delayed TileDB arrays*

Description

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

Constructing a TileDBArray

`TileDBArray(x, attr)` returns a TileDBArray object given:

- `x`, a string containing a URI to a TileDB backend, most typically a path to a directory.
- `attr`, a string specifying the attribute to represent in the array. Defaults to the first attribute.

Alternatively, `x` can be a TileDBArraySeed object, in which case `attr` is ignored.

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

`DelayedArray(x)` returns a TileDBArray object given `x`, a TileDBArraySeed.

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

Available operations

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

`extract_sparse_array(x, index)` will return a COO_SparseArray representing the subset of `x` corresponding to the indices in `index`. The latter should be a list of the same structure as described for `extract_array`.

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

`is_sparse(x)` will return a logical scalar indicating whether the TileDBArraySeed `x` uses a sparse format in the TileDB backend.

`path(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)

getTileDBDimType()

setTileDBDimType(dimtype = 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.
dimtype	String specifying the TileDB datatype to use for the dimensions.
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".
- dimtype defaults to "INT32".
- 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

See Also

writeTileDBArray, where these functions are most often used.

Examples

```
setTileDBPath("my_local_dir")
getTileDBPath()
```

TileDBArray-pkg *The* **TileDBArray** *package*

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

TileDBRealizationSink *Write arrays to TileDB*

Description

Write array data to a TileDB backend via **DelayedArray**'s RealizationSink machinery.

Writing a TileDBArray

```
TileDBRealizationSink(
    dim,
    dimnames=NULL,
    type="double",
    path=getTileDBPath(),
    attr=getTileDBAttr(),
    storagetype=NULL,
    dimtype=getTileDBDimType(),
    sparse=FALSE,
    extent=getTileDBExtent(),
    offset=1L,
    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 R data type for the newly written array. Currently only `"double"`, `"integer"` and `"logical"` arrays are supported.
- `path`, a string containing the location of the new TileDB backend.
- `attr`, a string specifying the name of the attribute to store.
- `storagetype`, a string specifying the TileDB data type for the attribute, e.g., `"UINT8"`, `"FLOAT32"`. If `NULL`, this is automatically determined from `type` using `r_to_tiledb_type`.
- `dimtype`, a string specifying the TileDB data type for the dimension.
- `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.
- `offset`, an integer scalar (or vector of length equal to `dim`) specifying the starting offset for each dimension's domain.
- `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, "TileDBArray")` 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

```
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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