
pygdf Documentation

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Continuum Analytics

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Contents:

1	API Reference	1
1.1	DataFrame	1
1.2	Series	8
1.3	Groupby	14
1.4	GpuArrowReader	16
2	Developer Documentation	17
2.1	Code Organization	17
2.2	Code that should move to libgdf	18
3	Indices and tables	19

1.1 DataFrame

class `pygdf.dataframe.DataFrame` (*name_series=None, index=None*)
A GPU Dataframe object.

Examples

Build dataframe with `__setitem__`

```
>>> from pygdf.dataframe import DataFrame
>>> df = DataFrame()
>>> df['key'] = [0, 1, 2, 3, 4]
>>> df['val'] = [float(i + 10) for i in range(5)] # insert column
>>> df
   key val
0  0  10.0
1  1  11.0
2  2  12.0
3  3  13.0
4  4  14.0
>>> len(df)
5
```

Build dataframe with initializer

```
>>> import numpy as np
>>> df2 = DataFrame([('a', np.arange(10)),
...                 ('b', np.random.random(10))])
>>> df2
   a b
0  0 0.777831724018
```

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```

1 1 0.604480034669
2 2 0.664111858618
3 3 0.887777513028
4 4 0.55838311246
[5 more rows]

```

Convert from a Pandas DataFrame.

```

>>> import pandas as pd
>>> from pygdf.dataframe import DataFrame
>>> pdf = pd.DataFrame({'a': [0, 1, 2, 3],
...                    'b': [0.1, 0.2, None, 0.3]})
>>> pdf
a    b
0  0  0.1
1  1  0.2
2  2  NaN
3  3  0.3
>>> df = DataFrame.from_pandas(pdf)
>>> df
a  b
0  0  0.1
1  1  0.2
2  2  nan
3  3  0.3

```

Attributes

columns Returns a tuple of columns

dtypes Return the dtypes in this object.

index Returns the index of the DataFrame

loc Returns a label-based indexer for row-slicing and column selection.

Methods

<code>add_column(name, data[, forceindex])</code>	Add a column
<code>apply_chunks(func, incol, outcols[, ...])</code>	Transform user-specified chunks using the user-provided function.
<code>apply_rows(func, incol, outcols, kwargs[, ...])</code>	Transform each row using the user-provided function.
<code>as_gpu_matrix([columns])</code>	Convert to a matrix in device memory.
<code>as_matrix([columns])</code>	Convert to a matrix in host memory.
<code>copy()</code>	Shallow copy this dataframe
<code>drop_column(name)</code>	Drop a column by <i>name</i>
<code>from_pandas(dataframe)</code>	Convert from a Pandas DataFrame.
<code>from_records(data[, index, columns])</code>	Convert from a numpy recarray or structured array.
<code>groupby(by[, sort, as_index])</code>	Groupby
<code>join(other[, on, how, lsuffix, rsuffix, sort])</code>	Join columns with other DataFrame on index or on a key column.
<code>label_encoding(column, prefix, cats[, ...])</code>	Encode labels in a column with label encoding.

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Table 1 – continued from previous page

<code>nlargest(n, columns[, keep])</code>	Get the rows of the DataFrame sorted by the <i>n</i> largest value of <i>columns</i>
<code>nsmallest(n, columns[, keep])</code>	Get the rows of the DataFrame sorted by the <i>n</i> smallest value of <i>columns</i>
<code>one_hot_encoding(column, prefix, cats[, ...])</code>	Expand a column with one-hot-encoding.
<code>query(expr)</code>	Query with a boolean expression using Numba to compile a GPU kernel.
<code>set_index(index)</code>	Return a new DataFrame with a new index
<code>sort_index([ascending])</code>	Sort by the index
<code>sort_values(by[, ascending])</code>	Sort by values.
<code>to_pandas()</code>	Convert to a Pandas DataFrame.
<code>to_records([index])</code>	Convert to a numpy recarray
<code>to_string([nrows, ncols])</code>	Convert to string

deserialize	
head	
reset_index	
serialize	
take	

add_column (*name, data, forceindex=False*)

Add a column

Parameters

name [str] Name of column to be added.

data [Series, array-like] Values to be added.

apply_chunks (*func, incols, outcols, kwargs={}, chunks=None, tpb=1*)

Transform user-specified chunks using the user-provided function.

Parameters

func [function] The transformation function that will be executed on the CUDA GPU.

incols: list A list of names of input columns.

outcols: dict A dictionary of output column names and their dtype.

kwargs: dict name-value of extra arguments. These values are passed directly into the function.

chunks [int or Series-like] If it is an `int`, it is the chunksize. If it is an array, it contains integer offset for the start of each chunk. The span of a chunk for chunk *i*-th is `data[chunks[i] : chunks[i + 1]]` for any $i + 1 < \text{chunks.size}$; or, `data[chunks[i] :]` for the $i == \text{len}(\text{chunks}) - 1$.

tpb [int; optional] It is the thread-per-block for the underlying kernel. The default uses 1 thread to emulate serial execution for each chunk. It is a good starting point but inefficient. Its maximum possible value is limited by the available CUDA GPU resources.

See also:

`apply_rows`

Examples

For `tpb > 1`, `func` is executed by `tpb` number of threads concurrently. To access the thread id and count, use `numba.cuda.threadIdx.x` and `numba.cuda.blockDim.x`, respectively (See [numba CUDA kernel documentation](#)).

In the example below, the *kernel* is invoked concurrently on each specified chunk. The *kernel* computes the corresponding output for the chunk. By looping over the range `range(cuda.threadIdx.x, in1.size, cuda.blockDim.x)`, the *kernel* function can be used with any *tpb* in an efficient manner.

```
>>> from numba import cuda
>>> def kernel(in1, in2, in3, out1):
...     for i in range(cuda.threadIdx.x, in1.size, cuda.blockDim.x):
...         x = in1[i]
...         y = in2[i]
...         z = in3[i]
...         out1[i] = x * y + z
```

apply_rows (*func, incol, outcols, kwargs, cache_key=None*)

Transform each row using the user-provided function.

Parameters

func [function] The transformation function that will be executed on the CUDA GPU.

incols: list A list of names of input columns.

outcols: dict A dictionary of output column names and their dtype.

kwargs: dict name-value of extra arguments. These values are passed directly into the function.

Examples

With a `DataFrame` like so:

```
>>> df = DataFrame()
>>> df['in1'] = in1 = np.arange(nelem)
>>> df['in2'] = in2 = np.arange(nelem)
>>> df['in3'] = in3 = np.arange(nelem)
```

Define the user function for `.apply_rows`:

```
>>> def kernel(in1, in2, in3, out1, out2, extral, extra2):
...     for i, (x, y, z) in enumerate(zip(in1, in2, in3)):
...         out1[i] = extra2 * x - extral * y
...         out2[i] = y - extral * z
```

The user function should loop over the columns and set the output for each row. Each iteration of the loop **MUST** be independent of each other. The order of the loop execution can be arbitrary.

Call `.apply_rows` with the name of the input columns, the name and dtype of the output columns, and, optionally, a dict of extra arguments.

```
>>> outdf = df.apply_rows(kernel,
...                       incol=['in1', 'in2', 'in3'],
...                       outcol=dict(out1=np.float64,
```

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```

...         out2=np.float64),
...         kwargs=dict(extra1=2.3, extra2=3.4))

```

Notes

When `func` is invoked, the array args corresponding to the input/output are strided in a way that improves parallelism on the GPU. The loop in the function may look like serial code but it will be executed concurrently by multiple threads.

as_gpu_matrix (*columns=None*)

Convert to a matrix in device memory.

Parameters

columns: sequence of str List of a column names to be extracted. The order is preserved. If None is specified, all columns are used.

Returns

A (nrow x ncol) numpy ndarray in “F” order.

as_matrix (*columns=None*)

Convert to a matrix in host memory.

Parameters

columns: sequence of str List of a column names to be extracted. The order is preserved. If None is specified, all columns are used.

Returns

A (nrow x ncol) numpy ndarray in “F” order.

columns

Returns a tuple of columns

copy()

Shallow copy this dataframe

drop_column (*name*)

Drop a column by *name*

dtypes

Return the dtypes in this object.

classmethod from_pandas (*dataframe*)

Convert from a Pandas DataFrame.

Raises

TypeError for invalid input type.

classmethod from_records (*data, index=None, columns=None*)

Convert from a numpy recarray or structured array.

Parameters

data [numpy structured dtype or recarray]

index [str] The name of the index column in *data*. If None, the default index is used.

columns [list of str] List of column names to include.

Returns

DataFrame

groupby (*by*, *sort=False*, *as_index=False*)

Groupby

Parameters

by [list-of-str or str] Column name(s) to form that groups by.

sort [bool] Force sorting group keys. Depends on the underlying algorithm. Current algorithm always sort.

as_index [bool; defaults to False] Must be False. Provided to be API compatible with pandas. The keys are always left as regular columns in the result.

Returns

The groupby object

Notes

Unlike pandas, this groupby operation behaves like a SQL groupby. No empty rows are returned. (For categorical keys, pandas returns rows for all categories even if they are no corresponding values.)

Only a minimal number of operations is implemented so far.

- Only *by* argument is supported.
- The output is always sorted according to the *by* columns.
- Since we don't support multiindex, the *by* columns are stored as regular columns.

index

Returns the index of the DataFrame

join (*other*, *on=None*, *how='left'*, *lsuffix=""*, *rsuffix=""*, *sort=False*)

Join columns with other DataFrame on index or on a key column.

Parameters

other [DataFrame]

how [str] Only accepts "left", "right", "inner", "outer"

lsuffix, rsuffix [str] The suffices to add to the left (*lsuffix*) and right (*rsuffix*) column names when avoiding conflicts.

sort [bool] Set to True to ensure sorted ordering.

Returns

joined : DataFrame

Notes

Difference from pandas:

- *other* must be a single DataFrame for now.
- *on* is not supported yet due to lack of multi-index support.

label_encoding (*column*, *prefix*, *cats*, *prefix_sep='_'*, *dtype=None*, *na_sentinel=-1*)

Encode labels in a column with label encoding.

Parameters

column [str] the source column with binary encoding for the data.

prefix [str] the new column name prefix.

cats [sequence of ints] the sequence of categories as integers.

prefix_sep [str] the separator between the prefix and the category.

dtype : the dtype for the outputs; see Series.label_encoding

na_sentinel [number] Value to indicate missing category.

Returns

a new dataframe with a new column append for the coded values.

loc

Returns a label-based indexer for row-slicing and column selection.

Examples

```
>>> df = DataFrame([('a', list(range(20))),
...                 ('b', list(range(20))),
...                 ('c', list(range(20)))]
# get rows from index 2 to index 5 from 'a' and 'b' columns.
>>> df.loc[2:5, ['a', 'b']]
   a  b
2  2  2
3  3  3
4  4  4
5  5  5
```

nlargest (*n*, *columns*, *keep='first'*)

Get the rows of the DataFrame sorted by the *n* largest value of *columns*

Difference from pandas: * Only a single column is supported in *columns*

nsmallest (*n*, *columns*, *keep='first'*)

Get the rows of the DataFrame sorted by the *n* smallest value of *columns*

Difference from pandas: * Only a single column is supported in *columns*

one_hot_encoding (*column*, *prefix*, *cats*, *prefix_sep='_'*, *dtype='float64'*)

Expand a column with one-hot-encoding.

Parameters

column [str] the source column with binary encoding for the data.

prefix [str] the new column name prefix.

cats [sequence of ints] the sequence of categories as integers.

prefix_sep [str] the separator between the prefix and the category.

dtype : the dtype for the outputs; defaults to float64.

Returns

a new dataframe with new columns append for each category.

query (*expr*)

Query with a boolean expression using Numba to compile a GPU kernel.

See pandas.DataFrame.query.

Parameters

expr [str] A boolean expression. Names in the expression refers to the columns. Any name prefixed with @ refer to the variables in the calling environment.

Returns

filtered [DataFrame]

set_index (*index*)

Return a new DataFrame with a new index

Parameters

index [Index, Series-convertible or str] Index: the new index. Series-convertible: values for the new index. str: name of column to be used as series

sort_index (*ascending=True*)

Sort by the index

sort_values (*by, ascending=True*)

Sort by values.

Difference from pandas: * *by* must be the name of a single column. * Support axis='index' only. * Not supporting: inplace, kind, na_position

Details: Uses parallel radixsort, which is a stable sort.

to_pandas ()

Convert to a Pandas DataFrame.

to_records (*index=True*)

Convert to a numpy recarray

Parameters

index [bool] Whether to include the index in the output.

Returns

numpy recarray

to_string (*nrows=NOTSET, ncols=NOTSET*)

Convert to string

Parameters

nrows [int] Maximum number of rows to show. If it is None, all rows are shown.

ncols [int] Maximum number of columns to show. If it is None, all columns are shown.

1.2 Series

class pygdf.dataframe.**Series** (*data, index=None*)

Data and null-masks.

Series objects are used as columns of DataFrame.

Attributes

cat**data** The gpu buffer for the data**dtype** dtype of the Series**has_null_mask** A boolean indicating whether a null-mask is needed**index** The index object**null_count** Number of null values**nullmask** The gpu buffer for the null-mask**valid_count** Number of non-null values**Methods**

<code>append(arbitrary)</code>	Append values from another <code>Series</code> or array-like object.
<code>applymap(udf[, out_dtype])</code>	Apply a elementwise function to transform the values in the Column.
<code>argsort([ascending])</code>	Returns a <code>Series</code> of int64 index that will sort the series.
<code>as_mask()</code>	Convert booleans to bitmask
<code>astype(dtype)</code>	Convert to the given <code>dtype</code> .
<code>ceil()</code>	Rounds each value upward to the smallest integral value not less than the original.
<code>count()</code>	The number of non-null values
<code>factorize([na_sentinel])</code>	Encode the input values as integer labels
<code>fillna(value)</code>	Fill null values with <code>value</code> .
<code>find_first_value(value)</code>	Returns offset of first value that matches
<code>find_last_value(value)</code>	Returns offset of last value that matches
<code>floor()</code>	Rounds each value downward to the largest integral value not greater than the original.
<code>from_categorical(categorical[, codes])</code>	Creates from a <code>pandas.Categorical</code>
<code>from_masked_array(data, mask[, null_count])</code>	Create a <code>Series</code> with null-mask.
<code>label_encoding(cats[, dtype, na_sentinel])</code>	Perform label encoding
<code>max()</code>	Compute the max of the series
<code>mean()</code>	Compute the mean of the series
<code>mean_var([ddof])</code>	Compute mean and variance at the same time.
<code>min()</code>	Compute the min of the series
<code>nlargest([n, keep])</code>	Returns a new <code>Series</code> of the <code>n</code> largest element.
<code>nsmallest([n, keep])</code>	Returns a new <code>Series</code> of the <code>n</code> smallest element.
<code>one_hot_encoding(cats[, dtype])</code>	Perform one-hot-encoding
<code>reset_index()</code>	Reset index to <code>RangeIndex</code>
<code>reverse()</code>	Reverse the <code>Series</code>
<code>scale()</code>	Scale values to <code>[0, 1]</code> in float64
<code>set_index(index)</code>	Returns a new <code>Series</code> with a different index.
<code>set_mask(mask[, null_count])</code>	Create new <code>Series</code> by setting a mask array.
<code>sort_index([ascending])</code>	Sort by the index.
<code>sort_values([ascending])</code>	Sort by values.
<code>std([ddof])</code>	Compute the standard deviation of the series
<code>sum()</code>	Compute the sum of the series

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Table 2 – continued from previous page

<code>take(indices[, ignore_index])</code>	Return Series by taking values from the corresponding <i>indices</i> .
<code>to_array([fillna])</code>	Get a dense numpy array for the data.
<code>to_gpu_array([fillna])</code>	Get a dense numba device array for the data.
<code>to_string([nrows])</code>	Convert to string
<code>unique()</code>	Returns unique values of this Series.
<code>values_to_string([nrows])</code>	Returns a list of string for each element.
<code>var([ddof])</code>	Compute the variance of the series

as_index	
deserialize	
head	
serialize	
sum_of_squares	
to_pandas	
unique_k	

append (*arbitrary*)

Append values from another `Series` or array-like object. Returns a new copy with the index resetted.

applymap (*udf, out_dtype=None*)

Apply a elementwise function to transform the values in the Column.

The user function is expected to take one argument and return the result, which will be stored to the output Series. The function cannot reference globals except for other simple scalar objects.

Parameters

udf [function] Wrapped by `numba.cuda.jit` for call on the GPU as a device function.

out_dtype [numpy.dtype; optional] The dtype for use in the output. By default, the result will have the same dtype as the source.

Returns

result [Series] The mask and index are preserved.

argsort (*ascending=True*)

Returns a Series of int64 index that will sort the series.

Uses stable parallel radixsort.

Returns

result: Series

as_mask ()

Convert booleans to bitmask

Returns

device array

astype (*dtype*)

Convert to the given dtype.

Returns

If the dtype changed, a new “Series“ is returned by casting each

values to the given dtype.

If the dtype is not changed, “self” is returned.

ceil ()

Rounds each value upward to the smallest integral value not less than the original.

Returns a new Series.

count ()

The number of non-null values

data

The gpu buffer for the data

dtype

dtype of the Series

factorize (*na_sentinel=-1*)

Encode the input values as integer labels

Parameters

na_sentinel [number] Value to indicate missing category.

Returns

(labels, cats) [(Series, Series)]

- *labels* contains the encoded values
- *cats* contains the categories in order that the N-th item corresponds to the (N-1) code.

fillna (*value*)

Fill null values with *value*.

Returns a copy with null filled.

find_first_value (*value*)

Returns offset of first value that matches

find_last_value (*value*)

Returns offset of last value that matches

floor ()

Rounds each value downward to the largest integral value not greater than the original.

Returns a new Series.

classmethod from_categorical (*categorical, codes=None*)

Creates from a pandas.Categorical

If *codes* is defined, use it instead of *categorical.codes*

classmethod from_masked_array (*data, mask, null_count=None*)

Create a Series with null-mask. This is equivalent to:

`Series(data).set_mask(mask, null_count=null_count)`

Parameters

data [1D array-like] The values. Null values must not be skipped. They can appear as garbage values.

mask [1D array-like of numpy.uint8] The null-mask. Valid values are marked as 1; otherwise 0. The mask bit given the data index *idx* is computed as:

```
(mask[idx // 8] >> (idx % 8)) & 1
```

null_count [int, optional] The number of null values. If None, it is calculated automatically.

has_null_mask

A boolean indicating whether a null-mask is needed

index

The index object

label_encoding (*cats*, *dtype=None*, *na_sentinel=-1*)

Perform label encoding

Parameters

values [sequence of input values]

dtype: numpy.dtype; optional Specifies the output dtype. If *None* is given, the smallest possible integer dtype (starting with np.int32) is used.

na_sentinel [number] Value to indicate missing category.

Returns

A sequence of encoded labels with value between 0 and n-1 classes(cats)

max ()

Compute the max of the series

mean ()

Compute the mean of the series

mean_var (*ddof=1*)

Compute mean and variance at the same time.

min ()

Compute the min of the series

nlargest (*n=5*, *keep='first'*)

Returns a new Series of the *n* largest element.

nsmallest (*n=5*, *keep='first'*)

Returns a new Series of the *n* smallest element.

null_count

Number of null values

nullmask

The gpu buffer for the null-mask

one_hot_encoding (*cats*, *dtype='float64'*)

Perform one-hot-encoding

Parameters

cats [sequence of values] values representing each category.

dtype [numpy.dtype] specifies the output dtype.

Returns

A sequence of new series for each category. Its length is determined

by the length of “cats”.

reset_index()

Reset index to RangeIndex

reverse()

Reverse the Series

scale()

Scale values to [0, 1] in float64

set_index(index)

Returns a new Series with a different index.

Parameters

index [Index, Series-convertible] the new index or values for the new index

set_mask(mask, null_count=None)

Create new Series by setting a mask array.

This will override the existing mask. The returned Series will reference the same data buffer as this Series.

Parameters

mask [1D array-like of numpy.uint8] The null-mask. Valid values are marked as 1; otherwise 0. The mask bit given the data index `idx` is computed as:

```
(mask[idx // 8] >> (idx % 8)) & 1
```

null_count [int, optional] The number of null values. If None, it is calculated automatically.

sort_index(ascending=True)

Sort by the index.

sort_values(ascending=True)

Sort by values.

Difference from pandas: * Support axis='index' only. * Not supporting: inplace, kind, na_position

Details: Uses parallel radixsort, which is a stable sort.

std(ddof=1)

Compute the standard deviation of the series

sum()

Compute the sum of the series

take(indices, ignore_index=False)

Return Series by taking values from the corresponding *indices*.

to_array(fillna=None)

Get a dense numpy array for the data.

Parameters

fillna [str or None] Defaults to None, which will skip null values. If it equals “pandas”, null values are filled with NaNs. Non integral dtype is promoted to np.float64.

Notes

if `fillna` is None, null values are skipped. Therefore, the output size could be smaller.

to_gpu_array (*fillna=None*)

Get a dense numba device array for the data.

Parameters

fillna [str or None] See *fillna* in `.to_array`.

Notes

if *fillna* is None, null values are skipped. Therefore, the output size could be smaller.

to_string (*nrows=NOTSET*)

Convert to string

Parameters

nrows [int] Maximum number of rows to show. If it is None, all rows are shown.

unique ()

Returns unique values of this Series.

valid_count

Number of non-null values

values_to_string (*nrows=None*)

Returns a list of string for each element.

var (*ddof=1*)

Compute the variance of the series

1.3 Groupby

class `pygdf.groupby.Groupby` (*df, by*)

Groupby object returned by `pygdf.DataFrame.groupby()`.

Methods

<code>agg(args)</code>	Invoke aggregation functions on the groups.
<code>apply(function)</code>	Apply a transformation function over the grouped chunk.
<code>as_df()</code>	Get the intermediate dataframe after shuffling the rows into groups.
<code>count()</code>	Compute the count of each group
<code>max()</code>	Compute the max of each group
<code>mean()</code>	Compute the mean of each group
<code>min()</code>	Compute the min of each group
<code>std()</code>	Compute the std of each group
<code>sum()</code>	Compute the sum of each group
<code>sum_of_squares()</code>	Compute the <code>sum_of_squares</code> of each group
<code>var()</code>	Compute the var of each group

apply_grouped	
deserialize	
serialize	

agg (*args*)

Invoke aggregation functions on the groups.

Parameters

args: **dict**, **list**, **str**, **callable**

- **str** The aggregate function name.
- **callable** The aggregate function.
- **list** List of *str* or *callable* of the aggregate function.
- **dict** key-value pairs of source column name and list of aggregate functions as *str* or *callable*.

Returns

result [DataFrame]

apply (*function*)

Apply a transformation function over the grouped chunk.

as_df ()

Get the intermediate dataframe after shuffling the rows into groups.

Returns

(df, segs) [namedtuple]

- **df** : DataFrame
- **segs** [Series] Beginning offsets of each group.

count ()

Compute the count of each group

Returns

result [DataFrame]

max ()

Compute the max of each group

Returns

result [DataFrame]

mean ()

Compute the mean of each group

Returns

result [DataFrame]

min ()

Compute the min of each group

Returns

result [DataFrame]

std()
Compute the std of each group

Returns

result [DataFrame]

sum()
Compute the sum of each group

Returns

result [DataFrame]

sum_of_squares()
Compute the sum_of_squares of each group

Returns

result [DataFrame]

var()
Compute the var of each group

Returns

result [DataFrame]

1.4 GpuArrowReader

class `pygdf.gpuarrow.GpuArrowReader` (*schema_data*, *gpu_data*)

Methods

<code>to_dict()</code>	Return a dictionary of Series object
------------------------	--------------------------------------

to_dict()
Return a dictionary of Series object

2.1 Code Organization

This shows the basic code organization.

Currently, the repo is basically flat. All implementations are directly under under the `pygdf/` directory. All tests are in `pygdf/tests/` directory.

Here's a quick map to decide which file contains which feature:

- **DataFrame:**
 - `dataframe.py`
- **Series:**
 - `series.py`
- **Column and its subclasses:**
 - `column.py`
 - `columnops.py`
 - `numerical.py` for numeric columns
 - `categorical.py` for categorical columns
- **Buffer:**
 - `buffer.py`
- **`.apply()` and simliar functions:**
 - `applyutils.py`
- **`.query()` and similar functions:**
 - `queryutils.py`
- **libgdf helpers:**

- `_gdf.py`
- **GPU helper functions:**
 - `cudautils.py`
- **Docstring helpers:**
 - `docutils.py`
- **Output formatting:**
 - `formatting.py`
- **Arrow:**
 - `gpuarrow.py`
- **Groupby:**
 - `groupby.py`
- **Dask serialization helpers:**
 - `serialize.py`
- **Index:**
 - `index.py`
- **Operations on multiple DataFrame, Series or Indices:**
 - `multi.py`
- **Other general helper functions:**
 - `utils.py`

2.2 Code that should move to libgdf

Code that should be re-implemented in libgdf in CUDA-C for better reusability and performance.

- `pygdf/cudautils.py` contains a lot of GPU helper functions that are jitted by numba with `@cuda.jit` into CUDA kernels.

All CUDA kernels in this file should be moved to libgdf if possible.

- Some logic in `pygdf/groupby.py` should be move to libgdf to make groupby operation faster. Some groupby aggregations are implemented with `@cuda.jit` here.

2.2.1 Code that cannot move to libgdf

Some features requires the jit to be useful; e.g features that use user-defined functions. These features cannot be moved to libgdf.

CHAPTER 3

Indices and tables

- `genindex`
- `modindex`
- `search`

A

add_column() (pygdf.dataframe.DataFrame method), 3
 agg() (pygdf.groupby.Groupby method), 15
 append() (pygdf.dataframe.Series method), 10
 apply() (pygdf.groupby.Groupby method), 15
 apply_chunks() (pygdf.dataframe.DataFrame method), 3
 apply_rows() (pygdf.dataframe.DataFrame method), 4
 applymap() (pygdf.dataframe.Series method), 10
 argsort() (pygdf.dataframe.Series method), 10
 as_df() (pygdf.groupby.Groupby method), 15
 as_gpu_matrix() (pygdf.dataframe.DataFrame method), 5
 as_mask() (pygdf.dataframe.Series method), 10
 as_matrix() (pygdf.dataframe.DataFrame method), 5
 astype() (pygdf.dataframe.Series method), 10

C

ceil() (pygdf.dataframe.Series method), 11
 columns (pygdf.dataframe.DataFrame attribute), 5
 copy() (pygdf.dataframe.DataFrame method), 5
 count() (pygdf.dataframe.Series method), 11
 count() (pygdf.groupby.Groupby method), 15

D

data (pygdf.dataframe.Series attribute), 11
 DataFrame (class in pygdf.dataframe), 1
 drop_column() (pygdf.dataframe.DataFrame method), 5
 dtype (pygdf.dataframe.Series attribute), 11
 dtypes (pygdf.dataframe.DataFrame attribute), 5

F

factorize() (pygdf.dataframe.Series method), 11
 fillna() (pygdf.dataframe.Series method), 11
 find_first_value() (pygdf.dataframe.Series method), 11
 find_last_value() (pygdf.dataframe.Series method), 11
 floor() (pygdf.dataframe.Series method), 11
 from_categorical() (pygdf.dataframe.Series class method), 11
 from_masked_array() (pygdf.dataframe.Series class method), 11

from_pandas() (pygdf.dataframe.DataFrame class method), 5
 from_records() (pygdf.dataframe.DataFrame class method), 5

G

GpuArrowReader (class in pygdf.gpuarrow), 16
 Groupby (class in pygdf.groupby), 14
 groupby() (pygdf.dataframe.DataFrame method), 6

H

has_null_mask (pygdf.dataframe.Series attribute), 12

I

index (pygdf.dataframe.DataFrame attribute), 6
 index (pygdf.dataframe.Series attribute), 12

J

join() (pygdf.dataframe.DataFrame method), 6

L

label_encoding() (pygdf.dataframe.DataFrame method), 6
 label_encoding() (pygdf.dataframe.Series method), 12
 loc (pygdf.dataframe.DataFrame attribute), 7

M

max() (pygdf.dataframe.Series method), 12
 max() (pygdf.groupby.Groupby method), 15
 mean() (pygdf.dataframe.Series method), 12
 mean() (pygdf.groupby.Groupby method), 15
 mean_var() (pygdf.dataframe.Series method), 12
 min() (pygdf.dataframe.Series method), 12
 min() (pygdf.groupby.Groupby method), 15

N

nlargest() (pygdf.dataframe.DataFrame method), 7
 nlargest() (pygdf.dataframe.Series method), 12
 nsmallest() (pygdf.dataframe.DataFrame method), 7

nsmallest() (pygdf.dataframe.Series method), 12
null_count (pygdf.dataframe.Series attribute), 12
nullmask (pygdf.dataframe.Series attribute), 12

O

one_hot_encoding() (pygdf.dataframe.DataFrame method), 7
one_hot_encoding() (pygdf.dataframe.Series method), 12

Q

query() (pygdf.dataframe.DataFrame method), 7

R

reset_index() (pygdf.dataframe.Series method), 13
reverse() (pygdf.dataframe.Series method), 13

S

scale() (pygdf.dataframe.Series method), 13
Series (class in pygdf.dataframe), 8
set_index() (pygdf.dataframe.DataFrame method), 8
set_index() (pygdf.dataframe.Series method), 13
set_mask() (pygdf.dataframe.Series method), 13
sort_index() (pygdf.dataframe.DataFrame method), 8
sort_index() (pygdf.dataframe.Series method), 13
sort_values() (pygdf.dataframe.DataFrame method), 8
sort_values() (pygdf.dataframe.Series method), 13
std() (pygdf.dataframe.Series method), 13
std() (pygdf.groupby.Groupby method), 15
sum() (pygdf.dataframe.Series method), 13
sum() (pygdf.groupby.Groupby method), 16
sum_of_squares() (pygdf.groupby.Groupby method), 16

T

take() (pygdf.dataframe.Series method), 13
to_array() (pygdf.dataframe.Series method), 13
to_dict() (pygdf.gpuarrow.GpuArrowReader method), 16
to_gpu_array() (pygdf.dataframe.Series method), 13
to_pandas() (pygdf.dataframe.DataFrame method), 8
to_records() (pygdf.dataframe.DataFrame method), 8
to_string() (pygdf.dataframe.DataFrame method), 8
to_string() (pygdf.dataframe.Series method), 14

U

unique() (pygdf.dataframe.Series method), 14

V

valid_count (pygdf.dataframe.Series attribute), 14
values_to_string() (pygdf.dataframe.Series method), 14
var() (pygdf.dataframe.Series method), 14
var() (pygdf.groupby.Groupby method), 16