OpenCReports 0.8.8 Manual

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Chapter 1. Introduction and concepts

1.1. The predecessor: RLIB

The idea to write OpenCReports[1] started with my getting acqauinted with RLIB[2] in 2005 and working with it (and on it) for a very long time, with the original implementors finally losing interest in developing RLIB further. This was around 2018. Even the original documentation site for RLIB was retired. But thanks to the Internet Archive, it may still be read[3]

To overcome some of the shortcomings seen in RLIB, its *ideas* were used for a completely new implementation with high level of compatibility to the original.

RLIB is a report generator library, so is OpenCReports. In this documentation, a lot of references contain comparisons to RLIB.

The name OpenCReports came from the fact that it's implemented in the C programming language in an open way, and using a free software license.

1.2. Concepts

1.2.1. What is a report generator?

A report generator uses a tabular data source, which contains rows and columns of data. The columns have labels or names. (An SQL database query is such a tabular data source.) It also uses some kind of description that specifies how to display the data. The input data is transformed into various output formats, some for human viewing, some for further machine processing. Such output formats may be PDF, HTML, XML, plain text or CSV.

1.2.2. XML based report description

The XML file format is widely used. It can describe structured data in a hierarchy with names for its sections or "nodes".

OpenCReports uses an RLIB-compatible report description with extensions. See Report XML description and the RLIB documentation[4]

1.2.3. Comprehensive API for report creation

The Low level C API allows creating a report purely via program code. The High level C API allows loading an XML report description that contains all details about the report, including database access. Mixing the high and low level APIs allows a balance anywhere between the two extremes. For example, load the report description, which contains the complete layout, and pass database access details via program code. As a comparison, RLIB's API and report description allowed neither extremes: it relied on the report description to provide the layout, with data access and other supplementary details controlled from programming code.

[1] https://github.com/zboszor/OpenCReports
[2] https://sourceforge.net/projects/rlib/
[3] https://web.archive.org/web/20131116192438/http://newrlib.sicom.com/~rlib/index.php/Main_Page
[4] https://web.archive.org/web/20131116192438/http://newrlib.sicom.com/~rlib/index.php/Main_Page

1.2.4. Strict expression parser

OpenCReports uses a Flex/Bison based expression parser. The expression grammar doesn't allow incorrect expressions. See the Expressions chapter.

1.2.5. Expression optimization

OpenCReports does some expression optimization to reduce runtime cost of computing expression values. For example, in `a*2/3` the part `2/3` is two constants in a division. This is precomputed into a single constant as an optimization. Naturally, only mathematically valid optimizations are performed.

1.2.6. Report variables

OpenCReports supports standard report variables for calculating sums, minimum, maximum and average values or custom defined ones. See Report variables

Report variables can also be used as manual expression optimization. A common subexpression can be moved to a report variable from multiple expressions, which in turn is computed once, and its result is used in the expressions referencing it.

1.2.7. Report breaks

A report break is a form of data grouping based on value changes. A break (break boundary) occurs when the value of a watched expression value changes from one data row to the next. OpenCReports supports report breaks defined on arbitrary expressions. Report variables can reset their value on break boundaries. See Report breaks and Breaks.

1.2.8. Extensive and extensible set of functions

OpenCReports has many operators and functions to be used in expressions. See Operators and functions in the Expressions chapter.

Custom functions can also be added to a report by programming code. Custom functions may override stock functions.

1.2.9. UTF-8 string handling

OpenCReports exclusively uses UTF-8 for strings. Input data must be in UTF-8 and output formats also use UTF-8. This allows text from different languages appear in the same report, provided that an applicable font is available.

1.2.10. High precision numeric data type

OpenCReports uses a high precision numeric data type. This allows scientific computation or monetary calculations even with late stage hyperinflation[5] prices. See Numeric constants in the Expressions chapter and the Numeric behavior related functions part in the Low level C API chapter.

1.2.11. Datetime and interval data types

OpenCReports handles both timestamp and time interval data types. The latter allows adding or subtracting a custom time period to and from timestamp data. See Datetime constants in the Expressions chapter.

[5] https://en.wikipedia.org/wiki/Hyperinflation

1.2.12. Automatic input data conversion

For maximum portability, databases provide their data in strings. They also indicate the column type. OpenCReports detects the columns' data type and applies the conversion automatically.

1.2.13. Versatile field alignment and multi-row fields

In the report output, fields may have a fixed width in which they are displayed. Some field values are longer than the field width. When displaying them in a single row, fields may be left-, right- or center-aligned to show the interesting part of the value or for visual reasons.

Fields longer than the designated width may be wrapped either at word or character boundaries. This way, they become multi-row fields. Multi-row fields are also called "memo" fields. Such fields may wrap lines at word boundaries or break words at some character. Multi-row fields have configurable line number limits. Memo fields can break over to the next column or to the next page. Hyphenation is done automatically when using character wrapping. Memo fields may also use *justified* alignment.

1.2.14. Multi-column reports

OpenCReports supports both single- and multi-column layout in its PDF output format. Other output formats may only use single-column layout.

1.2.15. Miscellaneous layout details

OpenCReports implements an RLIB compatibility mode for sizing report layout details, which uses a mix of units, mostly based on character widths (making it dependent on the font size used) mixed with points (1/72th inch) for some report elements.

OpenCReports also has a new, consistent size calculation method where everything is measured in points (1/72th inch).

OpenCReports supports both fixed and proportional fonts even with using the RLIB compatible size settings.

1.2.16. Multiple output formats

OpenCReports supports several output formats: PDF, HTML, CSV, TXT, XML and JSON.

1.2.17. Extensive set of unit tests

The unit tests ensure that OpenCReports' features keep working when adding new features or fixes. Units tests exercise many aspects of the high and low level API, report description handling, runtime behavior and output generation.

1.2.18. Standard Linux dependencies

OpenCReports uses LibXML2[6], utf8proc[7], MPFR[8], libpaper[9], libcsv[10], yajl[11], Cairo[12], Pango[13], librsvg2[14], gdk-pixbuf2[15], PostgreSQL[16], MariaDB[17] and unixODBC[18].

[6] https://gitlab.gnome.org/GNOME/libxml2/-/wikis/home
[7] https://juliastrings.github.io/utf8proc/
[8] https://www.mpfr.org

For running the unit tests, Ghostscript[19] and `compare` from Imagemagick[20] are also needed.

`xmllint`, `xsltproc` and `fop` are used to generate the documentation.

1.3. OpenCReports planned features

1.3.1. Graph and chart support in HTML and PDF output

Currently Gantt chart and various graph types (like barchart, pie chart and their various subtypes) are not supported.

1.3.2. Visual editor for report XML descriptions

There are other report generators on the market with nice GUIs to create the report visually.

[9] http://packages.qa.debian.org/libp/libpaper.html
[10] https://github.com/rgamble/libcsv
[11] http://lloyd.github.com/yajl/
[12] https://www.cairographics.org
[13] https://pango.gnome.org
[14] https://wiki.gnome.org/Projects/LibRsvg
[15] https://gitlab.gnome.org/GNOME/gdk-pixbuf
[16] https://www.postgresql.org
[17] https://mariadb.com
[18] http://www.unixodbc.org
[19] https://www.ghostscript.com
[20] https://imagemagick.org

Chapter 2. Data sources and queries

2.1. Data sources

OpenCReport separates data access into two entities: a data source driver and a query.

OpenCReports supports diverse data sources:

- SQL based data sources
- File based data sources
- Application data based data source
- Application defined data sources

2.1.1. SQL based data sources

SQL is the acronym for Standard Query Language. Many database software comply with the standard to a certain extent. The standard is occasionally revised, and a certain database software version complies to a specific version of the standard to a certain extent.

In general, database software are designed to store massive amounts of data and retrieve it as fast as possible. Database software and its data can be accessed through a network connection (even if it's installed in the same machine) or a faster local connection if both the database server and client are installed on the same computer.

The SQL based data sources OpenCReports natively supports are:

- MariaDB[1] and MySQL[2]
- PostgreSQL[3]
- Any SQL database server with a compliant ODBC[4] driver

2.1.1.1. MariaDB/MySQL data source

MariaDB[5] is a fork of MySQL[6] developing in a different direction but still maintaining strong compatibility with each other. The database client library is compatible with both, therefore OpenCReports supports both with the same driver.

2.1.1.2. PostgreSQL data source

PostgreSQL[7] (in their own words) is The World's Most Advanced Open Source Relational Database. OpenCReports supports using PostgreSQL.

[1] https://mariadb.org/
[2] https://www.mysql.com/
[3] https://www.postgresql.org/
[4] https://learn.microsoft.com/en-us/sql/odbc/microsoft-open-database-connectivity-odbc
[5] https://mariadb.org/
[6] https://www.mysql.com/
[7] https://www.postgresql.org/

The PostgreSQL datasource driver in OpenCReports is especially economic with memory by using a `WITH HOLD cursor`[8] and the PostgreSQL specific `FETCH count`[9] SQL statement to retrieve a specified number of rows in one round, as opposed to retrieving every row in one round that most database software supports.

This makes the report run slower for longer query results compared to other databases, but allows generating the report from extremely large datasets when other databases may fail due to memory exhaustion.

2.1.1.3. ODBC data source

OpenCReports supports using a generic ODBC connection to any database servers using a compliant client driver. OpenCReports uses a standard ODBC manager library, so it is able to use any ODBC DSN (Data Source Name) configured for the system or the user.

2.1.1.4. Special note for SQL datasources

The database client libraries for MariaDB, PostgreSQL and ODBC return all the query rows from the database server at once by default. As such, it is possible that a long query result doesn't fit into the computer memory.

The report needs to traverse the query result twice to pre-compute "delayed" values (see precalculated and Precalculated variables), so it needs to be able to rewind the data set once it was read to the end.

The alternative API in MariaDB to load the rows one by one doesn't allow rewinding, so it's not usable for the report's purposes.

It is only PostgreSQL that allows using an *SQL cursor* as a standalone entity, i.e. outside SQL procedures as defined by the SQL standard. This PostgreSQL extension to the standard allows saving memory in such a way that it allows processing very long query results. Behind the scenes, a `WITH HOLD` cursor is used and 1024 rows are loaded in one go from the server.

2.1.2. File based data sources

The file based data sources OpenCReports supports are:

- Comma-separated values[10] a.k.a. `CSV`
- eXtensible Markup Language[11] a.k.a. `XML`
- JavaScript Object Notation[12] a.k.a. `JSON`

The `XML` and `JSON` file types expect the data presented in a certain structure *syntax*. The *semantics* is application defined. The expected format for these file types are described below.

2.1.2.1. CSV file type

CSV ("Comma Separated Values") is a simple tabulated file format. Every line must have the same number of columns, the values are separated by commas. The first line in the file contains the column names.

[8] https://www.postgresql.org/docs/current/sql-declare.html
[9] https://www.postgresql.org/docs/current/sql-fetch.html
[10] https://en.wikipedia.org/wiki/Comma-separated_values
[11] https://en.wikipedia.org/wiki/XML
[12] https://en.wikipedia.org/wiki/JSON

Using only the CSV file, the data type cannot be determined. Because of this, every column is assumed to be a string, regardless if the values themselves are quoted or not in the file. Data conversion functions must be used, see for example Section 4.12.4, Section 4.10.16 and Section 4.10.10.

Using either report XML description or programming code, an optional set of type indicators may be added along with the CSV input file, so the explicit conversion functions may be omitted from expressions using the data.

2.1.2.2. JSON file type

A JSON file is expected in this format:

```
{
 "columns": ["colname1", ... ],
 "coltypes": ["type", ... ],
 "rows": [
  { "colname1": value1, ...  },
  ...
 ]
}
```

The JSON file is expected to list the column names in a string array called `columns`.

The column types are optionally listed in the string array called `coltypes`. If they are listed, the `coltypes` array must have the same number of strings as the `columns` array. The type names are `string`, `number` or `datetime`. If the column type array is missing, then all data values are assumed to be strings and data conversion functions must be used, see for example Section 4.12.4, Section 4.10.16 and Section 4.10.10.

The data rows are listed in a *JSON array* called `rows` and column data values for each row are in a *JSON collection* with data names from the `columns` and data types from the `coltypes` arrays.

The sections `columns`, `coltypes` and `rows` may appear in any order.

When the `coltypes` part is missing from the JSON input file, then using either report XML description or programming code, an optional set of type indicators may be added along with the JSON input file, so the explicit conversion functions may be omitted from expressions using the data.

2.1.2.3. XML file type

An XML file datasource is expected in this format:

```
<?xml version="1.0"?>
<data>
 <rows>
  <row>
   <col>value</col>
   ...
  </row>
  ...
 </rows>
 <fields>
  <field>column1</field>
  ...
 </fields>
```

```
 <coltypes>
  <col>type1</col>
  ...
 </coltypes>
</data>
```

The XML section names `<data>`, `<rows>` and `<fields>` are the same as they were in RLIB for its XML data source. The order of `<rows>` and `<fields>` is not important. But the order of field names in `<fields>` must match the column value order in each `<row>`.

The optional section <coltypes> is new in OpenCReports. If it's present, then it must list the data types in the same order as section `<fields>`. The types may be `string`, `number` or `datetime`. If this section is not present, all values are assumed to be strings and data conversion functions must be used, see for example Section 4.12.4, Section 4.10.16 and Section 4.10.10.

When the `coltypes` part is missing from the XML input file, then using either report XML description or programming code, an optional set of type indicators may be added along with the XML input file, so the explicit conversion functions may be omitted from expressions using the data.

2.1.3. Application data based datasource

Applications may also have internal data that can be used as input for OpenCReports.

OpenCReports supports using two-dimensional C arrays as directly accessible application data. Such arrays must be declared as

```
char *array[ROWS][COLUMNS]
```

or converted to it if using OpenCReports from a different language. Each element is a pointer to a zero-terminated C string. The first row contains the names of columns.

Optionally, a set of type indicators may be supplied, similarly to the File based data sources.

2.1.4. Application defined data sources

OpenCReports allows application defined datasource drivers that may even override built-in datasource drivers.

An application defined data source may be any of the previously listed types: SQL, file or data based.

2.2. Queries

Queries are the actual providers of tabular data. They use specific data source drivers.

Queries have unique names associated with them. This allows using multiple queries that have identical field (or column) names. See Section 3.4.2

2.2.1. SQL queries

An SQL query uses an SQL data source. An SQL query provides tabular data in rows and columns. The columns have names. One row of data is made up from individual values in columns.

Examples:

```
SELECT * FROM table1;

SELECT column1, column2 FROM table1;
```

For more information, read the specific database server documentation you intend to use.

2.2.2. File queries

File queries specify the file name and path on the computer. OpenCReports then loads the file into memory and processes it to present data on the report.

2.2.3. Data queries

Data queries pass the internal data. OpenCReports processes it to present data on the report.

2.2.4. Relation between queries

Reports may use one or more queries. If a report uses more queries, one of them must be the report's *primary query*.

Supplementary queries are either *followers* of the primary query, or *independent queries*

2.2.4.1. Follower queries

Supplementary queries may be associated with the primary query as so called *follower* queries. Any query may be a follower to the primary query.

There are two kinds of follower queries:

- regular, or basic follower queries, and
- so called N:1 (N-to-one) followers

2.2.4.1.1. Regular follower queries

A follower query is run along the primary query and their rows are laid out side by side. The first row of the follower query is assigned the first row of the primary query. The second row of the follower query is assigned to the second row of the primary query, and so on. The number of rows of the complete data set is determined by the primary query. If the follower query runs out of rows before the primary, the columns values will be presented as empty data, i.e. SQL NULLs.

This is similar to using `LEFT OUTER JOIN` and using `ROWNUM` in Oracle or the `row_number()` SQL function in PostgreSQL as the matching value between the primary query and the follower query.

2.2.4.1.2. N:1 follower queries

An N:1 follower query, for all intents and purposes, is the right side query in a `LEFT OUTER JOIN` query, with the primary query on the left side. Rows of the main query and the follower query are matched according to a specified boolean expression.

2.2.4.1.3. Note on follower queries

One of the use cases of follower queries is to use data from different datasources. Nowadays, with foreign queries standardized in SQL and more database servers implementing it in a performant manner, its use

case is more limited. Still, using data from different file based datasources, or using from an SQL database server and from a file based datasource at the same time is possible with OpenCReports.

2.2.4.2. Independent queries

Multiple queries may be declared for a report. If a query is neither set as a follower for a previously declared query, nor set as the report's main query, then it is an independent query.

Independent queries will stay on their first row during the report run, so they can be considered constant.

Therefore, column references of independent queries may be used in expressions that would need a constant value.

Chapter 3. Expressions in OpenCReports

3.1. Introduction

The previous section described Data sources and Queries which provide *raw data*. Raw data can be used as is, or can be processed further for the purposes of the report. This is where *expressions* come in.

There are three main data types in OpenCReports: `numeric`, `string`, and `datetime`. OpenCReports automatically detects the type of raw data supplied by Queries for SQL and some file based Data sources, and the application can supply extra data to indicate column data types.

Expressions can use and result in any of these types.

A `numeric` expression's result is a number. It uses high numeric precision. Most functions and operators deal with numbers.

For historic record, RLIB was designed for the US and for slower computers. It used a fixed point numeric representation. For the US, with its strong currency and prices expressed in low numbers, this was an acceptable design decision at the time. But for countries, where currencies are a few orders of magnitude weaker and conversely, the prices are similarly higher, the fixed point numeric value range was easily overflown (especially in report variables that added values), leading to wrong data in the report output.

Another potential problem with fixed point numeric representation is that converting numbers from the input data to this internal representation always rounds down. The numeric error (i.e. the difference between floating point values and fixed point values) can be demonstrated even with small data sets that add up percentages.

OpenCReports uses high precision floating point values. Technically, it's 256-bit precision GNU MPFR numerics by default, and the precision can be modified by the application if needed. This allows handling very large and very small numbers and directly consuming the SQL `numeric` and `decimal` types or arbitrary precision, or using `bcmath` numerics in PHP. This also allows scientific computation or monetary calculations even with late stage hyperinflation[1] prices.

A `string` expression's result is arbitrary text. Strings can be concatenated or otherwise processed by string functions.

A `datetime` expression may store a date, a time (with or without timezone) or both. Also, it may store a time interval, e.g. `2 months` that can be added to or subtracted from another `datetime` value.

There is a further data type: `error`. Errors usually occur if there is an error in processing, e.g. when a function argument does not match its expected parameter data type. The `error` type is a special case of strings: it stores a string literal, the *error message*. As opposed to the string data type, an `error` cannot be processed further by passing them as function arguments or operator operands. Instead, the first error is propagated up from subexpressions to the final result of the expression.

3.2. Constants

3.2.1. String literals

String literals in OpenCReports can be either single or double quoted. Some examples:

[1] https://en.wikipedia.org/wiki/Hyperinflation

```
"apple"
'apple'
"I've eaten an apple"
'This an "apple".'
```

The values of these strings are:

```
apple
apple
I've eaten an apple
This an "apple".
```

We can see how the other quoting character can be used as part of the string value.

String literals can also use BASIC language style double quoting to embed a single quoting character used for quoting the string itself:

```
'apple'''
'apple''pear'
'apple''''pear'
"apple"""
"apple""pear"
"apple""""pear"
```

The values of these strings are:

```
apple'
apple'pear
apple''pear
apple"
apple"pear
apple""pear
```

String literals can also use C language string continuation if there's at least one whitespace character (space, TAB or new line) between doubled quoting characters. String continuation can also switch quoting characters without whitespace between quoting.

```
"apple" "pear"
"apple" 'pear'
"apple"'pear'
```

The value of all these strings is:

```
applepear
```

3.2.2. Numeric constants

Numeric constants can be integer or fractional numbers with or without the so called *e-notation* or scientific notation. Some examples:

```
1
1.234
1e4
1e-4
1.234e-5
```

E-notation means that that number preceding the letter "e" or "E" is multiplied by ten to the power of the number after the letter "e" or "E", the latter being an integer value. The values of the above examples are:

```
1
1.234
10000
0.0001
0.00001234
```

Numbers greater than 0 and less than 1 can be written with or without the leading zero.

```
0.123
.123
```

Technically, there are no negative numeric constants. Instead, the number and the unary minus operator (see Unary operators) are initially handled separately. Then the expression optimizer merges them, creating the negative numeric constant.

3.2.3. Boolean constants

Boolean constants evalutate to numeric constans `1` and `0`. The boolean constants are:

```
yes
no
true
false
```

3.2.4. Datetime constants

There are no datetime constants per se, although expressions like `stodt('1980-06-30 16:00:00')` or `interval('2 months')` (i.e. function calls with constant arguments that result in a `datetime` value) are implicitly turned into constants by the expression optimizer.

3.2.5. Constant expressions

Constant expressions are ones that only contain constant values (of any type) and operators or functions.

3.3. Delayed (precalculated) expressions

Reports internally go through the data set twice, the second run generates the report output. The data set does not (must not) change between the two runs. This makes it possible to use so called *delayed* or *precalculated* values. A precalculated expression keeps the value computed for the last row of the data set during the first run. The second run uses this value.

By default, expressions are not precalculated. Let's call non-precalculated expressions and values *normal*.

Expressions need to be explicitly marked as precalculated. Marking expressions as precalculated is possible via the report XML description, or by the OpenCReports API. See Precalculated value in XML, Section 10.1.4.18, and Section 12.8.24.

OpenCReports allows mixing normal and precalculated values in the same expression. For example, if a normal expression references Precalculated variables, the result would be intuitively expected.

3.4. Identifiers

Expressions may reference query column names, environment variables, internal variables and user defined Report variables. These references are called *identifiers*. Their values are evaluated during the report execution.

3.4.1. Identifier names

Identifiers are in the format `domain.identifier` where the domain name or the dot are optional.

OpenCReports uses UTF-8 encoding even in identifier names. National or accented characters are accepted in identifiers.

Valid names for `domain` and `identifier` may start with an underscore or UTF-8 letters and may contain underscore, UTF-8 letters and numbers in subsequent characters.

3.4.2. Query field identifiers

Any valid identifier is by default a query column reference, with or without the domain name. Examples:

```
field_name
field_name5
myquery1.field_name
mez#_név
lekérdezés.mez#_név
```

In the above example, `mez#_név` means `field_name`, and `lekérdezés.oszlop_név` means `query.field_name` in Hungarian. The accented characters are a courtesy of UTF-8.

Query field identifiers in expressions are resolved by matching them against query names (used as the domain) and their field names.

If the domain name is specified, a query matching the domain name name must be declared for the report, either as the primary query, a follower query, or an independent query. That query must have a column name that matches the identifier name.

If the domain name is not specified, the field name references are matched against all the queries of the report in the order of their declaration. The first query with a matching column name will be used for that reference.

For exceptions (and exceptions from under the exceptions!), see below.

3.4.3. User defined variables

Domain `v` signifies user defined report variables, which can be used in breaks or to shortcut expressions. Example:

```
v.my_variable
```

For details, see Report variables and Variable node.

3.4.4. Special purpose identifier domains

Some domain names carry special meaning for the report.

3.4.4.1. Environment variables

Domain `m` indicates the domain of environment variables.

The nature of environment variables depends on the languange binding. For example in C, it's the environment variables in the operating system. In PHP, the identifier name is first matched against global PHP variables, and if not found, against the operating system environment variables. Example:

```
m.current_date
```

Since such a setting is controlled outside the report, and for the duration of running the report, its value cannot (or *shouldn't*) change, environment variable references are optimized into constants at the beginning of the report execution.

Environment variables can't change during report execution in single threaded applications, *but they can in multi-threaded ones*. By optimizing environment variables into constants in expressions instead of querying the environment every time the same expression is evaluated, potential data races (that may result in inconsistent results) are eliminated.

3.4.4.2. Internal report variables

Domain `r` indicates the domain of internal report variables.

3.4.4.2.1. Current page number

```
r.pageno
```

The current page of the report is maintained by the report layout during the report run. For example, if an expression is evaluated on page 4 of the report, and happens to reference the current page number variable, then this variable will have the value 4 in the result.

PDF output supports pagination. Other output formats do not. For them the value of this variable is 1.

3.4.4.2.2. Total number of pages

```
r.totpages
```

This variable carries the total number of pages in the report. Its value is maintained by the report.

Only the PDF output format supports pagination. For output formats not supporting pagination, the value of this variable is 1 throughout the report.

This variable is inherently precalculated. Expressions like this will intuitively produce the expected result:

```
printf("Page: %d / %d", r.pageno, r.totpages)
```

For example, on the 3rd page of a 5-page report, the value would be:

```
Page: 3 / 5
```

3.4.4.2.3. Line number

```
r.lineno
```

This variable gives the current row (line) number in the data set.

It can be thought as an alias to the Query row number function function which does the same by default. But functions may be overridden by user defined functions, while this variable will always work as described.

3.4.4.2.4. Detail count

```
r.detailcnt
```

This variable works similarly to the Line number variable and Query row number function, except it restarts from 1 when a field header is emitted on the report. See Detail node.

With the default behaviour of the field header regarding breaks (see Report field header priority attribute), i.e. when field header is printed on the top of every page, `r.detailcnt` works as a per page line count value.

When the report field header priority is set to *low*, the effect may be more emphasized because the value of this variable is reset more often.

3.4.4.2.5. Field value

```
r.value
```

Data on the report is represented by field description. Along with the data expression, supplementary expressions are used for metadata that make up the displaying of the value. Such supplementary expression exist for the foreground and background colors, the formatting of the value, and others.

The supplementary expressions may reference the field value, without having to type out the field expression multiple times.

Using `r.value` also helps reducing the report runtime because the value expression is not computed multiple times. This is a manual optimization.

Referencing `r.value` is only possible for supplementary expressions in the same field description. This variable cannot cross-reference other field descriptions, or anything not in the same scope. For this purpose, there are user Report variables.

3.4.4.2.6. Report output format value

```
r.format
```

This variable returns the current output format name as a string. For example: `PDF`, `HTML`, etc.

3.4.4.2.7. Expression self reference

```
r.self
```

This variable references the previous result of the expression. It is used in iterative expressions, like in user-defined Report variables. It can also be used in any user defined expression.

3.4.4.2.8. Subexpressions of user-defined variables

```
r.baseexpr
r.intermedexpr
r.intermed2expr
```

These variables are references for the three subexpressions that potentially make up a user-defined custom variable. The expressions in order are: base expression, and two intermediary expressions.

Actually, there's a fourth subexpression that exists in every user defined variable, namely the result expression. It's reference is simply the user variable reference, see User defined variables and Custom variable attributes.

They are evaluated in this order:

- `r.baseexpr`

  The base expression must not reference any of the others of `r.intermedexpr` and `r.intermed2expr`.

- `r.intermedexpr`

  The first intermediary expression can reference `r.baseexpr` but it must not reference `r.intermed2expr`.

- `r.intermed2expr`

  The second intermediary expression can reference both `r.baseexpr` and `r.intermedexpr`.

- The result expression, which has no internal variable name. It can reference all of `r.baseexpr`, `r.intermedexpr` and `r.intermed2expr`.

For example, a running average over a data series needs two intermediary expressions: one for the sum of the values, the other for the number of values in the series. The result is the sum of values divided by the number of values.

Their usage is only valid when declaring a custom user defined variable.

3.4.4.3. Quoted and dot-prefixed identifiers

Both `domain` and `identifier` names may be quoted or unquoted. Quoting names allow using semi-reserved and reserved words as identifiers and also allow special characters in identifier names. Examples:

```
query.field_name1
query."field_name2"
query."field with space in the name"
"query2".field_name3
"query2"."and"
```

3.4.4.4. Dot-prefixed identifiers

A dot-prefixed identifier is one where the domain name is not specified, but the identifier name is prefixed with a dot. Examples:

```
.field_name
."field_name"
```

The boolean constants are semi-reserved words. They can be used as identifiers with dot-prefixed identifier names without a domain name and without quoting:

```
.yes
.no
.true
.false
yes.no
```

The above unquoted identifiers are equivalent with these quoted ones below:

```
."yes"
."no"
."true"
."false"
"yes"."no"
```

Operator names are reserved words, e.g. `and` and `or`. They cannot be used with dot-prefixed operator names without quoting, as it would cause an expression syntax error. But they can be used as quoted identifiers, in case you would want to use such a query name and column name:

```
."and"
."or"
"and"."or"
```

3.4.4.5. Quoted special purpose identifier domains

When identifier domains are quoted, they lose their special meaning and the identifiers become query field identifiers. Of course, in this case, such a query name must exist and the query must have a field name specified in the identifier. Examples:

```
"m".current_date
"r".totpages
"v".my_variable
```

3.5. Operators and functions

OpenCReports expressions can use several operators and functions. The operator precedence is mostly as expected from the C programming language. One notable exception is implicit multiplication. The precedence classes are as below, in increasing order of precedence.

Note that all of the operators are implemented internally as a function call to the equivalent function. Since every function may be overridden by user functions, the operators may work differently than the documentation.

3.5.1. Ternary operator

The ternary operator works as in the C, PHP and other languages:

```
expression1 ? expression2 : expression3
```

It's evaluated as follows: if the value of numeric `expression1` is `true` (i.e. non-zero), then the result is the `expression2`, otherwise it's `expression3`. Type of `expression2` and `expression3` may differ, i.e. the result type will be the type of the underlying expression but it can result in runtime errors.

Internally, it's implemented using the iif() function.

3.5.2. Boolean logic operators with two operands

Logic OR can be written as `||` or `or`. Example: `a || b`

Logic AND can be written as `&&` or `and`. Logic AND has precedence over OR. Example: `a && b`

Internally, they are implemented using the Boolean AND and Boolean OR functions.

3.5.3. Bitwise operators with two operands

The bitwise operators in this precedence class and in their increasing order of precedence are: bitwise OR (`|`) and bitwise AND (`&`).

3.5.4. Equality and inequality comparison operators

The equality comparison operator can be written as `=` or `==`.

The inequality comparison operator can be written as `<>` or `!=`.

3.5.4.1. Equality and inequality comparison operators on vectors

Vector equality and inequality comparisons have the same precedence as scalar comparisons. These are not vectors in the mathematical sense, but a comma separated list of scalars inside brackets (`[ ... ]`), with `op` being any of the equality or inequality comparison operators:

```
[ expa1, expa2, ... ] op [ expb1, expb2, ... ]
```

Such comparisons are expanded into a logic operator form:

```
(expa1 op expb1) and (expa2 op expb2) and ...
```

Please, note that because of the mechanical conversion from the vector form to the expanded logic operator form, the following two lines have different meaning:

```
not ([ expa1, expa2, ... ] = [ expb1, expb2, ... ])
[ expa1, expa2, ... ] != [ expb1, expb2, ... ]
```

3.5.5. Other comparison operators

Less-than (`<`), less-or-equal (`<=`), greater-than (`>`) and greater-or-equal (`>=`).

3.5.5.1. Other comparison operators on vectors

Vector comparisons using `<`, `>`, etc. operators have the same precedence as their scalar counterpart. These are also expanded into the logic form, see Section 3.5.4.1 above.

3.5.6. Bitwise shifts

Bitwise shift left (`a >> b`) and bitwise shift right (`a << b`).

3.5.7. Addition and subtraction

`a + b` and `a - b`.

3.5.8. Multiplication, division and modulo (remainder)

`a * b`, `a / b` and `a % b`.

3.5.9. Power-of operator

`a ^ b` works as a-to-the-power-of-b.

3.5.10. Factorial operator

`a!`, the '!' sign used as postfix operator.

3.5.11. Unary plus and minus, logical and bitwise NOT, prefix increment and decrement

Unary plus (`+a`), unary minus (`-a`), logical NOT (`!a`, '!' used as prefix operator), bitwise NOT (`~a`), prefix increment (`++a`) and prefix decrement (`--a`).

3.5.12. Postfix increment and decrement

Postfix increment (`a++`) and decrement (`a--`).

3.5.13. Function calls and implicit multiplication

Function calls execute a function on operands: `function(operand[, ...])`. A function name is a single word known by OpenCReports at the time of parsing, either as a built-in function, or a user-supplied one. The function name cannot have a leading dot or be a domain-qualified identifier.

Implicit multiplication is when two distinct operands are in juxtaposition, in other words they are written side by side without any whitespace. In this case, there is an implied multiplication between them that acts with higher precedence than regular multiplication or division. Implicit multiplication is applicable in these situations:

- A numeric constant juxtaposed with an identifier, the numeric constant is the on the left side.

  ```
  2x
  ```

- A numeric constant juxtaposed with an expression inside parentheses. The constant can be on either side of the expression.

  ```
  2(a+b)
  (a+b)2
  ```

- An identifier juxtaposed with an expression inside parentheses, the identifier is on the left side of the expression.

  ```
  x(a+b)
  ```

  This is only treated as implicit multiplication if the following conditions are met:

  - the `x` identifier is not a function name at the time of parsing
  - there is a single expression inside the parentheses

  If any of the conditions below are true, the expression is treated as a function call:

  - `x` is a known function name

  - there is no expression inside the parentheses
  - a series of comma delimited expressions is inside the parentheses

  The function call validity is checked against the number of operands, with a potential parser error. If there's an ambiguity between function names and identifiers provided by data sources, it can be avoided by using dot-prefixed or dot-prefixed and quoted identifiers, or fully qualified identifiers in the form of `query.identifier`.

- An expression inside parentheses juxtaposed with an identifier on the right side.

  ```
  (a+b)a
  ```

- Two expressions inside parentheses juxtaposed with each other.

  ```
  (a+b)(c+d)
  ```

Implicit multiplication is NOT applicable in these situations, besides the exceptions already explained above:

- An identifier juxtaposed with a numeric constant, the numeric constant is the on the right side.

  ```
  x2
  ```

  Since an identifier name may include digits as the second and subsequent characters, the numeric constant, or at least its integer part is simply recognized as part of the identifier name itself according to the token matching. This can also result in syntax errors when not handled with care.

- An identifier juxtaposed with another identifier.

  ```
  ab
  ```

  The reason is the same as in the preceding case: there is only a single identifier according to token matching.

3.5.14. Parentheses

Parenthesized expressions are always computed first.

3.5.15. A note on token matching, precendence and syntax errors

Expression parsing works on two levels: token matching and applying grammar. Token matching breaks up the expression string into tokens in a greedy way: without whitepace delimiters, the longest possible token is chosen.

This may lead to slight confusion when coupled with implicit multiplication. For example, the expression `2e-1e` is broken up into two tokens: `2e-1` juxtaposed with `e`. The first token is interpreted as a numeric constant using *e-notation* (so that it will mean `2 * 10^(-1)`) and the second is the identifier `e`, leading to the meaning `0.2 * e`. This is unambiguous for the computer, but can be somewhat confusing to the the user reading or writing expressions. To avoid any confusion, don't use implicit multiplication and use whitespace and parentheses gratituously.

Expression parsing handles precedence and whitespaces. For example, these below do not mean exactly the same:

```
a++ + ++b
a+++++b
```

The former is obvious, but the latter may be a little surprising: `(a++)++ + b`. This is how the lexer or token matching works, i.e. it matches the longest applicable token first.

If `a` and `b` are numbers, then the result of both expressions is `a + b + 2`, but the way it's arrived at is different.

However, the `++` (increment) and `--` (decrement) operators may be interpreted differently for other types. For example, if both `a` and `b` are of the `datetime` type, then the result also depends on whether one of them is an interval datetime, and the other (regular) datetime value has valid time or not. To make the expression unambiguous, whitespace and/or parenthesis should be used.

Another ambiguous example:

```
a++b
```

The above may be interpreted as `a + +b` but since no whitespace is used, the tokenizer is free to interpret it as `a++ b`, because `++` is longer than `+`, so the former is matched first as an operator token. This is a syntax error and expression parsing throws an error for it.

Chapter 4. Functions

4.1. Introduction

This section lists the functions supported by OpenCReports in topics, and alphabetically in their topic.

Most functions below operate in this way, unless noted otherwise:

- numeric and bitwise functions with more than two operands take their first operand and perform the same operation using the second, third, etc. operands repeatedly.
- if any of the operands is an error (resulting from runtime processing of a subexpression), then the result will use the exact error of the first operand that is an error.
- if any of the operands is NULL (e.g. the data source is SQL and the field value is SQL NULL) then the result will also be NULL.
- Boolean logic functions treat their operands with 0 being false and anything else (even fractions less than 0.5) as true.
- Bitwise functions treat their operands as 64-bit numeric values, with rounding if they are fractions.
- String arithmetics operate on UTF-8 encoded strings and count in number of UTF-8 characters instead of byte length.

4.2. Arithmetic functions

4.2.1. abs()

Absolute value. It takes one numeric operand. Operator `|...|` is a shortcut for this function.

4.2.2. div()

Division. It takes two or more numeric operands. The way it works is: take the first operand and divide it by the second and subsequent operands in sequence. Operator `/` is a shortcut for this function.

4.2.3. factorial()

Factorial function. It takes one numeric operand. The postfix operator `!` is the alias for this function.

4.2.4. fmod()

The result to the value of `x - ny` (`x` and `y` being its two numeric operands), rounded according to the report's rounding mode, where `n` is the integer quotient of `x` divided by `y`, `n` is rounded toward zero. It takes two numeric operands.

4.2.5. mod()

An alias of `remainder()`. It takes two numeric operands. Operator `%` is a shortcut for this function.

4.2.6. mul()

Multiplication. It takes two or more numeric operands. Operator * is a shortcut for this function.

4.2.7. remainder()

The result to the value of x - ny (x and y being its two numeric operands), rounded according to the report's rounding mode, where n is the integer quotient of x divided by y, n is rounded toward to the nearest integer. It takes two numeric operands.

4.2.8. uminus()

Unary minus. Changes the sign of its numeric operand from positive to negative, or vice versa. It takes one numeric operand. Operator unary - is a shortcut of this function.

4.2.9. uplus()

Unary plus. Leaves the sign of its numeric operand as is. It takes one numeric operand. Operator unary + is a shortcut of this function.

4.3. Bitwise functions

4.3.1. and()

Bitwise AND. It takes two or more numeric operands. Operator & is a shortcut for this function.

4.3.2. not()

Bitwise NOT. It takes one numeric operand. It returns the bit-by-bit negated value of its operand. Prefix operator ~ is a shortcut for this function.

4.3.3. or()

Bitwise OR. It takes two or more numeric operands. Operator | is a shortcut for this function.

4.3.4. shl()

Bitwise shift left. It takes two numeric operands. Shifts the first operand left with the number of bits specified by the second operand. The operand << is a shortcut for this function.

4.3.5. shr()

Bitwise shift right. It takes two numeric operands. Shifts the first operand right with the number of bits specified by the second operand. The operand >> is a shortcut for this function.

4.3.6. xor()

Bitwise exclusive OR. It takes two or more numeric operands.

4.4. Boolean logic functions

4.4.1. land()

Boolean logic AND. It takes two or more numeric operands that are treated as boolean logic values. The function is executed until the result is fully determined, i.e. it stops at the first false value. Operator && is a shortcut for this function.

4.4.2. lnot()

Boolean logic NOT. It takes one numeric operand. It returns the negated boolean value of its operand. Prefix operator ! is a shortcut for this function.

4.4.3. lor()

Boolean logic OR. It takes two or more numeric operands that are treated as boolean logic values. The function is executed until the result is fully determined, i.e. it stops at the first true value. Operator || is a shortcut for this function.

4.5. Comparison functions

4.5.1. eq()

Equal. It takes two operands of the same type: numeric, string or datetime. The result is numeric value 1 or 0, if the two operands are equal or non-equal, respectively. The operators = and == are shortcuts for this function.

4.5.2. ge()

Greater-or-equal. It takes two operands of the same type, which can be either numeric, string or datetime. The operator >= is a shortcut for this function.

4.5.3. gt()

Greater-than. It takes two operands of the same type, which can be either numeric, string or datetime. The operator > is a shortcut for this function.

4.5.4. le()

Less-or-equal. It takes two operands of the same type, which can be either numeric, string or datetime. The operator <= is a shortcut for this function.

4.5.5. lt()

Less-than. It takes two operands of the same type, which can be either numeric, string or datetime. The operator < is a shortcut for this function.

4.5.6. ne()

Not equal. It takes two operands of the same type, which can be either numeric, string or datetime. The operator != and <> are shortcuts for this function.

4.6. Rounding and related functions

4.6.1. ceil()

Rounds its operand to the next higher or equal integer. It takes one numeric operand.

4.6.2. floor()

Rounds its operand to the next lower or equal integer. It takes one numeric operand.

4.6.3. rint()

Rounds its operand using the report's rounding mode. It takes one numeric operand.

4.6.4. round()

Rounds its operand to the nearest representable integer, rounding halfway cases away from zero. It takes one numeric operand.

4.6.5. trunc()

Rounds its operand to the next representable integer toward zero. It takes one numeric operand.

4.7. Exponential, logarithmic and related functions

4.7.1. exp()

Natural exponential. It takes one numeric operand.

4.7.2. exp10()

Base-10 exponential. It takes one numeric operand.

4.7.3. exp2()

Base-2 exponential. It takes one numeric operand.

4.7.4. ln()

Alias for `log()`.

4.7.5. log()

Natural logarithm. It takes one numeric operand.

4.7.6. log10()

Base-10 logarithm. It takes one numeric operand.

4.7.7. log2()

Base-2 logarithm. It takes one numeric operand.

4.7.8. pow()

This function raises the first operand to the power of its second operand. It takes two numeric operands. Operator ^ is a shortcut for this function.

4.7.9. sqr()

Square. It takes one numeric operand.

4.7.10. sqrt()

Square root. It takes one numeric operand.

4.8. Trigonometric functions

4.8.1. acos()

Arc-cosine function. It takes one numeric operand.

4.8.2. asin()

Arc-sine function. It takes one numeric operand.

4.8.3. atan()

Arc-tangent function. It takes one numeric operand.

4.8.4. cos()

Cosine function. It takes one numeric operand.

4.8.5. cot()

Cotangent function. It takes one numeric operand.

4.8.6. csc()

Cosecant function. It takes one numeric operand.

4.8.7. sec()

Secant. It takes one numeric operand.

4.8.8. sin()

Sine. It takes one numeric operand.

4.8.9. tan()

Tangent. It takes one numeric operand.

4.9. String functions

4.9.1. concat()

Concatenate strings. It takes two or more string operands.

4.9.2. left()

Return the leftmost N characters of a string. It takes two operands, the first operand is a string, the second is the string length, a numeric integer.

4.9.3. lower()

Convert to lowercase. It takes one string operand.

4.9.4. mid()

Return characters from the middle of the string. It takes three operands, the first operand is a string, the second and third are numeric integer values, start offset and length, respectively. The offset is 1-based just like in BASIC, with the offset value 0 being identical to 1. Negative offsets count from the right end of the string, i.e. `mid(s,-n,n)` is equivalent to `right(s,n)`.

4.9.5. proper()

Return the string converted lowecase, except the first letter of the first word, which will be uppercase. This function takes one string operand.

4.9.6. right()

Return the rightmost N characters of a string. It takes two operands, the first operand is a string, the second is the string length, a numeric integer.

4.9.7. strlen()

Return the number of characters in the string. It takes one string operand.

4.9.8. upper()

Convert to uppercase. It takes one string operand.

4.10. Datetime functions

4.10.1. chgdateof()

Change the date part of the first operand to the date part of the second operand. It takes two datetime operands.

4.10.2. chgtimeof()

Change the time part of the first operand to the date part of the second operand. It takes two datetime operands.

4.10.3. date()

Return the current date. It takes zero operands.

4.10.4. dateof()

Return the date part. It takes one datetime operand.

4.10.5. day()

Return the day of month value as a number. It takes one datetime operand.

4.10.6. dim()

Returns the number of days in the month according to the year and month values of the operand. It takes one datetime operand.

4.10.7. dtos()

Convert a datetime to string. The date part of the datetime is formatted according to the date format of the currently set locale. It takes one datetime operand.

4.10.8. dtosf()

Convert a datetime to formatted string. It takes two operands, one datetime and one string. It takes the second (string) operand as a format string and formats the datetime value according to the format string. If the second operand is NULL or empty string, this function behaves like the dtos() function. Otherwise it behaves like the format() function with the operands reversed.

4.10.9. gettimeinsecs()

Convert the time part of the datetime to seconds elapsed from 00:00:00. It takes one datetime operand.

4.10.10. interval()

Convert the parameter(s) to an interval subtype of the datetime type. It takes either one string operand, or six numeric operands.

In the first case, the string is parsed for interval values, like `1 year` or `2 months`, etc., and sets the specific datetime part values.

In the second case, the six numeric operands are the values for the datetime parts, in the order of years, months, days, hours, minutes and seconds.

4.10.11. month()

Return the month value of a datetime. It takes one datetime operand.

4.10.12. now()

Return the current timestamp in a datetime value. It takes zero operands.

The "current timestamp" is determined at the beginning of generating the report. This function returns the same stable value for the lifetime of the report.

4.10.13. settimeinsecs()

Return a datetime with the time part of a datetime changed to the specified seconds after 00:00:00. It takes two operands, the first operand is a datetime, the second is a numeric integer.

4.10.14. stdwiy()

Return the ISO-8601 week number of a datetime as a decimal number, range 01 to 53, where week 1 is the first week that has at least 4 days in the new year. It takes one datetime operand.

4.10.15. stod()

Alias for `stodt()`.

4.10.16. stodt()

Convert a string to a datetime value. It takes one string operand.

This function is smart enough to recognize locale specific and standard ISO-8601 formats. It handles whole datetime, date-only and time-only values in the string.

4.10.17. stodtsql()

Alias for `stodt()`.

4.10.18. timeof()

Return time part of the datetime operand. It takes one datetime operand.

4.10.19. tstod()

Alias for `stodt()`.

4.10.20. wiy()

Return the week number of the operand as a decimal number, range 00 to 53, starting with the first Sunday as the first day of week 01. It takes one datetime operand.

4.10.21. wiy1()

Return the week number of the operand as a decimal number, range 00 to 53, starting with the first Monday as the first day of week 01. It takes one datetime operand.

4.10.22. wiyo()

This function returns the week number of the first operand as a decimal number, range 00 to 53, starting with the specified day number as the first day. (0 = Sunday, 1 = Monday, 2 = Tuesday, ...) It takes two operands, the first is a datetime, the second is a numeric integer.

4.10.23. year()

Return the year value of the operand as a numeric value. It takes one datetime operand.

4.11. Type agnostic functions

4.11.1. add()

Add the operands. It takes two or more operands of different types and returns the sensible result for cases that make sense. It throws an error for invalid cases. Operator `+` is a shortcut for this function.

For `numeric` arguments, it's the arithmetic addition.

For `string` arguments, it is equivalent to concatenation, i.e. the concat() function.

Certain combinations of `datetime` and `numeric` arguments make sense.

- normal `datetime` and `numeric` added together results in the `datetime` value increased by the specified number of seconds or days, depending on whether the `datetime` value *has valid time part or not*, respectively
- the interval subtype of `datetime` and `numeric` added together results in the `datetime` value increased by the specified number of seconds
- normal `datetime` and the interval subtype of the `datetime` added together results in the normal `datetime` value increased by the specified time interval
- two intervals added together results in the first interval increased by the second interval

4.11.2. dec()

Decrement by one. It takes one numeric or datetime operand. The operator `--` is the shortcut for it, either as prefix or postfix operator.

4.11.3. inc()

Increment by one. It takes one numeric or datetime operand. The operator `++` is the shortcut for it, either as prefix or postfix operator.

4.11.4. sub()

Subtract the second, etc. operands from the first. It takes two or more operands of different types and returns the sensible result for cases that make sense. It throws an error for invalid cases. Operator `-` is a shortcut for this function.

For `numeric` arguments, it's simply the arithmetic subtraction.

For `string` arguments, it throws an error.

Certain combinations of `datetime` and `numeric` arguments make sense.

- a `numeric` value subtracted from a normal `datetime` results in the `datetime` value decreased by the specified number of seconds or days, depending on whether the `datetime` value *has valid time part or not*, respectively
- a `numeric` value subtracted from the interval subtype of `datetime` results in the `datetime` value decreased by the specified number of seconds
- an interval value subtracted from a normal `datetime` value results in the normal `datetime` value decreased by the specified time interval
- two intervals subtracted results in the first interval decreased by the second interval

4.12. Formatting and conversion functions

4.12.1. format()

It takes two operands, the first operand is of any type, the second operand is a string. This function formats the first value according to the second operand as a format string. If the first operand doesn't match the expected type in the format string, an error is returned.

It an RLIB compatibility function and is a special case of the `printf()` function. See Formatting data.

4.12.2. printf()

This function takes one or more operands. The first operand is a string and used as the format string. Subsequent operands have to be of the expected type according to the format string, otherwise an error is returned. If everything is correct, it returns the formatted data as a string. See Formatting data.

4.12.3. str()

It takes three numeric operands. The first operand is converted to a string with the length and number of decimal digits specified by the second and the third operands, respectively.

4.12.4. val()

Numeric value. It takes one numeric or string operand.

If a string value is passed, and it can be converted to a numeric value successfully, then it returns the converted numeric value.

The value of a numeric operand is passed through as is.

4.13. Miscellaneous functions

4.13.1. brownum()

Current row number of a break since its last break boundary. The row number restarts from 1 at every break boundary. It takes one string operand, the name of the break.

4.13.2. error()

Return an artificially generated error. It takes one string operand, the error message. Used by unit tests but it may be useful in some other cases.

4.13.3. eval()

Parse an expression string. If it's correct, it is inserted into the parent expression in place of the function call. If there is a syntax error, the error is re-thrown for the main expression. It takes one string operand.

This is a pseudo-function. The grammar detects its use and converts the embedded expression string into a regular subexpression, like if it was inside parenthesis in the parent expression contents. This allows the subexpression to be optimized in the parent expression context.

Fox example, the expression `3 * eval('1 + 2')` is optimized into the numeric constant `9`.

Note, that the grammar transformation only takes place if there is no user defined function with the same name. In this case, the user defined function is used.

4.13.4. fxpval()

Move the decimal separator to the left by the specified number of digits. It takes two operands. The first operand may either be a string containing a numeric value, or a numeric. If it's a string, then it will be converted to numeric first. The second operand is numeric.

It is an RLIB compatibility function. The function divides the numeric value of the first operand with 10 to the power of the value of the second operand. One use case is that if the value of the first operand contains prices in cents, then `fxpval(data, 2)` puts the decimal separator to the correct place.

4.13.5. iif()

Ternary function. It takes three operands of which the first one is numeric, the second and third operands can be of any type. If the first operand is non-zero (i.e.: "true") then it returns the second operand, otherwise the third operand. The ternary operator `exp1 ? exp2 : exp3` is a shortcut for this function.

4.13.6. isnull()

Returns numeric 1 if the operand is NULL, 0 otherwise. It takes one operand of any type.

4.13.7. null()

Generate NULL value using the type of its operand. It takes one operand of any type.

4.13.8. nulldt()

Generate NULL of the datetime type. It takes zero operands.

4.13.9. nulln()

Generate NULL of the numeric type. It takes zero operands.

4.13.10. nulls()

Generate NULL of the string type. It takes zero operands.

4.13.11. prevval()

Return the previous value. It takes one operand of any type.

The interesting use case for this function is non-constant expressions. It returns the operand's previous value, i.e. the value generated for the previous query row. If there is no previous value row, the result is an error. This function allows showing values carried over from the previous page to be shown in a header section of the current page.

4.13.12. random()

Generate a pseudo-random numeric value between 0 and 1. It takes zero operands.

4.13.13. rownum()

Return the row number of a query in the report. It takes either zero operands or one string operand. If zero operands are passed, it returns the current row number of the primary query. If a string operand is passed, then it returns the current row number of the query with that name. See Queries.

4.13.14. translate()

Translate the operand. It takes one string operand.

This function returns the translated version of the string operand according to translation and locale settings using `dgettext()` from Gettext.

4.13.15. translate2()

Translate the operands using singular and plural variants and the number of the object in the statement. It takes three operands. The first two operands are strings, for the singular and plural strings. The third operand is the number that determines which translation form is used.

This function translates its operands according to the translation and locale settings using `dngettext()` from Gettext.

Chapter 5. Report variables

5.1. Introduction to report variables

In OpenCReports, there are a few variable types:

- expression variables, practically named aliases for Expressions
- pre-defined numeric operations for simple statistics, like summing, counting, or averaging a data series, or finding the highest or lowest values in a data series
- custom variables where the data type and the operation on the data are user-defined

Variables may be reset at break boundaries. See Report breaks and the Reset on break attribute.

5.2. Expression variables

The value of an expression variable is calculated from the expression using current row of data from the query.

This can be thought of as a kind of shortcut. A variable may use a long expression. Other expressions may use the same long expression as a subexpression, i.e. part of themselves. Typing the same long expression over and over is error-prone. The variable allows typing the expression once, then the variable can be used in other expressions. This not only saves on typing. The expression value of the varable is calculated once, and referencing the variable simply uses the already calculated value, thereby saving report execution time.

5.2.1. Variables with iterative expressions

An expression may be iterative, where the new value is derived from the previous value of itself. See Expression self reference.

5.2.2. Expression variable examples

Examples cannot be understood without the context in which they are used. Complete variable examples are in the Variable node section of the Report XML description chapter.

5.3. Variable types for simple statistics

There are pre-defined variable types for performing simple statistic calculations. All of them (except data series counting) operate on numeric values and use iterative expressions internally.

The pre-defined variables types are as below:

- Summing a data series. The variable type is `sum`.
- Counting a data series. The variable type is `count` or `countall`. The difference between the two is that plain `count` does not count NULL data, while `countall` does. It's equivalent to the difference between `COUNT(query1.field1)` and `COUNT(*)` in `SQL`. The former doesn't count NULL (empty) values, the latter does.
- Averaging in a data series. Averaging uses two running expressions behind the scenes. One is the `sum` of data, the other is the `count` of data. The sum is divided by the count.

Here, two different calculation is possible again, depending on which counting method is used, see above. NULL data contributes 0 to the sum, but the count (the denominator in the division) may differ. The result depends on this detail.

For this reason, `average` and `averageall` variable types exist.

- Highest and lowest values of a data series. Finding the highest and lowest values in a data series is done by the `highest` and the `lowest` variable types.

  NULL values don't contribute to the result of either variable type, so in an all-NULL series, each variable will give a NULL result, i.e. empty when displayed.

5.3.1. Statistics variable examples

Examples cannot be understood without the context in which they are used. Complete variable examples are in the Variable node section of the Report XML description chapter.

5.4. Custom variables

As seen in Expression variables and also in the Complete variable examples, variables are not mysterious. They can be iterative or non-iterative and their operation can be spelled out. On the other hand, the pre-defined variables for doing simple statistics may be limiting. Maybe we need an iteratively calculated value that uses a different type than `numeric`. This is where `custom` variables may be useful.

For a `custom` variable, all details can be freely defined:

- the base type: `numeric`, `string` or `datetime`; `number` is also accepted as an alias for `numeric`
- the base expression
- two intermediary expressions that both may use the base expression's result, and the second intermediary may also use the first one's result
- the result expression that may use all three expressions' results

See the Custom variable example on how the `average` type variable can be spelled out as a custom variable.

5.5. Precalculated variables

By default, variables produce results that are valid for the data rows they are derived from. Iterative variables variable produce results that are valid for the current row and preceding rows.

Usually, we are not interested in the *running average*, only in the average of the whole data series.

This is where the *precalculated* variables come in.

A variable can be set to be precalculated via the Precalculate attribute.

As it was already mentioned for precalculated expressions, the report goes through the data set twice. At the end of the first run, the value of precalculated variables computed for the last row are kept. In the second run, the same value is supplied for every data row. The value of such a precalculated variable can be displayed in a report header, which is shown before any report details to inform the reader in advance without having to look at the last page.

See Precalculate attribute for an example.

Chapter 6. Report breaks

6.1. Grouping data

OpenCReports, being a report generator, works on tabular data: the data consists of ordered (named) columns and ordered or unordered rows.

It is often necessary to group data by certain properties. Imagine a list of employees of a company, grouped by their departments, pay grade, or location of employment. A report may show the list of the employees with visual separation according to any of these properties.

Multiple groupings may be prioritized (nested):

1. by department
2. by pay grade

With the above, in each department, subgrouping would separate employees according to the pay grade in that department.

For this to work, the rows of data must be fed to the report generator in a certain order. For example, in SQL the ordering can be done by:

```
SELECT ...
ORDER BY department,paygrade,employee;
```

This grouping of data is called a *break* in a report generator.

6.2. Report breaks in OpenCReports

Expressions can reference data via the column names of a row. Arbitrary expressions may be used to watch for changes in the value of the expression data breaks. Breaks occurs on the boundary of changes in the expression value.

Prioritization (nesting) of breaks is done according their order of declaration. See Breaks and Break node.

Visual separation is optionally helped with break headers and footers. See BreakHeader and BreakFooter.

6.3. Resetting a variable on break boundaries

It may also be useful to use a regular or precalculated variable that only considers data rows in break ranges. For example printing a running average for detail rows in breaks, or printing the total average calculated for a break range in the header for that period.

For this purpose, variables may be reset on break boundaries. See examples of such variables in Reset on break attribute and Precalculate attribute in the Variable node section of the Report XML description chapter.

6.4. Example

Examples cannot be understood without the context in which they are used. A complete break example can be found at the end of the Breaks section of the Report XML description chapter.

Chapter 7. Formatting

7.1. Formatting functions

Formatting data can be done via the format() function, the printf function and the Text element format attribute. After formatting, regardless of the data type that was formatted, the type of the result value is string. This string can be displayed in the report output or processed further as needed.

7.2. Format strings

OpenCReports supports the same set of format strings as RLIB, with extensions. RLIB and OpenCReports support:

- legacy format strings for strings, numbers and datetime values
- "new style" format strings with `!` prefix

The legacy and the "new style" format strings can only be used in the format() function and the Text element format attribute, due to them being RLIB compatible. They can also be used in the printf function in limited cases, i.e. when formatting a single data value.

OpenCReports also supports a 2nd generation new style format strings with a prefix and a pair of brackets (`{}`) that embed the format strings. The 2nd generation format strings can also be used with the printf function in a completely unambiguous manner.

7.3. Legacy format strings

Legacy format strings are like in C, but not always identical.

7.3.1. Format string for strings

To print a string, the `%s` format string can be used. Examples for using it in the Text element format attribute can be found in the Format attribute examples.

Example expressions for the format() function:

```
format(query1.field1, '%s')
format(query1.field1, 'Look, there is a %s there!')
```

Example expressions for printf function:

```
printf('%s, 'query1.field1')
printf('Look, there is a %s there!', query1.field1)
```

Supplementary format string flags are supported. See the string flags in printf(3)[1]

7.3.2. Format string for numeric values

To print a number, the `%d` format string can be used. As opposed to the C `printf` format specifier where `%d` is used for integers, this is used for printing fractions, too. Examples for using it in the Text element format attribute can be found in the Format attribute examples.

[1] https://man7.org/linux/man-pages/man3/printf.3.html

The same format string can be used for the the format() function and the printf function, just like in the previous examples for strings.

Supplementary format string flags are supported. See the decimal and float/double format flags in printf(3)[2]

7.3.3. Format string for datetime values

RLIB approximated `strftime()` when printing a datetime value. OpenCReports *uses* `strftime()`. See the strftime()[3] function description for the complete description of format string flags.

When a datetime field didn't have an explicit format string, RLIB used the US date format to print the datetime value. On the other hand, OpenCReports uses the locale specific date format if the report has a locale set.

7.4. New style format strings

RLIB supported "new style" format strings that allowed formatting numeric data as monetary values and allowed to disambiguate between format strings used for different data types. This was needed because some format flags are used in both `printf()`, `strfmon()` and `strftime()`.

7.4.1. New style format string for strings

This is an extension over RLIB, which didn't have such a notion. In OpenCReports, the new style flag is prefixed with `!&`.

7.4.2. New style format string for numeric data

The new style flag is the legacy flag prefixed with `!#`

7.4.3. New style format string for monetary data

There was way to format numeric data using the legacy formatting flags. The new style flag is prefixed with `!$` and uses the flags of `strfmon()`. See the strfmon()[4] function for details.

To print the correct currency name, the locale must be set for the report. Only one locale can be set, so a single currency name will be used for every value using monetary formatting.

7.4.4. New style format string for datetime values

The new style flag is the legacy flags prefixed with `!@`. Formatting a datetime value uses strftime()[5].

7.4.5. New style format string examples

Examples for using these in the Text element format attribute can be found in the Format attribute examples.

[2] https://man7.org/linux/man-pages/man3/printf.3.html
[3] https://man7.org/linux/man-pages/man3/strftime.3.html
[4] https://man7.org/linux/man-pages/man3/strfmon.3.html
[5] https://man7.org/linux/man-pages/man3/strftime.3.html

7.5. Second generation new style format strings

This format string style builds upon the original new style format strings, with the addition of brackets that embed the underlying format strings.

7.5.1. 2nd gen new style format string for strings

The format string format is the legacy format string embedded in `!&{...}`.

7.5.2. 2nd gen new style format string for numeric data

The format string format is the legacy format string embedded in `!#{...}`

7.5.3. 2nd gen new style format string for monetary data

The format string format is the same as the first generation. Instead of just having a prefix, the `strfmon()` format string is embedded in `!${...}`

Formatting monetary values uses `strfmon()`. See strfmon(3)[6]

To print the correct currency name, the locale must be set for the report. Only one locale can be set, so a single currency name will be used for every value using monetary formatting.

7.5.4. 2nd gen new style format string for datetime values

The format string format is embedded in `!@{...}`. Formatting a datetime value uses `strftime()`.

7.5.5. 2nd gen new style format string examples

Examples for using these in the Text element format attribute can be found in the Format attribute examples.

7.6. The swiss army knife of formatting

The printf function is the most versatile formatting function in OpenCReports. It does not exist in RLIB. Using the second generation format strings makes it completely unambiguous.

The `printf()` function in OpenCReports allows formatting every data type into a common result string. Example:

```
printf('You had %d %s on !@{%Y-%m-%d} '
      'and %d %s on !@{%Y-%m-%d} in your pocket.',
      6, 'apples', stodt('2022-05-01'),
      2, 'oranges', stodt('2022-05-02'))
```

The result is:

[6] https://man7.org/linux/man-pages/man3/strfmon.3.html

```
You had 6 apples on 2022-05-01 and 2 oranges on 2022-05-02 in your
 pocket.
```

Chapter 8. Report XML description

8.1. XML description structure

OpenCReports[1] uses an RLIB[2]-compatible report description with extensions.

The report XML description, like all XML files start with declaring that it's an XML file and the optional declaration of the Document Type Definition that the XML file can be checked against. For an OpenCReports report description, the first two lines are:

```
<?xml version="1.0"?>
<!DOCTYPE OpenCReport SYSTEM "opencreport.dtd">
```

The DTD file `opencreport.dtd` can be found in the sources of OpenCReports here[3].

After the XML header lines, a fully specified report description looks like this:

```
<OpenCReport>
    <Datasources>
        ...
    </Datasources>
    <Queries>
        ...
    </Queries>
    <Part>
        <pr>
            <pd>
                <Report>
                    ...
                </Report>
            </pd>
        </pr>
    </Part>
</OpenCReport>
```

or like this:

```
<OpenCReport>
    <Datasources>
        ...
    </Datasources>
    <Queries>
        ...
    </Queries>
    <Report>
        ...
    </Report>
</OpenCReport>
```

The XML sections Datasources and Queries are optional in the XML description. They can be substituted by program code using the datasource and query related calls in the Low level C API, similarly to RLIB.

[1] https://github.com/zboszor/OpenCReports
[2] https://sourceforge.net/projects/rlib/
[3] https://github.com/zboszor/OpenCReports/blob/main/opencreport.dtd

For RLIB compatibility, a report description may start with either `<Part>` or `<Report>` as the toplevel node. In this case, there's no other way to add datasources and queries, but through program code, like the Low level C API.

Since XML files are hierarchical with a single toplevel node with child nodes, multiple `<Report>` nodes in the same report output were only possible in RLIB with using `<Part>` as the toplevel node, with all the nodes having to be spelled out between `<Part>` and `<Report>`. With `<OpenCReport>` being the toplevel node, multiple `<Report>` child nodes can be used without the parent `<Part>` node.

8.1.1. Notes about XML syntax and attributes

Most (if not all) XML attributes in the report description file are handled with the expression parser (see Expressions), with fallback to literal strings if the the location of expression wouldn't allow identifier references at that location.

For example, the datasource name may be declared using either of the three examples below:

```
<Datasource name="mysource" ... />
<Datasource name="'mysource'" ... />
<Datasource name="&amp;quot;mysource&amp;quot;" ... />
```

The first form is a regular XML string value. Since expression parsing would find that `mysource` is an identifier which may be a query column name and this is not a valid place for a query reference, the non-parsed string value is used.

The second form is a single quoted OpenCReports string constant. The value of the string constant (i.e. `mysource`) is used.

The third form is a double quoted OpenCReports string constant, but in XML the double quote character must be substituted with `&quot;` because they are reserved for quoting the attribute values. The value of the string constant (i.e. `mysource`) is used. (This substitution is called "string escaping" and various other formats besides XML require some kind of substutition for reserved characters.)

To make the XML easier to read, the second form is recommended because it still allows embedding the single quote character inside a string (see Report XML description) in case e.g. a strong password contains this. For security-by-obscurity, the third form may be used because it is harder to read. For all special characters that should be escaped in XML, see Simplified XML Escaping[4].

8.2. OpenCReport element

The toplevel `<OpenCReport>` element controls some global settings and serves as the topmost XML element for child elements.

8.2.1. Size unit attribute

The `size_unit` attribute specifies report behaviour for size related settings:

```
<OpenCReport size_unit="'rlib'">
<OpenCReport size_unit="'points'">
```

Default is `rlib` which is the legacy RLIB behavior, where sizing of layout details are a mix of units, making it harder to design the report layout:

[4] https://stackoverflow.com/a/46637835/290085

- width for `field` and `literal` (see Output node) are in number of characters. This is influenced by the font size set in either Part font size, Report font size or Line font size.
- height for Part column is measured in number of characters influenced by Part font size
- height for Report is measured in percentage of Part column and considered to be a minimum value, so padding is added if the report contents end earlier than the limit
- width of horizontal lines and the optional border width around reports are specified in points
- gaps between columns of multi-column reports is measured in inches

Note that RLIB only expected monospace fonts that have the same width for every character. It also expected that the character height is identical to the character width. The latter expectation is false for many monospace fonts, i.e. their height is usually greater than their width. Also, there are problems with field widths calculated in number of characters. Widths using a 12 point font (for example, used for regular text) is not the same as widths using a 20 point font used for text in a header line. Due to this, width of header and data lines will not align properly and it will show when using background color for both of them.

With proportional fonts (where the width of characters depend on their image, i.e. an "i" is thinner than an "m") width of text fields cannot reliably be set in a "number of characters" unit because it's not an exact value. There is a workaround for this in OpenCReports but it isn't available in RLIB so it's not backward compatible. See Text element width.

When `size_unit` is set to `points`, all size related settings in the report are in points, a.k.a. 1/72th inch. It's consistent and avoids the above described issues.

8.2.2. No query show NoData

The report uses data from Queries through the report's Query attribute. When a query provides no data rows, an alternative section called NoData node with static information may be shown instead if it exists in the report. The report uses the first query declared in Queries if it's not explicitly set via Query attribute.

RLIB had a trick to disable showing the NoData node. This was enabled by specifying a query name that does not exist. This option controls the layout behaviour for that case.

```
<OpenCReport noquery_show_nodata="yes">
<OpenCReport noquery_show_nodata="no">
```

Default is `true` (or `yes`) when `<OpenCReport>` is the toplevel node, `false` (or `no`) when either `<Part>` or `<Report>` is the toplevel node for RLIB compatibility.

8.2.3. Report height after last

A report may specify its height through Report height. Multiple `<Report>` nodes may exist in the same `<pd>` section. For more information, see Part column and Report.

This option controls whether report height is applied after the last `<Report>` in the same `<pd>` node.

```
<OpenCReport report_height_after_last="yes">
<OpenCReport report_height_after_last="no">
```

Default is `false`.

8.2.4. Follower match single

Queries may be daisy-chained together as Follower queries in two ways, regular and N:1 followers. See the links for details.

When set to `false`, N:1 followers behave fully like `LEFT OUTER JOIN` in SQL, with duplicating data from the primary query if multiple matching rows exist in followers. When set to `true`, only the first matching row is used. The latter approximates the RLIB implementation.

```
<OpenCReport follower_match_single="yes">
<OpenCReport follower_match_single="no">
```

Default is `yes` in RLIB compatibility mode, i.e. when either `<Part>` or `<Report>` are used as the toplevel XML node for the report description. Otherwise the default is `no`.

8.2.5. Precision bits

This controls the precision for numeric computations. For more information, see Expressions

```
<OpenCReport precision_bits="512">
```

Default is `256`.

8.2.6. Rounding mode

This controls the rounding mode for numeric computations. Possible values are: `nearest`, `to_minus_inf`, `to_inf`, `to_zero`, `away_from_zero`, or `faithful`.

```
<OpenCReport rounding_mode="nearest">
<OpenCReport rounding_mode="to_minus_inf">
<OpenCReport rounding_mode="to_inf">
<OpenCReport rounding_mode="to_zero">
<OpenCReport rounding_mode="away_from_zero">
<OpenCReport rounding_mode="faithful">
```

Default is `nearest`. Note that according to the MPFR documentation, `faithful` is experimental.

8.2.7. Locale

This controls the language settings, like the decimal separator, weekday names, month names and similar. This setting is also used as the language of translation.

```
<OpenCReport locale="de_DE">
```

Default is `C` locale which approximates US English.

8.2.8. Translation settings

These two settings control the translation.

```
<OpenCReport
    translation_domain="mydomain"
```

```
    translation_directory="/path/to/translation/files">
```

Translation is based on GNU Gettext[5]. A subdirectory tree is expected under the specified translation directory in the form of `locale/LC_MESSAGES` (e.g.: `de_DE/LC_MESSAGES`) with `mydomain.mo` files in them. These `.mo` files contain translated messages for a given language.

8.3. Paths

Some report description elements reference file. Such elements are `<load>` and `<Image>`, see Loaded report and Image node. By default, these files must be in the same directory as the report XML description file, or in the current working directory for the application using OpenCReports. To lift this limitation and to allow organizing files, a search path or multiple search paths may be added. For files referenced with relative paths, the search paths will be used in their order of declaration. Search paths and the relative file path are concatenated together to form an absolute path. The first successful absolute file path match will be used in the element referencing the file.

Search paths are in the following format:

```
<Paths>
    <Path value="/absolute/path" />
    ...
</Paths>
```

8.4. Datasources

Datasources in OpenCReports are either database connections, or accessors (mini-drivers) for data files in certain formats.

Datasource descriptions are in the following format:

```
<Datasources>
    <Datasource name="mysource" type="..." ... />
</Datasources>
```

A report may have multiple datasources, i.e. the description may list multiple `<Datasource>` lines.

Datasources must have unique names in a report and their type may be: `mariadb` (or `mysql`), `postgresql`, `odbc`, `csv`, `json`, `xml` or `array`.

8.4.1. MariaDB (MySQL) database connection

A MariaDB database connection may be declared in three ways. Either by using the database host and port, the database name, user name and password directly:

```
<Datasource
    name="mysource" type="mariadb"
    host="..." port="..."
    dbname="..." user="..." password="..." />
```

or alternatively, instead of the host and port, specifying the UNIX Domain Socket file for a local connection if it's not in the standard location:

[5] https://www.gnu.org/software/gettext/

```
<Datasource
    name="mysource" type="mariadb"
    unix_socket="..."
    dbname="..." user="..." password="..." />
```

or moving these details out to an external configuration file in an INI file format:

```
<Datasource
    name="mysource" type="mariadb"
    optionfile="myconn.cnf" group="myconn" />
```

In the last case, the configuration file `myconn.cnf` would contain something like this:

```
[myconn]
!include /etc/my.cnf
database=mydb
user=myuser
#password=
#host=
#port=
#unix_socket=
```

Please note that the INI group name `[myconn]` matches `group="myconn"` in the above datasource declaration.

The database name and user name are mandatory. The user password is optional, depending on the database security authentication setup.

The database host and port, or the socket file location are all optional. Without these, a local connection is attempted using the default settings. If the host name is specified but the port isn't, the remote host is used on the default port (as known by the local MariaDB database client library).

8.4.2. PostgreSQL database connection

A PostgreSQL database connection may be declared in three ways. Either by using the database host and port, the database name, user name and password directly:

```
<Datasource
    name="mysource" type="postgresql"
    host="..." port="..."
    dbname="..." user="..." password="..." />
```

or alternatively, instead of the host and port, specifying the UNIX Domain Socket file for a local connection if it's not in the standard location:

```
<Datasource
    name="mysource" type="postgresql"
    unix_socket="..."
    dbname="..." user="..." password="..." />
```

or using a so called connection string:

```
<Datasource
    name="mysource" type="postgresql"
    connstr="..." />
```

For the connection string format, see the PostgreSQL documentation[6].

The database name and user name are mandatory. The user password is optional, depending on the database security authentication setup.

The database host and port, or the socket file location are all optional. Without these, a local connection is attempted using the default settings. If the host name is specified but the port isn't, the remote host is used on the default port (as known by the local PostgreSQL database client library).

8.4.3. ODBC database connection

The above described MariaDB and PostgreSQL database connection types are using their respective client libraries. There is a more generic way, i.e. ODBC. ODBC was invented by Microsoft in the 1990s for Windows. See Microsoft Open Database Connectivity (ODBC)[7] In their solution, there's an abstract client library and individual database drivers adhere to the APIs offered by ODBC toplevel library. Since then, UNIX and UNIX-like systems also gained their ODBC client libraries in two different implementations, both of which are supported by OpenCReports: unixODBC[8] and iODBC[9].

An ODBC database setup is done a differently. There are two system-wide configuration files. The first one is `odbcinst.ini` that lists the database drivers installed into the system. The second one is `odbc.ini` which references the first one and lists pre-defined database connections. These database connections are named. In ODBC speak, these are called Data Source Names or DSNs. The DSNs specify the low level connection parameters, like the database host and port, and optionally the user name and password, too.

Thus, an ODBC database connection may be declared in two ways. The first way is by using the DSN name, and optionally the user name and password:

```
<Datasource
    name="mysource" type="odbc"
    dbname="..." user="..." password="..." />
```

In this case, the `dbname` attribute is not the low level database name, but the ODBC abstract DSN name.

There's also a way to use the so called connection string which contain the same connection information:

```
<Datasource
    name="mysource" type="odbc"
    connstr="..." />
```

For the connection string format, see the public examples[10].

8.4.4. CSV file datasource

For a generic description of the CSV file format, see CSV file type.

A CSV file datasource is declared very simply:

```
<Datasource name="mysource" type="'csv'" />
```

In this case, the actual CSV file is not declared, only that a "query" using a CSV file will be listed later under `<Queries>`.

[6] https://www.postgresql.org/docs
[7] https://docs.microsoft.com/en-us/sql/odbc/microsoft-open-database-connectivity-odbc
[8] https://www.unixodbc.org
[9] https://www.iodbc.org
[10] https://www.connectionstrings.com/

8.4.5. JSON file datasource

For a generic description of the expected JSON file format, see JSON file type.

Similarly to CSV, the JSON file datasource is also declared very simply:

```
<Datasource name="mysource" type="'json'" />
```

In this case, the actual JSON file is not declared, only that a "query" using a JSON file will be listed later under `<Queries>`.

8.4.6. XML file datasource

Similarly to CSV and JSON, the XML file datasource is also declared very simply:

```
<Datasource name="mysource" type="'xml'" />
```

In this case, the actual XML file is not declared, only that a "query" using an XML file will be listed later under `<Queries>`.

8.4.7. Array datasource

Arrays are global in-memory structures in the application that should be accessible to the OpenCReports library. For example, when using the C programming language, global non-static symbols are visible to libraries if the application is compiled with `-rdynamic`.

Similarly to file based datasources, the array datasource is declared very simply:

```
<Datasource name="mysource" type="'array'" />
```

In this case, the actual array is not declared, only that a "query" using an array will be listed later under `<Queries>`.

A C array is declared in this format:

```
const char *array[ROWS + 1][COLUMNS] = {
    { "column1", ... },
    { "value1",  ... },
    ...
};
```

The array is declared as a two-dimensional array of C strings. The first row of the array is the column names, `[ROWS + 1]` in the array declaration accounts for the title row.

All rows have the same number of columns. Column values may be NULL, in which case they will be treated the same as SQL NULLs in SQL query results.

Optionally, a column types array is declared separately:

```
#include <opencreport.h>

const enum ocrpt_result_type coltypes[COLUMNS] = {
    ...
};
```

If this array is present, it must have the same number of `COLUMNS` as the matching data array. The `enum ocrpt_result_type` usable in data array type declaration are `OCRPT_RESULT_STRING`, `OCRPT_RESULT_NUMBER` and `OCRPT_RESULT_DATETIME`.

8.4.8. Common datasource properties

8.4.8.1. Encoding

OpenCReports expects strings in UTF-8 encoding. However, some datasources may use a different encoding. To use and display strings from the datasource, an internal conversion to UTF-8 is needed. To perform this correctly, the datasource encoding must be set.

```
<Datasource
    name="mysource"
    ...
    encoding="ISO-8859-2" />
```

8.5. Queries

Queries in OpenCReports are SQL queries for database connections, or data files files in certain formats. The queries are declared like this:

```
<Queries>
    <Query name="..." ... />
    ...
</Queries>
```

8.5.1. SQL queries for SQL datasources

SQL queries for MariaDB, PostgreSQL and ODBC datasources may be declared two ways, either as the XML value for `<Query>`:

```
<Query
    name="myquery"
    datasource="mysource">
SELECT * FROM some_table
</Query>
```

or as the `value` attribute:

```
<Query
    name="myquery"
    datasource="mysource"
    value="SELECT * FROM some_table" />
```

Note, that the XML attribute `datasource="..."` must match a previously declared datasource.

The SQL query can be any `SELECT` statement.

8.5.2. Queries for file based datasources

Queries for CSV, XML and JSON datasources may be declared two ways. Either as the XML value for `<Query>`:

```
<Query
    name="myquery"
    datasource="mysource"
>xmldata.xml</Query>
```

or as the `value` attribute:

```
<Query
    name="myquery"
    datasource="mysource"
    value="'xmldata.xml'" />
```

Notes:

- The XML attribute `datasource="..."` must match a previously declared datasource.
- It is recommended that the `value="..."` form is used, since it's not ensured that whitespace before or after the file name is trimmed in the first variant if the XML is "beautified". The file name that the OpenCReports library receives must be correct in order to use it.
- The declaration must specify a file in the correct format for the datasource type.
- The optional type declaration for columns in the XML and JSON file formats, or for CSV, the complete lack of it can be supplemented with a memory array using the optional `coltypes="..."` and `cols="..."` attributes. For details, see the Array queries.

8.5.3. Queries for array based datasources

Queries for array datasources may be declared two ways. Either as the XML value for `<Query>`:

```
<Query
    name="myquery"
    datasource="mysource"
    coltypes="'coltypes'"
    rows="30"
    cols="6"
>array</Query>
```

or as the `value` attribute:

```
<Query
    name="myquery"
    datasource="mysource"
    value="'array'"
    coltypes="'coltypes'"
    rows="30"
    cols="6" />
```

Notes:

- The XML attribute `datasource="..."` must match a previously declared datasource.
- It is recommended that the `value="..."` form is used, since it's not ensured that whitespace before or after the symbol name is trimmed in the first variant if the XML is "beautified". The symbol name that the OpenCReports library receives must be correct in order to use it. The array name must match

the correct global symbol name. The library discovers this symbol using the Array discovery function, by default via `dlsym()`.

- Similarly to the array symbol name, the `coltypes="..."` array name must match the correct global symbol name. The library discovers this symbol using the Array discovery function, by default via `dlsym()`.
- The value for `cols` must match the second dimension of the data array. It may be omitted if the Array discovery function is smarter than the default implementation and returns the arrays' dimensions.
- The value for `rows` must match the number of data rows in the array, excluding the title row. I.e. it must be one less than the first dimension of the array. It may be omitted if the Array discovery function is smarter than the default implementation and returns the arrays' dimensions.

Failing to fulfill the above may cause crashes or wrong data to be used in the report.

8.5.4. Follower queries

8.5.4.1. Regular follower queries

A regular follower query is declared by adding the `follower_for="..."` attribute. The value for `follower_for="..."` is the `name` of a previously declared query. Example:

```
<Query
  name="myquery1"
  datasource="mysource1"
  value="'SELECT * FROM table1'" />

 <Query
  name="myquery2"
  datasource="mysource2"
  value="'SELECT * FROM table1'"
  follower_for="myquery1" />
```

In this example, two queries of two different datasources are used. This is one of the advantages of using follower queries, i.e. data from different databases may be used. Nowadays, with foreign queries implemented in e.g. PostgreSQL, its use case is more limited.

8.5.4.2. N:1 follower queries

See Section 2.2.4.1.2 for explanation.

The follower matching expression is specified with the `follower_expr="..."` attribute. Example:

```
<Query
 name="myquery1"
 datasource="mysource1"
 value="'SELECT * FROM table1'" />

<Query
 name="myquery2"
 datasource="mysource2"
 value="'SELECT * FROM table1'"
 follower_for="myquery1"
```

```
 follower_expr="myquery1.id = myquery2.id" />
```

8.6. Report parts

An OpenCReports XML description may consists of multiple separate reports. This is achieved by so called "report parts". Such a <Part> may be under the toplevel <OpenCReport> node, in which case multiple report parts may exist in the same XML. It may also be the toplevel node of the XML. In the latter case, only a single <Part> may be present in the XML description.

```
<Part>
    <pr>
        <pd>
            <Report>
                ...
            </Report>
            ...
        </pd>
        ...
    </pr>
    ...
</Part>
```

A report <Part> may consist multiple reports, arranged in

- rows (<pr>),
- columns in rows (<pd>), and
- reports (<Report>) arranged vertically in a column.

The rows and columns in rows do not form a grid as rows are independent of each other. E.g. one row may contain two columns, the next one may contain three, the next one may contain one. It is completely freeform.

This allows very complex report layouts. One possible application of such a complex layout is printed forms.

8.6.1. Part attributes

Note that any attribute setting below may only use constant expressions or an query column reference from Independent queries. An environment variable (since it can't - or shouldn't - change during the report execution) is considered constant. See Expressions. This allows external control for the attributes in question.

8.6.1.1. Font name

The font name attribute specifies the font for the report part's global scope. It can be overridden by child nodes for their scope. It may be specified in two forms, the first one is the preferred name, the second is for RLIB compatibility:

```
<Part font_name="'Arial'">
<Part fontName="'Arial'">
```

If both forms are specified, font_name is used.

Default font name is `Courier`.

8.6.1.2. Font size

The font size attribute specifies the font size for the report part's global scope. It can be overridden by child nodes for their scope. It may be specified in two forms, the first one is the preferred name, the second is for RLIB compatibility:

```
<Part font_size="10">
<Part fontSize="10">
```

If both forms are specified, `font_size` is used.

Default font size is 12.

8.6.1.3. Size unit

Shortcut for the Size unit attribute in `<OpenCReport>` when `<Part>` is the toplevel node.

```
<Part size_unit="'rlib'">
<Part size_unit="'points'">
```

When `<OpenCReport>` is the toplevel node in the XML, this attribute for `<Part>` is ignored.

8.6.1.4. No query show NoData attribute

Shortcut for No query show NoData attribute in `<OpenCReport>` when `<Part>` is the toplevel node.

```
<Part noquery_show_nodata="yes">
<Part noquery_show_nodata="no">
```

See default in No query show NoData attribute See also NoData node.

8.6.1.5. Report height after last attribute

Shortcut for Report height after last attribute in `<OpenCReport>` when `<Part>` is the toplevel node.

```
<Part report_height_after_last="yes">
<Part report_height_after_last="no">
```

See default in Report height after last attribute See also NoData node.

8.6.1.6. Orientation

Page orientation for the whole `<Part>`.

```
<Part orientation="'portrait'">
<Part orientation="'landscape'">
```

Default is portrait orientation.

8.6.1.7. Margin settings

Margin settings for the page for the whole `<Part>`. Individual settings exist for the top, bottom, left and right margins of the page. Every setting exist in two forms: the RLIB compatible "lowerCamelCase" variant and the all lowercase with underscore. The latter variants are preferred.

```
<Part top_margin="0.2">
<Part topMargin="0.2">
<Part bottom_margin="0.2">
<Part bottomMargin="0.2">
<Part left_margin="0.2">
<Part leftMargin="0.2">
<Part right_margin="0.2">
<Part rightMargin="0.2">
```

When `size_unit="'rlib'"` is in effect (the default case) the margin unit is inches. The margin unit is points (1/72th inches) when `size_unit="'points'"` is in effect.

Default values for the top, bottom, left and right margins are all 0.2, regardless of the unit.

Note that `rightMargin` didn't exist in RLIB.

8.6.1.8. Paper type

Paper type (implicitly: page size) for the whole `<Part>`. It exists in two forms: the RLIB compatible "lowerCamelCase" variant and the all lowercase with underscore. The latter variant is preferred.

```
<Part paper_type="'A4'">
<Part paperType="'A4'">
```

Default value is the current system paper type that libpaper[11] uses. E.g. if the system is set to US English, the default paper type is implicitly `letter`. In most of Europe, the default paper type is `A4`

The paper type can be specified in either lower case or upper case, both are accepted.

8.6.1.9. Iterations

The same `<Part>` may be executed multiple times.

```
<Part iterations="3">
```

Default value is 1.

Note that a `<Part>` and every iteration of it start on a new page. This is one way to print multiple copies of a report and encode it into the output, e.g. in the PDF file.

8.6.1.10. Suppress

Report parts may be suppressed.

```
<Part suppress="yes">
```

Default value is `false`, i.e. no suppression.

8.6.1.11. Suppress page header on the first page

The `<PageHeader>` section (see Page header below) for `<Part>` may be suppressed on the first page.

```
<Part suppressPageHeaderFirstPage="yes">
```

[11] http://packages.qa.debian.org/libp/libpaper.html

Default value is no.

Note that this suppression applies only to the first page of the complete result (e.g. PDF) and not to the first page of an iteration, which may fall on a later page of the result.

8.6.2. Part subsections

As described at the beginning of this section (see Report parts), a <Part> may contain one or more report rows (<pr>) which in turn may contain one or more columns (<pr>). See Part row and Part column. Apart from these, global page headers and footers may also be used for report parts.

8.6.2.1. Page header

This is the description of the page header. It contains an Output node. The expressions in it cannot reference query columns. See also Report page header.

```
<Part>
    <PageHeader>
        <Output>
            ...
        </Output>
    </PageHeader>
</Part>
```

8.6.2.2. Page footer

This is the description of the page footer. It contains an Output node. The expressions in it cannot reference query columns. See also Report page footer.

```
<Part>
    <PageFooter>
        <Output>
            ...
        </Output>
    </PageFooter>
</Part>
```

8.6.2.3. Part row

See Part row.

```
<Part>
    <pr>
        <pd>
            ...
        </pd>
    </pr>
</Part>
```

8.7. Part row

A part row (<pr>) may contain one or more Part columns (<pd>) which are layed out side by side horizontally. The longest running column will control the height of the row. The next row will be continuous from that vertical page position.

8.7.1. Part row attributes

Note that any attribute setting below may only use constant expressions or an query column reference from Independent queries. An environment variable (since it can't - or shouldn't - change during the report execution) is considered constant. See Expressions. This allows external control for the attributes in question.

8.7.1.1. Layout

The `layout` attribute exists only for RLIB compatibility, it's ignored. It accepts two values: `flow` and `fixed`.

```
<pr layout="'flow'">
<pr layout="'fixed'">
```

8.7.1.2. New page

The `newpage` attribute controls whether the part row starts from the point where the previous row in the same part ended, or it should start on a new page.

```
<pr newpage="yes">
```

Default value is `no`

8.7.1.3. Suppress

Report rows may be suppressed.

```
<pr suppress="yes">
```

Default value is `false`, i.e. no suppression.

8.8. Part column

A part column (`<pd>`) may contain one or more Reports (`<Report>`) which are layed out vertically in this column continuously.

Such a report may be inlined:

```
<Part>
    <pr>
        <pd>
            <Report>
                ...
            </Report>
        </pd>
    </pr>
</Part>
```

A report may also be loaded from a separate file. For details, see Loaded report.

```
<Part>
    <pr>
        <pd>
```

```
            <load ... />
        </pd>
    </pr>
</Part>
```

8.8.1. Part column attributes

Note that any attribute setting below may only use constant expressions or an query column reference from Independent queries. An environment variable (since it can't - or shouldn't - change during the report execution) is considered constant. See Expressions. This allows external control for the attributes in question.

8.8.1.1. Width

Width of the part column. Optional.

```
<pd width="60">
```

When Size unit attribute is set to `rlib` (the default), the column width is measured in characters, which is controlled by Part font size. Note, that the font width and height may differ, depending on the font face controlled by Part font name. Width is computed from the font width.

When Size unit attribute is set to `points`, width is measured in points.

Columns without explicitly specified width are dynamically sized according to Paper type, Margin settings and other columns in the same Part row that do have explicitly set width.

Columns that exceed the total page width (according to Paper type and Margin settings) will be shown partially, or won't be shown at all.

8.8.1.2. Height

Height of the part column.

```
<pd height="120">
```

When Size unit attribute is set to `rlib` (the default), the column height is measured in characters, which is controlled by Part font size. Note, that the font width and height may differ, depending on the font face controlled by Part font name. Column height is computed from the font height.

When Size unit attribute is set to `points`, height is measured in points.

Report details in this part column are layed out up to the specified height. See Report height for further explanation.

Note, that OpenCReports allows fixed height columns to break over page boundaries. This is a deviation from RLIB.

8.8.1.3. Border width

Border width around the part column. It is measured in points.

```
<pd border_width="2">
```

When set, a rectangle around the part column will be drawn. The width of outline of the rectangle is measured in points.

This is a deviation from RLIB where the width of the outline was a fixed 0.1 points and an inner margin (all of top, bottom, left and right) inside the column border was used.

If the column breaks over a page boundary, the border will be drawn the column parts on every page.

8.8.1.4. Border color

When `border_width` is set, this color is used to draw the border rectangle.

```
<pd border_color="'blue'">
```

See Color specification.

8.8.1.5. Detail columns

Inner `<Report>`s are layed out in one or more columns.

```
<pd detail_columns="3">
```

Default value is 1.

8.8.1.6. Column padding

When `detail_columns` is set to higher than 1, inner padding between the detail columns may be specified.

```
<pd column_pad="0.2">
```

Default value is 0, i.e. no padding.

The unit of padding is inches if Size unit attribute is set to `rlib` (default), points otherwise.

8.8.1.7. Suppress

Report columns may be suppressed.

```
<pd suppress="yes">
```

Default value is `false`, i.e. no suppression.

8.9. Report

This section may occur in a wider context or standalone in an OpenCReports XML report description file.

Example XML skeleton structure with `<OpenCReport>` as the toplevel node:

```
<OpenCReport>
    <Part>
        <pr>
            <pd>
                <Report>
                    ...
                </Report>
            </pd>
        </pr>
    </Part>
```

```
</OpenCReport>
```

Example XML skeleton structure with `<Part>` as the toplevel node:

```
<Part>
    <pr>
        <pd>
            <Report>
                ...
            </Report>
        </pd>
    </pr>
</Part>
```

Example XML skeleton structure with a standalone `<Report>` node:

```
<Report>
    ...
</Report>
```

When `<Report>` is the toplevel node, parent nodes for `<Part>`, `<pr>` and `<pd>` are implicitly created. Subsections and many attributes specific to these parent nodes can be used as shortcuts in the `<Report>` node.

8.9.1. Report attributes

Note that any attribute setting below may only use constant expressions or an query column reference from Independent queries. An environment variable (since it can't - or shouldn't - change during the report execution) is considered constant. See Expressions. This allows external control for the attributes in question.

8.9.1.1. Font name

The font name attribute specifies the font for the report's scope. It can be overridden by child nodes for their scope. It may be specified in two forms, the first one is the preferred name, the second is for RLIB compatibility:

```
<Report font_name="'Arial'">
<Report fontName="'Arial'">
```

If both forms are specified, `font_name` is used.

Default font name is what's set for Part font name, or `Courier` if both are unset.

8.9.1.2. Font size

The font size attribute specifies the font size for the report's scope. It can be overridden by child nodes for their scope. It may be specified in two forms, the first one is the preferred name, the second is for RLIB compatibility:

```
<Report font_size="10">
<Report fontSize="10">
```

If both forms are specified, `font_size` is used.

Default font name is what's set for Part font size, or `12` if both are unset.

8.9.1.3. Size unit

Shortcut for the Size unit attribute in <OpenCReport> when <Report> is the toplevel node.

```
<Report size_unit="'rlib'">
<Report size_unit="'points'">
```

When <OpenCReport> or <Part> is the toplevel node in the report XML description, this attribute for <Report> is ignored.

8.9.1.4. No query show NoData attribute

Shortcut for No query show NoData attribute in <OpenCReport> when <Report> is the toplevel node.

```
<Report noquery_show_nodata="yes">
<Report noquery_show_nodata="no>
```

See default in No query show NoData attribute See also NoData node.

8.9.1.5. Report height after last attribute

Shortcut for Report height after last attribute in <OpenCReport> when <Part> is the toplevel node.

```
<Report report_height_after_last="yes">
<Report report_height_after_last="no">
```

See default in Report height after last attribute See also NoData node.

8.9.1.6. Orientation

Shortcut for Part page orientation for the implicitly created parent <Part> node when <Report> is standalone.

```
<Report orientation="'portrait'">
<Report orientation="'landscape'">
```

Default is portrait orientation.

This setting for <Report> is ignored when there is a parent <Part> node in the XML description.

8.9.1.7. Margin settings

Shortcuts for Margin settings for the implicitly created parent <Part> node. Individual settings exist for the top, bottom, left and right margins of the page. Every setting exist in two forms: the RLIB compatible "lowerCamelCase" variant and the all lowercase with underscore. The lowecase-with-underscore variants are the preferred ones.

```
<Report top_margin="0.2">
<Report topMargin="0.2">
<Report bottom_margin="0.2">
<Report bottomMargin="0.2">
<Report left_margin="0.2">
<Report leftMargin="0.2">
<Report right_margin="0.2">
<Report rightMargin="0.2">
```

When `size_unit="'rlib'"` is in effect (the default case) the margin unit is inches. The margin unit is points (1/72th inches) when `size_unit="'points'"` is in effect.

Default values for the top, bottom, left and right margins are all 0.2, regardless of the unit.

Note that `rightMargin` didn't exist in RLIB.

These settings for `<Report>` are ignored when there is a parent `<Part>` node in the XML description.

8.9.1.8. Paper type

Shortcut for Paper type for the implicitly created parent `<Part>` node. It exists in two forms: the RLIB compatible "lowerCamelCase" variant and the all lowercase with underscore. The lowecase-with-underscore variant is preferred.

```
<Part paper_type="'A4'">
<Part paperType="'A4'">
```

Default value is the current system paper type that libpaper[12] uses. E.g. if the system is set to US English, the default paper type is implicitly `letter`. In most of Europe, the default paper type is `A4`

The paper type can be specified in either lower case or upper case, both are accepted.

This setting for `<Report>` is ignored when there is a parent `<Part>` node in the XML description.

8.9.1.9. Height

Height of the report.

```
<Report height="120">
```

This setting is interpreted differently depending on whether the report XML description uses `<OpenCReport>` as the toplevel node, or it uses either `<Part>` or `<Report>`.

8.9.1.9.1. Report height in OpenCReports mode

When Size unit attribute is set to `rlib` (the default), the report height is measured in characters, which is controlled by Report font size. Note, that the font width and height may differ, depending on the font face controlled by Report font name. Report height is computed from the font height.

When Size unit attribute is set to `points`, height is measured in points.

Report details are layed out up to the specified height. If the report would run longer than the specified height, it gets truncated. When the report fits in the specified height, the next report starts with the remaining height added as padding before it.

If the `<Report>` is the last one in the `<pd>` node, then the report may or may not be padded with the remaining height, depending on the Report height after last attribute.

If height is unset for the parent `<pd>` node, it is expanded with this vertical padding.

In case height is set for both the parent `<pd>` node and the `<Report>` nodes in it, the height value for `<pd>` is applied first. It would limit the displayed rows in whichever `<Report>` node is terminated by it. Subsequent `<Report>` nodes would no be displayed in that `<pd>` node.

[12] http://packages.qa.debian.org/libp/libpaper.html

Note, that OpenCReports allows fixed-height reports to break over page boundaries. This is a deviation from RLIB.

8.9.1.9.2. Report height in RLIB compatibility mode

When parsing XML descriptions from RLIB, i.e. when either `<Part>` or `<Report>` is used as the toplevel node, compatibility mode is turned on for interpreting this setting.

In this mode, the report height is interpreted as a percentage of the height set in Part column height attribute. In this case, the report height setting is a hint, to use it as *minimum height*. If the `<Report>` is rendered on the same page from start to end, and is shorter than the height of the parent `<pd>` node, then a gap is added to the `<Report>`. If there are multiple `<Report>` nodes in the same `<pd>` node, this will separate them visually.

Note, that this behaviour is not available when using the programming API to create a report. It's only for RLIB compatibility which relied only on the report XML description file.

8.9.1.10. Iterations

The same `<Report>` may be executed multiple times.

```
<Report iterations="3">
```

Default value is 1.

8.9.1.11. Suppress

Reports may be suppressed.

```
<Report suppress="yes">
```

Default value is `false`, i.e. no suppression.

8.9.1.12. Suppress page header on the first page

Shortcut for Suppress page header on the first page in the implicitly created parent `<Part>` node when `<Report>` is the toplevel node.

```
<Report suppressPageHeaderFirstPage="yes">
```

Default value is `no`.

This setting for `<Report>` is ignored when there is a parent `<Part>` node in the XML description.

8.9.1.13. Query

Set the primary query name for `<Report>` from the list of Queries.

```
<Report query="query1">
```

Default value is unset, i.e. use the first query from the list of Queries.

Column references of the report's primary query and its follower queries may be used in Expressions of Output node sections in a `<Report>` node: Report page header, Report page footer, Report header, Report footer, `<FieldHeaders>` and `<FieldDetails>` in Detail node, and also in Break nodes and Variable nodes.

When a query is empty (i.e. it doesn't have data rows) then the NoData node will be shown.

When the query name is set to a non-existing query, then the appearance of the NoData node is controlled by No query show NoData attribute.

8.9.1.14. Field header priority

Set the field header priority for the report versus break (header and footer) priority. This setting selects which report detail is encompassing the other.

```
<Report field_header_priority="'low'">
<Report field_header_priority="'high'">
```

Default value is `high`. In this mode, the field header is printed on the top of every page of the report and break headers and footers are encompassed by it. The default is chosen for RLIB compatibility.

When this setting is `low`, field headers are handled with lower priority compared to break headers and footers. In this mode, a break header is followed by the field header, then data rows (field details), followed by the break footer. This brings the field header closer to the field details.

8.9.1.15. Border width

This is a shortcut for Part column border width for the implicitly created `<pd>` node when `<Report>` is standalone. It is measured in points.

```
<Report border_width="2">
```

When set, a rectangle around the part column (in this case, around the single report in the part column) will be drawn. The width of outline of the rectangle is measured in points.

This is a deviation from RLIB where the width of the outline was a fixed 0.1 points and an inner margin (all of top, bottom, left and right) inside the column border was used. Also, this shortcut didn't exist in RLIB, the `<pd>` node had to be present.

If the report (column) breaks over a page boundary, the border will be drawn the column parts on every page.

This setting for `<Report>` is ignored when there is a parent `<pd>` node.

8.9.1.16. Border color

This is a shortcut for Part column border color for the implicitly created `<pd>` node when `<Report>` is standalone. When `border_width` is set, this color is used to draw the border rectangle.

```
<Report border_color="'blue'">
```

See Color specification.

8.9.1.17. Detail columns

Shortcut for Detail columns in the implicitly created parent `<pd>` when `<Parent>` is the toplevel node.

```
<Report detail_columns="3">
```

Default value is 1.

This setting for <Parent> is ignored when there is a parent <pd> node in the report XML description.

8.9.1.18. Column padding

Shortcut for Column padding in the implicitly created parent <pd> node when <Parent> is the toplevel node.

```
<Report column_pad="0.2">
```

Default value is 0, i.e. no padding.

The unit of padding is inches if Size unit attribute is set to rlib (default), points otherwise.

8.9.2. Report subsections

8.9.2.1. Page header

This may be seen as a shortcut for Page header in the implicitly created <Part> node when <Report> is standalone. Except that report query column references are also allowed in expressions instead of only constants and column references of Independent queries. It contains an Output node.

```
<Report>
    <PageHeader>
        <Output>
            ...
        </Output>
    </PageHeader>
</Part>
```

This subsection for <Report> is ignored when there is a page header section defined for the <Part> node, either in the <Part> node itself or in a previous child <Report> node for the same <Part>. A warning is issued in this case.

8.9.2.2. Page footer

This may be seen as a shortcut for Page footer in the implicitly created <Part> node when <Report> is standalone. Except that report query column references are also allowed in expressions instead of only constants and column references of Independent queries. It contains an Output node.

```
<Report>
    <PageFooter>
        <Output>
            ...
        </Output>
    </PageFooter>
</Part>
```

This subsection for <Report> is ignored when there is a page footer section defined for the <Part> node, either in the <Part> node itself or in a previous child <Report> node for the same <Part>. A warning is issued in this case.

8.9.2.3. Report header

This is the description of the report header that is print at the beginning of the report. It contains an Output node.

```
<Report>
    <ReportHeader>
        <Output>
            ...
        </Output>
    </ReportHeader>
</Part>
```

8.9.2.4. Report footer

This is the description of the report footer that is printed at the end of the report. It contains an Output node.

```
<Report>
    <ReportFooter>
        <Output>
            ...
        </Output>
    </ReportFooter>
</Part>
```

8.9.2.5. Variables

This section describes the Variables in the report.

```
<Report>
    <Variables>
        <Variable ... />
        ...
    </Variables>
</Part>
```

8.9.2.6. Breaks

This section describes the Breaks in the report.

```
<Report>
    <Breaks>
        <Break ... >
            ...
        </Break>
        ...
    </Breaks>
</Part>
```

8.9.2.7. Detail

This section describes the tabular details of the report. There are two subsections in this node, both contain an Output node.

```
<Report>
    <Detail>
        <FieldHeaders>
            <Output>
                ...
```

```
            </Output>
        </FieldHeaders>
        <FieldDetails>
            <Output>
                ...
            </Output>
        </FieldDetails>
    </Detail>
</Part>
```

<FieldHeaders> is used to describe the header for data rows.

<FieldDetails> is used to show data that is derived from the current data row produced by the report query.

8.9.2.8. Alternate output for no data

This section describes the alternate output of the report when the query has no data rows, or there is no such query name defined that's set in Report query name. It contains an Output node.

This section may be declared in two ways. One way is to spell out the <Alternate> node:

```
<Report>
    <Alternate>
        <NoData>
            <Output>
                ...
            </Output>
        </NoData>
    </Alternate>
</Part>
```

The other way is without the <Alternate> node:

```
<Report>
    <NoData>
        <Output>
            ...
        </Output>
    </NoData>
</Part>
```

When the Report query name does not exist in in the global list of Queries and the No query show NoData attribute is set, then the <NoData> section is not displayed.

8.10. Loaded report

It is like an inline Report it is loaded from a different file.

8.10.1. Loaded Report attributes

8.10.1.1. File name

```
<load name="report1.xml" />
```

8.10.1.2. Query

This attribute overrides the Query attribute of `<Report>`. This way, the report in the separate file can be reused for a different data set.

```
<load query="query1" />
```

8.10.1.3. Iterations

This attribute overrides the Report iterations attribute of `<Report>`.

```
<load iterations="5" />
```

8.11. Variables

This is the parent node for individual `<Variable>` nodes that describe each variable.

```
<Variables>
    <Variable ... />
    ...
</Variables>
```

8.12. Variable

This node describes one `<Variable>` node. It has no children nodes, only attributes.

```
<Variable ... />
```

8.12.1. Variable attributes

8.12.1.1. Name

The name of the variable. It must be unique in the list of variables for the parent `<Report>` node.

```
<Variable name="var1" />
```

8.12.1.2. Value

The "value" of the variable, or rather, the expression from which the value is computed. Variables' values are computed for every data row produced by the report query. The expression may therefore reference field names of queries that are declared in the XML description or in programming code.

```
<Variable value="q1.field1 + 2 * q2.field2" />
```

8.12.1.3. Type

The type of the variable. Several variable types exist:

```
<Variable value="q1.field" type="expression"/>

<Variable value="q1.field" type="count"/>
<Variable value="q1.field" type="countall"/>
```

```
<Variable value="q1.field" type="sum"/>

<Variable value="q1.field" type="average"/>
<Variable value="q1.field" type="averageall"/>

<Variable value="q1.field" type="highest"/>
<Variable value="q1.field" type="lowest"/>

<Variable type="custom" ... />
```

Default type is `expression`. This is just a shortcut for the computed value of the expression that saves both typing (in other expressions referencing this variable) and time to generate the report. This can be considered a manual optimization.

The `count` and `countall` variable types count the number of expression results for the data set. The former leaves out NULL values, the latter includes them. This is equivalent to `COUNT(field)` and `COUNT(*)` in SQL.

The `sum` variable type sums the non-NULL values of the expression results for the data set.

The `average` and `averageall` variable types are combinations of `sum` and either `count` or `countall`. They take the value computed for each data row, add them together, and divide by the number of values. The result of `average` and `averageall` may differ if there is NULL data in the result set.

The `highest` and `lowest` variable types return the highest and the lowest values for the data set, respectively.

All of the above pre-defined variables types work on numeric data.

The `custom` variable type allow arbitrary user variables if the predefined types are not enough, for example, when the base type needs to be something else then a number. See below.

8.12.1.3.1. Complete variable examples

Here's a complete example of an expression variable:

```
<Report>
    <Variables>
        <Variable
            name="var1"
            value="query1.field1 + query2.field2"
            type="expression" />
    </Variables>

    <Detail>
        <FieldHeaders>
            <literal value="'My variable'" />
        </FieldHeaders>

        <FieldDetails>
            <field value="v.var1" />
        </FieldDetails>
    </Detail>
</Report>
```

Note, that in this simple example, there is no difference if the variable is used in the `<field>` or the `query1.field1 + query2.field2` expression. The efficiency of not computing the variable again for the same data row can be observed when the variable is used multiple times and the report processes a huge data set.

Here's a complete example of using a variable:

```
<Report>
    <Variables>
        <Variable
            name="var1"
            value="r.self + query1.field1 + query2.field2"
            type="expression" />
    </Variables>

    <Detail>
        <FieldHeaders>
            <literal value="'My variable'" />
        </FieldHeaders>

        <FieldDetails>
            <field value="v.var1" />
        </FieldDetails>
    </Detail>
</Report>
```

The trick is to use the `r.self` internal variable.

Please note, that the above example will not work as is, because for the first row, *there is no previous row*. But there is a trick to avoid such problems, namely using the Ternary operator (or its equivalent, the iif() function) and the `rownum()` to perform only safe computations. (Note that the `value=...` part below is a single line.)

```
<Variable>
    ...
    value="rownum() == 1 ?
           query1.field1 + query2.field2 :
           r.self + query1.field1 + query2.field2"
    ...
</Variable>
```

This example shows the correct operation of an iterative expression. For the first row, set a known good value. For every subsequent rows, the previous row value may be used for deriving the new value from.

The above spelled out example can also be written as a `sum`ming variable:

```
<Report>
    <Variables>
        <Variable
            name="var1"
            value="query1.field1 + query2.field2"
            type="sum" />
    </Variables>

    <Detail>
```

```
        <FieldHeaders>
            <literal value="'My variable'" />
        </FieldHeaders>

        <FieldDetails>
            <field value="v.var1" />
        </FieldDetails>
    </Detail>
</Report>
```

Here are two examples of the `count` and `countall` variable types:

```
<Report>
    <Variables>
        <Variable
            name="var1"
            value="query1.field1"
            type="count" />

        <Variable
            name="var2"
            value="query1.field1"
            type="countall" />
    </Variables>
</Report>
```

Here are two examples of using the `average` and `averageall` variable types:

```
<Report>
    <Variables>
        <Variable
            name="var1"
            value="query1.field1"
            type="average" />

        <Variable
            name="var2"
            value="query1.field1"
            type="averageall" />
    </Variables>
</Report>
```

Here are two examples of using `highest` and `lowest` variable types:

```
<Report>
    <Variables>
        <Variable
            name="var1"
            value="query1.field1"
            type="highest" />

        <Variable
            name="var2"
            value="query1.field1"
            type="lowest" />
```

```
    </Variables>
</Report>
```

8.12.1.4. Custom variable attributes

These attributes below define a custom variable. A base expression, up to two intermediary expressions and one result expression may be defined, together with the expression type.

```
<Variable
    baseexpr="..."
    intermedexpr="..."
    intermed2expr="..."
    resultexpr="..."
    basetype="..."
    type="custom"/>
```

`baseexpr`, `intermedexpr`, `intermed2expr` and `resultexpr` are Expressions.

Iterative or recursive variables can use Expression self reference.

Possible values for `basetype` are `number`, `string` or `datetime`.

It's the user's responsibility to use expressions valid for the base type. Failing that, the result value will be an appropriate error message.

Note that the `baseexpr` attribute is an alias for `value`.

8.12.1.4.1. Custom variable example

For example, the `average` variable works this way behind the scenes as written below.

```
<Report>
    <Variables>
        <Variable
            name="averagevar1"
            type="custom"
            basetype="number"
            baseexpr="query1.field1"
            intermedexpr="(rownum() == 1 ? 0 : r.self) +
                          (isnull(r.baseexpr) ?
                              0 : r.baseexpr)"
            intermed2expr="r.self +
                           (isnull(r.baseexpr) ? 0 : 1)"
            resultexpr="r.intermedexpr / r.intermed2expr"
            />
    </Variables>
</Report>
```

8.12.1.5. Reset on break

A variable may be reset on break boundaries to the base expression value, e.g. 0 for `count` and other pre-defined variable types. See Break node and Report breaks.

```
<Variable resetonbreak="break1" />
```

Default is unset, i.e. no reset on a break.

Here's an example to use a variable that's value is reset on a break boundary:

```
<Report>
    <Breaks>
        <Break name="break1" ... >
            <BreaksHeader>
                <Output>
                    <field value="v.var1" />
                </Output>
            </BreaksHeader>
            <BreaksFields>
                <BreaksField value="query1.field2" />
            </BreaksFields>
        </Break>
    </Breaks>

    <Variables>
        <Variable
            name="var1"
            value="query1.field1"
            type="average"
            precalculate="yes"
            resetonbreak="'break1'" />
    </Variables>
    ...
</Report>
```

8.12.1.6. Precalculate (delayed)

A variable may work two ways. The first way is to generate an immediate value that is valid for the current row. See Expressions. An expression may reference the value computed for previous data row, see Expression self reference.

The other way is Precalculated variables. The attribute is accepted under two names:

```
<Variable precalculate="yes" />
<Variable delayed="yes" />
```

Default is `no`.

A precalculated variable may also use the Reset on break attribute. In this case, the precalculated value is computed for each break range separately.

Precalculated variables may be used to show totals in e.g. Report header, in `<FieldHeaders>` in Detail node, in BreakHeader and in Report page header, among other places.

Here's an example of a precalculated variable:

```
<Report>
    <Variables>
        <Variable
            name="var1"
            value="query1.field1"
            type="average"
            precalculate="yes" />
```

```
    </Variables>

    <ReportHeader>
        <Output>
            <field value="v.var1">
        </Output>
    </ReportHeader>
</Report>
```

To reveal the internals of a variable that's value is reset on break boundaries, here is the equivalent using a `custom` variable. The value returned by the Break row number function automatically resets at every break boundary, so it can be used as below.

```
<Variables>
    <Variable
        name="var1"
        type="custom"
        baseexpr="query1.field1"
        intermedexpr="(brrownum('break1') == 1 ? 0 : r.self) +
                     (isnull(r.baseexpr) ?
                         0 : r.baseexpr)"
        intermed2expr="r.self +
                       (isnull(r.baseexpr) ? 0 : 1)"
        resultexpr="r.intermedexpr / r.intermed2expr"
        />
</Variables>
```

8.13. Breaks

This is the parent node for individual `<Break>` nodes that describe each break. See Report breaks

```
<Breaks>
    <Break ... />
    ...
</Break>
```

8.14. Break

This node describes one `<Break>`.

```
<Break ... >
    <BreakHeader>
        <Output>
            ...
        </Output>
    </BreakHeader>
    <BreakFooter>
        <Output>
            ...
        </Output>
    </BreakFooter>
    <BreakFields>
        <BreakField />
```

```
        ...
    </BreakFields>
</Break>
```

The order in which `Break` nodes are listed matters for two reasons.

The primary reason is that break fields are hierarchical. The break fields listed earlier are higher in the hierarchy. If a break field earlier in the list triggers, all subsequent break fields also trigger implicitly.

The second reason is a consequence of the previous one: emitting the BreakHeaders occur in the order of the list. For logical reasons, BreakFooters are in reverse order.

8.14.1. Break attributes

8.14.1.1. Name

The name of the break. It must be unique in the list of breaks for the parent `<Report>` node.

```
<Break name="break1" />
```

8.14.1.2. Header on new page

After a break boundary, the header starts on a new page. Accepted in two variants:

```
<Break headernewpage="yes" />
<Break newpage="yes" />
```

The `newpage="yes"` variant is parsed but ignored in RLIB.

8.14.1.3. Suppress break header and footer for blank break fields

Suppress break header and footer in case any of the break fields' values are either `NULL` or an empty string, if the break field is of the string type.

```
<Break suppressblank="yes" />
```

8.14.2. Break subsections

8.14.2.1. BreakHeader

The break header is printed before the new data row if it causes a break, i.e. the values in the set of break fields changed from one row to the next. It contains an Output node child node.

```
<BreakHeader>
    <Output>
        ...
    </Output>
</BreakHeader>
```

8.14.2.2. BreakFooter

The break header is printed after the previous data row if it causes a break, i.e. the values in the set of break fields changed from one row to the next. Also before the first row in the data set. It contains an Output node child node.

```
<BreakHeader>
    <Output>
        ...
    </Output>
</BreakHeader>
```

8.14.2.3. BreakFields

The break fields node contains one or more BreakField children nodes.

```
<BreakFields>
    <BreakField ... />
    ...
</BreakFields>
```

8.14.2.3.1. BreakField

The break field node only has one attribute and contains no child nodes.

```
<BreakField value="..."/>
```

The sole attribute in `<BreakField>` is `<value>` where the expression watched for changes is declared. See Expressions.

There must be at least one `<BreakField>` node listed. When more than one break fields are listed, then all of them are watched for value changes. If any of them changes, a break boundary occurs for the break.

8.14.3. A complete break example

This XML part below shows a complete example of nested breaks based on the real life example mentioned in Section 6.1.

```
<Report>

    <Breaks>

        <Break>

            <BreakHeader>
                <Output>
                    <Line>
                        <field value="query1.department" />
                    </Line>
                </Output>
            </BreakHeader>

            <BreakFooter>
                <Output>
                    <Line>
                        <literal>End of </literal>
                        <field value="query1.department" />
                    </Line>
                </Output>
            </BreakFooter>
```

```
            <BreakFields>
                <BreakField value="query1.department" />
            </BreakFields>

        </Break>

        <Break>

            <BreakHeader>
                <Output>
                    <Line>
                        <literal width="30" />
                        <field value="query1.paygrade" />
                    </Line>
                </Output>
            </BreakHeader>

            <BreakFooter>
                <Output>
                    <Line>
                        <literal width="30" />
                        <literal>End of </literal>
                        <field value="query1.paygrade" />
                    </Line>
                </Output>
            </BreakFooter>

            <BreakFields>
                <BreakField value="query1.paygrade" />
            </BreakFields>

        </Break>

    </Breaks>

    <Detail>

        <FieldHeaders>
            <Output>
                <Line>
                    <literal width="60" />
                    <literal>Employee name</literal>
                </Line>
            </Output>
        </FieldHeaders>

        <FieldDetails>
            <Output>
                <Line>
                    <literal width="60" />
                    <field value="query1.employee" />
                </Line>
            </Output>
```

```
        </FieldDetails>

    <Detail>

</Report>
```

Assuming that Size unit attribute is set to `points`, the indentation would be 30 and 60 points for certain elements (see the empty `<literal>`s) and the result would look like this:

1. Before the first row on every page, the contents of `<FieldHeaders>` is printed.
2. Before the first row, the contents of `<BreakHeader>` is printed for every break declared in the `<Report>` in the order of their declaration.
3. The contents of `<FieldDetails>` is printed for the current row. Repeat until a value change is observed between adjacent rows for a break's expression. In this case, the employees are printed in one block that are in the current paygrade category and working at the current department.
4. When a value change happened between adjacent rows for a break's expression, then this break and every break declared after it triggers. For every triggering breaks, their `<BreakFooter>` is printed in the reverse order of their declaration. This is done using the *previous row*, so if any data used from the row or derived from it (e.g. a variable) and is to be displayed in the footer, it will be valid for the break range that just ended.
5. Before the new row, the contents of `<BreakHeader>` is printed for every break that just triggered. For example, the department's name is not printed if only the paygrade category changed in the same department from the one row to the next.
6. Repeat from step 3 until there are no more data rows.

8.15. Output

The `<Output>` node is used by many previously mentioned sections. This is the generic node that describes how details are displayed in reports.

8.15.1. Output attributes

Note that Expressions in attribute settings below depend on the parent node context. Some may only use constant expressions or query column references from Independent queries. `<Output>` nodes in `<Report>` context may also use report query column references.

8.15.1.1. Suppress

Output nodes may be suppressed as a whole.

```
<Output suppress="yes">
```

Default value is `false`, i.e. no suppression.

8.15.2. Output subsections

8.15.2.1. Line

A line containing text elements of varying widths. See Line node.

```
<Output>
    <Line>
        ...
    </Line>
</Output
```

8.15.2.2. HorizontalLine

A horizontal line. See HorizontalLine node.

```
<Output>
    <HorizontalLine ... />
</Output
```

8.15.2.3. Image

An image. See Image node.

```
<Output>
    <Image ... />
</Output
```

8.15.2.4. Barcode

A barcode. See Barcode node.

```
<Output>
    <Barcode ... />
</Output
```

8.15.2.5. Image end

Terminator for a previous image or barcode node. See ImageEnd node.

```
<Output>
    <ImageEnd/>
</Output
```

8.16. Line

A line containing text elements of varying widths.

```
<Output>
    <Line>
        ...
    </Line>
</Output
```

8.16.1. Line attributes

Note that Expressions in attribute settings below depend on the parent node context. Some may only use constant expressions or query column references from Independent queries. Child nodes of `<Output>` nodes in `<Report>` context may also use report query column references.

8.16.1.1. Font name

The font name attribute specifies the font for the line's scope. It can be overridden by child nodes for their scope. It may be specified in two forms, the first one is the preferred name, the second is for RLIB compatibility:

```
<Line font_name="'Arial'">
<Line fontName="'Arial'">
```

If both forms are specified, `font_name` is used.

Default font name is what's set (in decreasing priority) in Report font name or Part font name. If none of them is set, it's `Courier`.

8.16.1.2. Font size

The font size attribute specifies the font size for the line's scope. It can be overridden by child nodes for their scope. It may be specified in two forms, the first one is the preferred name, the second is for RLIB compatibility:

```
<Line font_size="10">
<Line fontSize="10">
```

If both forms are specified, `font_size` is used.

Default font name is what's set (in decreasing priority) in Report font size or Part font size. If none of them is set, it's `12`.

8.16.1.3. Bold font

Whether the line elements use bold font.

```
<Line bold="yes">
```

Default is `false`.

8.16.1.4. Italic font

Whether the line elements use italic font. It is accepted in two forms:

```
<Line italic="yes">
<Line italics="yes">
```

Default is `false`.

8.16.1.5. Suppress

Text lines may be suppressed. If the parent `<Output>` node is in `<FieldDetails>`, the expression may be derived from a query field.

```
<Line suppress="yes">
```

Default value is `false`, i.e. no suppression.

8.16.1.6. Text color

This color is used to render text. It's accepted with both American and British spelling.

```
<Line color="'blue'">
<Line colour="'blue'">
```

Default is `black`. See Color specification.

8.16.1.7. Background color

This color is used to render the background rectangle under the text. It's accepted with both American and British spelling.

```
<Line bgcolor="'blue'">
<Line bgcolour="'blue'">
```

Default is `white`. See Color specification.

8.16.2. Line subsections

8.16.2.1. Text element

See the Text element node. Two variants are accepted.

```
<Line>
    <field value="expression..." ... />
</Line>
```

and

```
<Line>
    <literal ... >Literal text</literal>
</Line>
```

8.16.2.2. Image element

An `<Image>` is accepted as a line element. See the Image node.

```
<Line>
    <Image value="expression..." ... />
</Line>
```

8.16.2.3. Barcode element

A `<Barcode>` is accepted as a line element. See the Barcode node.

```
<Line>
    <Barcode value="expression..." ... />
</Line>
```

8.17. Text element

Two variants are accepted.

```
<Line>
    <field value="expression..." ... />
</Line>
```

and

```
<Line>
    <literal ... >Literal text</literal>
</Line>
```

Neither `field` nor `literal` have child nodes, only attributes or XML values.

The two variants are interchangeable, see Text element value below.

8.17.1. Text element attributes

Note that Expressions in attribute settings below depend on the parent node context. Some may only use constant expressions or query column references from Independent queries. Child nodes of `<Output>` nodes in `<Report>` context may also use report query column references.

8.17.1.1. Value

The value of the text element. It's accepted in two ways: in the `value` attribute or as the XML value for the `field` and `literal` nodes.

```
<Line>
    <field value="'This text'" />
    <field>This text</field>
    <literal value="'This text'" />
    <literal>This text</literal>
</Line>
```

The value is parsed as an expression from the `value` attribute. See Expressions.

On the other hand, the value is taken as a literal string from the XML value in the second and fourth examples above.

8.17.1.2. Delayed (precalculated) value

This setting indicates whether the value is "delayed" or "precalculated", i.e. the value for the last row in the data set is used for every row. It is equivalent to referencing an Expression variable with `precalculate="yes"` and without `resetonbreak`.

```
<field delayed="yes" />
<field precalculate="yes" />
```

Default is `false`.

This setting is only applicable for line elements in the Output node node in `<Report>` context.

Note that in OpenCReports, an expression may mix references to precalculated variables with non-precalculated variables and query field references. The result will use the precalculated value only for the precalculated variables. Other references will use values derived from the current row in the data set. This is an extension over RLIB.

8.17.1.3. Format string

The format string is one way to format the field `value` to be displayed in the generated output.

The format string is expected to be a string so quoting around it is needed.

See Formatting data for details.

8.17.1.3.1. Format attribute examples

Format a value as a string, first as is, second with adding a surrounding text:

```
<field value="query1.field1" format="'%s'" >

<field value="query1.field1"
       format="'Look, there is a %s there!'" >
```

Here's the same with the "new syle" formatting flag:

```
<field value="query1.field1" format="'!&%s'" />

<field value="query1.field1"
       format="'Look, there is a !&%s there!'" >
```

Also, with the 2nd generation new style formatting flag:

```
<field value="query1.field1"
       format="'!&{%s}'" ... />
```

Here's an example to truncate a string to 6 characters using format string flags in legacy and both new style formatting flags:

```
<field value="query1.field1"
       format="'%6.6s'" ... />

<field value="query1.field1"
       format="'!&%6.6s'" ... />

<field value="query1.field1"
       format="'!&{%6.6s}'" ... />
```

Format a numeric value with three decimal places, first as is, second with adding a surrounding text:

```
<field value="query1.field1"
       format="'%.3d'" >

<field value="query1.field1"
       format="'You have %.3d apples.'" >
```

Convert a number from a string and the value with two decimal places:

```
<field value="val(query1.field1)"
       format="'%.2d'" />
```

Here are the same examples using the "new style" formatting flags:

```
<field value="query1.field1"
       format="'!#%.3d'" >

<field value="query1.field1"
       format="'You have !#%.3d apples.'" >

<field value="val(query1.field1)"
```

```
       format="'!#%.2d'" />
```

Here are the same examples using the 2nd generation new style formatting flags:

```
<field value="query1.field1"
       format="'!#{%.3d}'" >

<field value="query1.field1"
       format="'You have !#{%.3d} apples.'" >

<field value="val(query1.field1)"
       format="'!#%.2d'" />
```

Format a numeric value with monetary details either using the first or the second generation format strings:

```
<field value="query1.field1"
       format="'!$%=*#150n'" />

<field value="query1.field1"
       format="'!${%=*#150n}'" />
```

Format a datetime value, first with the preferred datetime format for the locale, then only the year, month and day using the YYYY-MM-DD format:

```
<field value="query1.field1"
       format="'!@%c'" />

<field value="query1.field1"
       format="'!@%Y-%m-%d'" ... />
```

Here's the same using the second generation format strings:

```
<field value="query1.field1"
       format="'!@{%c}'" ... />

<field value="query1.field1"
       format="'!@{%Y-%m-%d}'" ... />
```

8.17.1.4. Width

The field width.

```
<field value="3" format="'%.2d'" width="6" />
```

Default is unset, i.e. the field width is implicitly set to the rendered width (in points) of the field's formatted value as text, using the font name and font size of the field.

When the field is the last one in the `<Line>`, then its width will be the remaining page or column width.

If set, the width's unit depends on the Size unit attribute.

When the Size unit attribute is set to `rlib`, the field width is measured in number of characters.

The character width is queried from the font set by Line font name and Line font size, Report font name and Report font size, or Part font name and Part font size in decreasing order of precedence.

Text element font name and Text element font size *do not influence* the field width calculation.

This allows using uniquely set font name and size for individual text elements, including proportional fonts, using the RLIB compatible field width settings.

When using different font names or font sizes for different text elements in the same `<Line>`, the text elements are aligned vertically so all text elements are rendered on the same typographic baseline.

8.17.1.5. Alignment

It specifies the alignment for the text element. It works in accordance with the Text element width, i.e. the field's formatted value (as text) is aligned inside the specified field width.

```
<field value="3" format="'%.2d'"
       width="6" align="'center'" />
```

The alignment values may be `left`, `right`, `center` or `justified`.

Justified alignment is like left alignment, but for Multi-line (memo) fields, all lines but the last are justified. This is best used with the default word wrapping. In this case, the spacing between words is enlarged. `justified` and `left` behave the same for single-line fields.

Default is `left`.

OpenCReports decoupled the data from displaying it. For example, with the PDF output, the text element is not truncated to the element width. Instead, pixel perfect alignment is used together with masking the parts of the value with a bounding box. This is an improvement over RLIB where data was truncated (in every output formats) because it was designed for using only monospace fonts.

8.17.1.6. Text color

This color is used to render text. It's accepted with both American and British spelling.

```
<Line color="'blue'">
<Line colour="'blue'">
```

Default is what's set for Line node, otherwise `black`. See Color specification.

8.17.1.7. Background color

This color is used to render the background rectangle under the text. It's accepted with both American and British spelling.

```
<Line bgcolor="'blue'">
<Line bgcolour="'blue'">
```

Default is what's set for Line node, otherwise `white`. See Color specification.

8.17.1.8. Font name

The font name attribute specifies the font for the text element's scope. It may be specified in two forms, the first one is the preferred name, the second is for RLIB compatibility:

```
<Part font_name="'Arial'">
<Part fontName="'Arial'">
```

If both forms are specified, `font_name` is used.

Default font name is what's set (in decreasing priority) in Line font name, Report font name or Part font name. If none of them is set, it's `Courier`.

8.17.1.9. Font size

The font size attribute specifies the font size for the text element's scope. It may be specified in two forms, the first one is the preferred name, the second is for RLIB compatibility:

```
<Part font_size="10">
<Part fontSize="10">
```

If both forms are specified, `font_size` is used.

Default font name is what's set (in decreasing priority) in Line font size, Report font size or Part font size. If none of them is set, it's `12`.

8.17.1.10. Bold font

Whether the text element uses bold font. It overrides the Line bold attribute for this text element.

```
<field bold="yes" />
```

Default is what's set for Line bold attribute. `false` if both are unset.

8.17.1.11. Italic font

Whether the text element uses italic font. It overrides the Line italic attribute for this text element. It is accepted in two forms:

```
<field italic="yes" />
<field italics="yes" />
```

Default is what's set for Line italic attribute. `false` if both are unset.

8.17.1.12. Web link

This attribute adds a weblink to the text element. E.g. clicking on this text element in the generated PDF will open a browser with the website.

```
<field value="'This is my website'"
       link="'https://github.com/zboszor/OpenCReports'" />
```

Default is no weblink.

8.17.1.13. Multi-line (memo) field

This attribute allows breaking long text fields to multiple lines according to the Text element width.

```
<field value="'This is a long text...'"
       width="12" memo="yes" />
```

Default is `false`, i.e. the field is rendered on a single line.

Every line of the text element (regardless if it's a memo field or not) is aligned according to Text element alignment.

8.17.1.14. Multi-line field wrapping

This attribute allows wrapping multi-line text at characters as opposed to words.

```
<field value="'This is a long text...'"
       width="12" memo="yes" memo_wrap_chars="yes" />
```

Default is `false`, i.e. the field is wrapped at word boundaries.

In OpenCReports, character wrapping adds hyphenation. This is an improvement over RLIB.

8.17.1.15. Multi-line field row limit

This attribute allows limiting multi-line text with a maximum row number.

```
<field value="'This is a long text...'"
       width="12" memo="yes" memo_max_lines="20" />
```

Default is no limit.

8.17.1.16. Translation

This attribute allows the text element to be translated to a specified language or locale. See Locale.

```
<field value="'This is a field'"
       translate="yes" />
```

The expression result for `translate` must be numeric (boolean).

For translations to work, the translation settings and the language (locale) must be correctly set up.

OpenCReports will attempt to translate both the format string (if specified) and the text element's value. For example, if the format string has a translated variant in the translations, then this formatted result will be translated:

```
<field value="q.apples"
       format="'You have %d apples.'"
       translate="yes" />
```

Default is `no`.

An alternative way is to use the translation functions directly in the field expression. See translate() and translate2(). When using them, the `translate="yes"` attribute is not needed.

8.17.1.17. Column number

This attribute is accepted for RLIB compatibility, but it's unused.

```
<field value="'This is a long text...'"
       col="3" />
```

8.18. HorizontalLine

A horizontally drawn line.

```
<Output>
```

```
    <HorizontalLine ... />
</Output
```

8.18.1. HorizontalLine attributes

Note that Expressions in attribute settings below depend on the parent node context. Some may only use constant expressions or query column references from Independent queries. Child nodes of `<Output>` nodes in `<Report>` context may also use report query column references.

8.18.1.1. Line width

The line width is measured in points, regardless of the Size unit attribute.

```
<HorizontalLine size="3" />
```

Default is `1.0`

8.18.1.2. Line alignment

The possible alignment values are `left`, `right` and `center`. Default is `left` alignment. The alignment is only applied if the line length is shorter than the designated page or column width without the margins.

```
<HorizontalLine align="'center'"
                length="200" />
```

Default is `1.0`

8.18.1.3. Indentation

Extra indentation for the line. It is measured in points, regardless of the Size unit attribute.

```
<HorizontalLine indent="15" />
```

Default is `0.0`

8.18.1.4. Length

The line length.

```
<HorizontalLine length="150" />
```

The line length unit depends on the Size unit attribute. When set to `rlib`, it is measured in number of characters. The is influenced by HorizontalLine font size, Report font size and Part font size in decreasing order, which in turn is influenced by Report font name and Part font name in decreasing order.

When Size unit attribute is set to `points`, the line length is measured in points.

Default is unset, i.e. the line is drawn across the page width.

8.18.1.5. Font size

An extra knob to influence line length computation. See HorizontalLine length. It is accepted in two forms, `font_size` is the preferred one, the other is accepted for RLIB compatibility:

```
<HorizontalLine font_size="14" />
<HorizontalLine fontSize="14" />
```

Default is unset, i.e. only Report font size and Part font size would contribute to the horizontal line width computation.

8.18.1.6. Suppress

Horizontal lines may be suppressed. If the parent `<Output>` node is in `<FieldDetails>`, the expression may be derived from a query field.

```
<HorizontalLine suppress="yes" />
```

Default value is `false`, i.e. no suppression.

8.18.1.7. Line color

This color is used to render text. It's accepted with both American and British spelling. For RLIB compatibility, it is also accepted as `bgcolor`, with both American and British spelling.

```
<HorizontalLine color="'blue'" />
<HorizontalLine colour="'blue'" />
<HorizontalLine bgcolor="'blue'" />
<HorizontalLine bgcolour="'blue'" />
```

Default is `black`. See Color specification.

8.19. Image

An image to draw on the page, either on its own, which controls indentation for subsequent elements:

```
<Output>
    <Image ... />
</Output
```

or as a line element:

```
<Output>
    <Line ... >
        <Image ... />
    <Line/>
</Output
```

After a valid (standalone) image specification, subsequent Line nodes and HorizontalLine nodes are indented by the image width in the same `<Output>` node, or until an `<ImageEnd>` node is encountered in that `<Output>` node.

8.19.1. Image attributes

Note that Expressions in attribute settings below depend on the parent node context. Some may only use constant expressions or query column references from Independent queries. Child nodes of `<Output>` nodes in `<Report>` context may also use report query column references.

8.19.1.1. File name

The file name of the image.

```
<Image value="'filename.jpg'" />
```

Default is unset. It makes the `Image` not shown.

8.19.1.2. Suppress

The image may be suppressed.

```
<Image value="'filename.jpg'"
       suppress="yes" />
```

Default is `false`, i.e. no suppression.

8.19.1.3. Type

Accepted for RLIB compatibility.

```
<Image value="'filename.jpg'"
       type="'jpg'" />
```

Default is unset, i.e. autodetect.

Various image formats are supported with autodetection via `gdk-pixbuf`. SVG (Scalable Vector Graphics) is supported via `librsvg`.

8.19.1.4. Width

Image width, measured in points regardless of the Size unit attribute.

```
<Image value="'filename.jpg'"
       width="100" />
```

Default is unset. The image would not be shown, unless both width and height are set.

When the image is used as a line element, this setting is ignored. Instead, the image is automatically scaled according to the line height.

8.19.1.5. Height

Image height, measured in points regardless of the Size unit attribute.

```
<Image value="'filename.jpg'"
       height="100" />
```

Default is unset. The image would not be shown, unless both width and height are set.

When the image is used as a line element, this setting is ignored. Instead, the image is automatically scaled according to the line height.

8.19.1.6. Text width

When the image is used as a line element, this is the width in which the image is shown. Its unit is subject to the Size unit attribute, by default it's measured in text character width for the parent `<Line>`. This setting is only used when the image is a line element. Two variants are accepted:

```
<Image value="'filename.jpg'"
       text_width="8" />

<Image value="'filename.jpg'"
```

```
       textWidth="8" />
```

Default is 0. As a result, the image would be 0 points wide, i.e. not shown.

This setting is ignored when the image is used as an output subsection.

8.19.1.7. Background color

Image background color. When the image is a line element, then the width in which it's shown may be wider than the scaled image width. Or possibly, the image is vector graphics (SVG) and there is no background defined in the image file. Or the image file contains transparency (i.e. PNG). The color background will be shown around the image or where there are transparent pixels.

```
<Image value="'filename.jpg'"
       bgcolor="'red'" />
```

Default is unset, i.e. white.

8.19.1.8. Alignment

Image alignment. When the image is a line element, then the width in which it's shown may be wider than the scaled image width. The image then may be aligned. `left`, `right` and `center` are accepted.

```
<Image value="'filename.jpg'"
       align="'center'" />
```

Default is left alignment.

This setting is ignored when the image is used as an output subsection.

8.20. Image end

Terminator for a previous image. This node doesn't have any attributes or child nodes. Its purpose is to reset indentation caused by a previous Image node or Barcode node.

```
<Output>
    <ImageEnd/>
</Output
```

8.21. Barcode element

This line or output element renders a barcode in various formats.

```
<Line>
    <Barcode value="expression..." ... />
</Line>
```

The `Barcode` does not have child nodes, only attributes.

8.21.1. Barcode element attributes

Note that Expressions in attribute settings below depend on the parent node context. Some may only use constant expressions or query column references from Independent queries. Child nodes of `<Output>` nodes in `<Report>` context may also use report query column references.

8.21.1.1. Suppress

`<Barcode>` elements in `<Output>` may be suppressed.

```
<Line>
    <Barcode suppress="yes" ... />
</Line>
```

Default value is `false`, i.e. no suppression.

The expression for `suppress` must be a constant expression. An environment variable (since it can't - or shouldn't - change during the report execution) is considered constant. See Expressions.

8.21.1.2. Value

The string value to be encoded as barcode.

```
<Line>
    <Barcode value="'1234567890128'" />
</Line>
```

The value is parsed as an expression from the `value` attribute. See Expressions.

8.21.1.3. Delayed (precalculated) value

This setting indicates whether the value is "precalculated", i.e. the value for the last row in the data set is used, or it would be the actual value for the current row in the data set.

```
<Barcode delayed="yes" />
<Barcode precalculate="yes" />
```

Default is `false`.

This setting is only applicable for line elements in the Output node node in `<ReportHeader>`, `<ReportFooter>`, `<Fieldheaders>` `<FieldDetails>`, since they are the ones under the `<Report>` scope with a query.

8.21.1.4. Barcode type

The format string is used to format the `value` to be displayed in the generated output. For example, to print a number with two decimal places:

```
<Barcode value="'123456789012'" type="'ean-13'" />
```

The type may be optional, in which case it's autodetected and the barcode is rendered in the format that first allows the `value` string to be rendered. Possible types (in the order of autodetection) are: `upc-a`, `ean-13`, `upc-e`, `ean-8`, `isbn`, `code39`, `code39ext`, `code128b`, `code128c`, or `code128`. If `type` is specified, the `value` is rendered in that barcode type if the string is valid for the type. If the `value` is invalid for the specified `type`, or autodetection fails, because the `value` is invalid for any of the above listed types, the barcode is not rendered.

8.21.1.5. Width

The field width.

```
<Barcode value="'...'" width="6" />
```

Default is unset, i.e. the field width is implicitly set to the rendered width (in points) of the barcode's inherent encoding width.

If set, the barcode is scaled to the specified width. Its unit depends on the Size unit attribute.

When the field is the last one in the `<Line>` and its width is unset, then depending on the remaining width of the line, the barcode is either rendered as is, or it's scaled to the remaining width.

When the Size unit attribute is set to `rlib`, the field width is measured in number of characters that is set for the `<Line>`.

8.21.1.6. Height

The field height.

```
<Barcode value="'...'" height="6" />
```

Default is unset, i.e. the barcode height is implicitly controlled by the text in the line or the font height set for the line.

If set, and it's larger than the text in the line, the barcode height controls the line height, with empty space added before and after the text elements vertically. is scaled to the specified width. It's measured in `points`, i.e. 1/72th of an inch.

When the field is the last one in the `<Line>` and its width is unset, then depending on the remaining width of the line, the barcode is either rendered as is (if the remaining width is larger), or it's scaled down to the remaining width.

8.21.1.7. Barcode color

This color is used to render the barcode's bars. It's accepted with both American and British spelling.

```
<Barcode color="'blue'">
<Barcode colour="'blue'">
```

Default is what's set for Line node, otherwise `black`. See Color specification.

8.21.1.8. Barcode background color

This color is used to render the background (the "gaps") in the barcode. It's accepted with both American and British spelling.

```
<Barcode bgcolor="'blue'">
<Barcode bgcolour="'blue'">
```

Default is what's set for Line node, otherwise `white`. See Color specification.

8.22. Color specification

Colors may be specified by HTML notation. This contains six hexadecimal digits, representing RGB (red, green, blue) values between 0 and 255 for each color component, prefixed by the # character.

```
<Line bgcolor="'#ffff00'" ... >
```

```
<HorizontalLine color="'#ff00ff'" ... >
```

Colors may also be specified by hexadecimal notation. This contains six hexadecimal digits, representing RGB (red, green, blue) values between 0 and 255 for each color component, prefixed by `0x`.

```
<Line bgcolor="'0xffff00'" ... >
<HorizontalLine color="'0xff00ff'" ... >
```

Color names may also be specified by name. The following color names are supported for RLIB compatibility. Color names are matched in a case-insensitive way.

Chapter 9. High level C language API reference

9.1. Header file

For using OpenCReports, this single header must be used:

```
#include <opencreport.h>
```

The header can be used from C and C++ source code.

9.2. High level C API

Example code using the high level C API where everything concerning the report (including the data source) is described in the report XML:

```
#include <opencreport.h>

int main(void) {
    opencreport *o = ocrpt_init();

    if (!ocrpt_parse_xml(o, "report.xml")) {
        printf("XML parse error\n");
        ocrpt_free(o);
        return 1;
    }

    ocrpt_set_output_format(o, OCRPT_OUTPUT_PDF);
    ocrpt_execute(o);
    ocrpt_spool(o);
    ocrpt_free(o);
    return 0;
}
```

The above code will load `report.xml`, set the output format to PDF, runs the report and prints its output on `stdout`.

9.2.1. Report handler initialization

```
opencreport *
ocrpt_init(void);
```

9.2.2. Load a report XML description

This function loads the specified XML file into the report handler. It returns `true` for success, `false` for failure.

```
bool
ocrpt_parse_xml(opencreport *o,
                const char *filename);
```

9.2.3. Parse report XML description from a buffer

This function parses the buffer as if it contained XML contents and loads the details into the report handler. It returns `true` for success, `false` for failure.

```
bool
ocrpt_parse_xml_from_buffer(opencreport *o,
                            const char *buffer,
                            size_t size);
```

9.2.4. Set report output format

```
enum ocrpt_format_type {
    OCRPT_OUTPUT_UNSET,
    OCRPT_OUTPUT_PDF,
    OCRPT_OUTPUT_HTML,
    OCRPT_OUTPUT_TXT,
    OCRPT_OUTPUT_CSV,
    OCRPT_OUTPUT_XML
};
typedef enum ocrpt_format_type ocrpt_format_type;

void
ocrpt_set_output_format(opencreport *o,
                        ocrpt_format_type format);
```

9.2.5. Set report output parameter

Set output parameters for the report.

```
void
ocrpt_set_output_parameter(opencreport *o,
                           const char *param,
                           const char *value);
```

Possible parameters for the HTML output driver:

- `document_root` sets the document root for trimming path prefix from image paths.
- `meta` extends the default `<meta charset="utf-8">`. The passed-in string value may contain the whole `<meta ...>`, in which case the inner parameters are used only. The `charset` specification is ignored. Only the rest is used.
- `suppress_head` suppresses the default `<head> ... </head>` section. Possible values are `yes`, `true`, `on` or any positive non-zero number. Anything else disables it. Be aware, that the default section contains importand CSS stylesheet settings that are needed for the correct layout.

Possible parameters for the CSV output driver:

- `csv_filename` sets the file name for `Content-Disposition` in the HTTP metadata returned by `ocrpt_get_content_type()`.
- `csv_as_text` sets the MIME type for `Content-Type` in the HTTP metadata returned by `ocrpt_get_content_type()` to `text/plain` when enabled. By default it's `text/csv`.

Possible values to enable it are `yes`, `true`, `on` or any positive non-zero number. Anything else disables it.

- `csv_delimiter` (also aliased as `csv_delimeter` according to the historical typo in RLIB) sets the CSV field delimiter to the first character of the string. By default it's a comma.
- `no_quotes` will create a CSV output with values unquoted. Possible values to enable it are `yes`, `true`, `on` or any positive non-zero number. Anything else disables it. It takes precedence over `only_quote_strings`
- `only_quote_strings` will create a CSV output with only string values quoted. Possible values to enable it are `yes`, `true`, `on` or any positive non-zero number. Anything else disables it.

Note that some languages (e.g. German, Swedish and Hungarian) use comma as the decimal separator instead of the decimal dot. For these languages, either set `csv_delimiter` to something else, or don't enable either `no_quotes` or `only_quote_strings`.

Possible parameters for the XML output driver:

- `xml_rlib_compat` sets the flag to create an RLIB compatible XML output. Possible values to enable it are `yes`, `true`, `on` or any positive non-zero number. Anything else disables it.

  When enabled, the toplevel element will be `<rlib>` and `<Report>`s inside `<pd>` won't be embedded in a `report` element.

9.2.6. Run the report

This function executes the report, constructs the result in memory. It returns `true` for success, `false` for failure. It is a failure if the output format is unset.

```
bool
ocrpt_execute(opencreport *o);
```

9.2.7. Dump report result

Dump the report output on the program's standard output channel.

```
void
ocrpt_spool(opencreport *o);
```

9.2.8. Get report result

Get the report output. The application then can save it as a file.

```
const char *
ocrpt_get_output(opencreport *o, size_t *length);
```

9.2.9. Get report content type

Get the report content type for web publishing. The content type depends on the output type the report was executed with. It returns an array of `ocrpt_string *` pointers for potentially multiple HTTP header lines. The last pointer in the array is `NULL`.

```
const ocrpt_string **
```

```
ocrpt_get_content_type(opencreport *o);
```

9.2.10. Report handler destruction

Calling this function frees up the report handler structure and everything created for it, even the details that were created by the low level API.

```
void
ocrpt_free(opencreport *o);
```

9.2.11. Get library version

This function reports the OpenCReports library version.

```
const char *
ocrpt_version(void);
```

Chapter 10. Low level C language API reference

10.1. Low level C API

The low level API extends the High level C API to either fine-tune the report behaviour, or to create a report purely from program code.

10.1.1. Numeric behavior related functions

10.1.1.1. `Set numeric precision`

The default is 256 bits of floating point precision. The expression string must evaluate to a numeric value, the integer part will be used to set the number of precision bits for numeric calculations.

```
void
ocrpt_set_numeric_precision_bits(opencreport *o,
                                 const char *expr_string);
```

10.1.1.2. `Get numeric precision`

The report XML description may set the numeric precision. This function allows the application to query it.

```
mpfr_prec_t
ocrpt_get_numeric_precision_bits(opencreport *o);
```

10.1.1.3. Set rounding mode

The expression string must evaluate to a string value. Possible values are: `nearest`, `to_minus_inf`, `to_inf`, `to_zero`, `away_from_zero` and `faithful`. The default is `nearest`.

```
void
ocrpt_set_rounding_mode(opencreport *o,
                        const char *expr_string);
```

10.1.2. Locale related functions

10.1.2.1. Set up translation

Setting up the translation needs two parameters: the so called *translation domain* and the toplevel directory for the translations. It relies on GNU Gettext.

```
void
ocrpt_bindtextdomain(opencreport *o,
                     const char *domainname,
                     const char *dirname);
```

10.1.2.2. Set up translation (delayed variant)

Setting up the translation needs two parameters: the so called *translation domain* and the toplevel directory for the translations. It relies on GNU Gettext. This function allows setting the translation from

a supplemental query. The passed in expressions strings must evaluate to string values, with potential fallbacks to plain strings in case of parse errors or if the expressions may be interpreted as query columns but no such column names exist in any query.

```
void
ocrpt_bindtextdomain_from_expr(opencreport *o,
                               const char *domain_expr,
                               const char *dir_expr);
```

10.1.2.3. Set report locale

Setting the locale for the report does not affect the main program or other threads. A locale setting includes the language and the country. The UTF-8 suffix is necessary. E.g.: `en_GB.UTF-8` or `de_DE.UTF-8`

```
void
ocrpt_set_locale(opencreport *o,
                 const char *locale);
```

10.1.2.4. Set report locale (delayed variant)

This function allows setting the locale from a supplementary query of the report. It is used by the report XML parser code and it's a lower priority setting than the previous function: the application executing the report may need to be run a different locale. The expression string must evaluate to a string value that's a valid locale string.

```
void
ocrpt_set_locale_from_expr(opencreport *o,
                           const char *expr_string);
```

10.1.2.5. Print monetary data in the report locale

A customized monetary printing function was implemented for the purposes of the report which MPFR doesn't provide. It is used in OpenCReports both internally and by unit tests.

```
ssize_t
ocrpt_mpfr_strfmon(opencreport *o,
                   char *s, size_t maxsize,
                   const char *format, ...);
```

10.1.3. Data source and query related functions

The following `enum` and `struct` types are used by OpenCReports for datasources and queries.

```
enum ocrpt_result_type {
    OCRPT_RESULT_ERROR,
    OCRPT_RESULT_STRING,
    OCRPT_RESULT_NUMBER,
    OCRPT_RESULT_DATETIME
};

struct ocrpt_datasource;
typedef struct ocrpt_datasource ocrpt_datasource;

struct ocrpt_query;
typedef struct ocrpt_query ocrpt_query;
```

```
struct ocrpt_query_result;
typedef struct ocrpt_query_result ocrpt_query_result;
```

For more details, see Data sources and queries. Multiple queries may use the same data source.

10.1.3.1. Add a datasource

Add a datasource of the specific *type* to the report handler with the associated *source_name*, using optional *connection parameters*.

```
ocrpt_datasource *
ocrpt_datasource_add(opencreport *o,
                     const char *source_name,
                     const char *type,
                     const ocrpt_input_connect_parameter
 *conn_params);
```

The pointer to connection parameters can be NULL for `array`, `csv`, `json`, and `xml` datasource types.

10.1.3.1.1. MariaDB connection parameters

There are two methods to connect to a MariaDB (or MySQL) database.

The first method uses a MariaDB (MySQL) specific configuration `ini` file and the `group` name in it. The `group` parameter is mandatory as the main database configuration may also have such a group section, in which case the separate `optionfile` is not needed.

```
ocrpt_input_connect_parameter conn_params[] = {
    { .param_name = "group", .param_value = "..." },
    { .param_name = "optionfile", .param_value = "..." },
    { .param_name = NULL }
};
```

The second method spells out individual connection parameters. This allows *local* and *remote* database connections. The `dbname` parameter is mandatory, others are optional.

```
ocrpt_input_connect_parameter conn_params[] = {
    { .param_name = "dbname", .param_value = "..." },
    { .param_name = "host", .param_value = "..." },
    { .param_name = "port", .param_value = "..." },
    { .param_name = "unix_socket", .param_value = "..." },
    { .param_name = "user", .param_value = "..." },
    { .param_name = "password", .param_value = "..." },
    { .param_name = NULL }
};
```

These connection parameters can be used as XML node attributes, see MariaDB database connection.

10.1.3.1.2. PostgreSQL connection parameters

There are three methods to connect to a PostgreSQL database.

The first method uses the PostgreSQL specific *connection string*. It is the only setting and as such, it's mandatory. Its content is almost freeform, with optional elements. See PostgreSQL connection string[1].

[1] https://www.postgresql.org/docs/current/libpq-connect.html#LIBPQ-CONNSTRING

```
ocrpt_input_connect_parameter conn_params[] = {
    { .param_name = "connstr", .param_value = "..." },
    { .param_name = NULL }
};
```

The second method spells out individual connection parameters. This allows *local* database connections on a *named socket*. The `unix_socket` and `dbname` parameters are mandatory, others are optional.

```
ocrpt_input_connect_parameter conn_params[] = {
    { .param_name = "unix_socket", .param_value = "..." },
    { .param_name = "dbname", .param_value = "..." },
    { .param_name = "user", .param_value = "..." },
    { .param_name = "password", .param_value = "..." },
    { .param_name = NULL }
};
```

The third method also spells out individual connection parameters. This allows *remote* database connection using the `host` and `port` parameters. Only the `dbname` parameter is mandatory, others are optional.

```
ocrpt_input_connect_parameter conn_params[] = {
    { .param_name = "dbname", .param_value = "..." },
    { .param_name = "host", .param_value = "..." },
    { .param_name = "port", .param_value = "..." },
    { .param_name = "user", .param_value = "..." },
    { .param_name = "password", .param_value = "..." },
    { .param_name = NULL }
};
```

These connection parameters can be used as XML node attributes, see PostgreSQL database connection.

10.1.3.1.3. ODBC connection parameters

There are two methods to connect to an ODBC database.

The first method uses the ODBC specific *connection string*. It is the only setting, and as such, it's mandatory. Its content is defined by the ODBC knowledge base with optional elements. See Microsoft Open Database Connectivity[2] and Connection string examples [3].

```
ocrpt_input_connect_parameter conn_params[] = {
    { .param_name = "connstr", .param_value = "..." },
    { .param_name = NULL }
};
```

The second method spells out *some* individual connection parameters. It requires that an ODBC data source (DSN) is already configured. Whether the database connections is *local* or *remote* depends on the pre-configured DSN. The `dbname` parameters is mandatory, others are optional.

```
ocrpt_input_connect_parameter conn_params[] = {
    { .param_name = "dbname", .param_value = "..." },
    { .param_name = "user", .param_value = "..." },
    { .param_name = "password", .param_value = "..." },
    { .param_name = NULL }
};
```

[2] https://docs.microsoft.com/en-us/sql/odbc/microsoft-open-database-connectivity-odbc
[3] https://www.connectionstrings.com/

These connection parameters can be used as XML node attributes, see ODBC database connection.

10.1.3.2. Find a datasource

Find the data source using its name. It returns NULL if the named data source is not found.

```
ocrpt_datasource *
ocrpt_datasource_get(opencreport *o,
                     const char *source_name);
```

10.1.3.3. `Set the encoding of a datasource`

Set the encoding of a datasource in case if it's not already UTF-8, so data provided by it is automatically converted.

```
void
ocrpt_datasource_set_encoding(ocrpt_datasource *source,
                              const char *encoding);
```

10.1.3.4. `Free a datasource`

Free a datasource from the opencreport structure it was added to. It's not needed to be called, all datasources are automatically free with `ocrpt_free()`

```
void
ocrpt_datasource_free(ocrpt_datasource *source);
```

10.1.3.5. Add a direct data based query

Add a direct (application internal) data based query to the report handler.

```
ocrpt_query *
ocrpt_query_add_data(ocrpt_datasource *source,
                     const char *name,
                     const void *data,
                     int32_t rows, int32_t cols,
                     const int32_t *types,
                     int32_t types_cols);
```

The built-in `array` datasource interprets `void *data` as a two-dimensional array containing pointers to C strings, a.k.a.

```
char *array[rows + 1][cols]
```

The first row of the array are the column (field) names. The `types` array contains `cols` (or fewer) number of `enum ocrpt_result_type` elements to indicate the column data types.

If the `types` pointer is `NULL`, the column values are treated as `string` data. This is how RLIB worked.

The call is only successful if the datasource is direct data based. See Section 10.1.3.9 and Datasource input driver details.

10.1.3.6. Add a symbolic data based query

Add a "symbolic" (discoverable by name) data based query.

```
ocrpt_query *
ocrpt_query_add_symbolic_data(ocrpt_datasource *source,
                              const char *name,
                              const char *data_name,
                              int32_t rows, int32_t cols,
                              const char *types_name,
                              int32_t types_cols);
```

Symbols of the application can be discovered via `dlsym()` if the application was built with the compiler option `-rdynamic`.

The call is only successful if the datasource is symbolic data based. See Section 10.1.3.10 and Datasource input driver details.

10.1.3.7. Add a file based query

Add a file based query to the report handler.

```
ocrpt_query *
ocrpt_query_add_file(ocrpt_datasource *source,
                     const char *name,
                     const char *filename,
                     const int32_t *types,
                     int32_t types_cols);
```

The call is only successful if the datasource is file based. See Section 10.1.3.11 and Datasource input driver details.

The `types` array pointer may be NULL. For file based datasource types that don't support data type specifiers internally (or they are optional and omitted), this means that the column values are of the `string` data type. This is how RLIB worked. In this case, conversion functions like Section 4.12.4, Section 4.10.16 and Section 4.10.10 are needed to process the values using their actual data type.

When the `types` array pointer is not NULL, it is used to set the data type specifiers for built-in file based datasources, even if the file contains type specifiers.

The JSON file format expected by OpenCReports is defined in JSON file type.

The XML file format expected by OpenCReports is defined in XML file type.

10.1.3.8. Add an SQL statement based query

Add an SQL statement based query to the report handler.

```
ocrpt_query *
ocrpt_query_add_sql(ocrpt_datasource *source,
                    const char *name,
                    const char *querystr);
```

The call is only successful if the datasource is SQL based. See Section 10.1.3.12 and Datasource input driver details.

10.1.3.9. Test whether a datasource is direct data based

```
bool
```

```
ocrpt_datasource_is_data(ocrpt_datasource *source);
```

10.1.3.10. Test whether a datasource is direct data based

```
bool
ocrpt_datasource_is_symbolic_data(ocrpt_datasource *source);
```

10.1.3.11. Test whether a datasource is file based

```
bool
ocrpt_datasource_is_file(ocrpt_datasource *source);
```

10.1.3.12. Test whether a datasource is SQL based

```
bool
ocrpt_datasource_is_sql(ocrpt_datasource *source);
```

10.1.3.13. `Find a query`

Find a query using its name.

```
ocrpt_query *
ocrpt_query_get(opencreport *o,
                const char *name);
```

10.1.3.14. `Get the current data row from a query`

Create (first call) or get the `ocrpt_query_result` array from a query. Output parameter `cols` returns the number of columns in the result array. It must be re-run after ocrpt_navigate_next() since the previously returned pointer becomes invalid.

```
ocrpt_query_result *
ocrpt_query_get_result(ocrpt_query *q,
                       int32_t *cols);
```

10.1.3.15. `Get column name`

Using the `ocrpt_query_result * ` result from `ocrpt_query_get_result()`, the column names can be discovered from a query.

```
const char *
ocrpt_query_result_column_name(ocrpt_query_result *qr,
                               int32_t col);
```

10.1.3.16. `Get column data`

Using the `ocrpt_query_result *` result from `ocrpt_query_get_result()`, get a pointer to the column data in its internal (hidden) representation.

```
ocrpt_result *
ocrpt_query_result_column_result(ocrpt_query_result *qr,
                                 int32_t col);
```

10.1.3.17. Add a follower query

Add a `follower` query to the `leader` query. The leader is the primary query and the follower will run in parallel with it until the leader runs out of rows. In case the leader has more rows than the follower, then for rows in the leader where there are no follower rows, the follower fields are set to NULL.

```
bool
ocrpt_query_add_follower(ocrpt_query *leader,
                         ocrpt_query *follower);
```

10.1.3.18. Add an N:1 follower query

Add an N:1 `follower` query to the `leader` query. The leader is the primary query and rows from the follower will be matched using the `match` expression. If there are multiple rows in the follower matching the leader row, then the leader row will be listed that many times. For rows in the leader where there are no matching rows in the follower, the follower fields are set to NULL. It is similar to `LEFT OUTER JOIN` in SQL databases. For creating an `ocrpt_expr` expression pointer, see the next section.

```
bool
ocrpt_query_add_follower_n_to_1(ocrpt_query *leader,
                                ocrpt_query *follower,
                                ocrpt_expr *match);
```

10.1.3.19. Refresh query contents

Call the ocrpt_input::refresh() method for datasources that support it. It returns `true` if all queries were successfully refreshed.

```
bool
ocrpt_query_refresh(opencreport *o);
```

10.1.3.20. Free a query

Free a query and remove it from the report handler. It's optional. `ocrpt_free()` frees the queries added to the `opencreport` structure.

```
void
ocrpt_query_free(ocrpt_query *q);
```

10.1.3.21. Start the main query

Start query (or query set) navigation. `q` should be the primary query of the report.

```
void
ocrpt_query_navigate_start(ocrpt_query *q);
```

10.1.3.22. Navigate to the next query row

Navigate the query (or query set) to the next row. Returns `false` if there was no more rows. in which case the `ocrpt_query_result` arrays for all queries in the query set (returned by previous `ocrpt_query_get_result()` calls contain invalid data.

```
bool
ocrpt_query_navigate_next(ocrpt_query *q);
```

10.1.3.23. Navigate use previous/next row

These functions expose an implementation detail of the data traversal in OpenCReports. There is a 3-row data cache in which there is always the current row. One past row is kept so e.g. break boundaries can be detected and there is one row read-ahead to detect the end-of-data condition early. These functions allow to switch back and forth in the 3-row data cache, making the previous or next row the "current" one momentarily. The query must always be the primary query of the report. Used by unit tests that don't use `ocrpt_execute()`.

```
void
ocrpt_query_navigate_use_prev_row(ocrpt_query *q);

void
ocrpt_query_navigate_use_next_row(ocrpt_query *q);
```

10.1.3.24. API specific data discovery function

For direct (application internal) data based data sources and queries, OpenCReports needs a way to to find the data pointer and the supplementary type identifier array. These are language specific. The below ones are the C specific ones. An override function is also provided to set a new discovery function. The discovery function *should* return the dimensions for both the (usuall 2D array) `data` and the 1D `types` array. It also returns whether `types` must be freed by the caller.

```
typedef void
(*ocrpt_query_discover_func)(const char *,
                             void **,
                             int32_t *,
                             int32_t *,
                             const char *,
                             void **,
                             int32_t *,
                             bool *);

void
ocrpt_query_set_discover_func(ocrpt_query_discover_func func);

extern ocrpt_query_discover_func ocrpt_query_discover_array;

void
ocrpt_query_discover_array_c(const char *arrayname,
                             void **array,
                             int32_t *rows,
                             int32_t *cols,
                             const char *typesname,
                             void **types,
                             int32_t *types_cols,
                             bool *free_types);
```

Note that the C specific generic discovery function does not and cannot return the array dimensions, since there is no official API related to `dlsym()` that would return the size associated with a symbol. It's up to the application writers to come up with a smarter (application specific) discovery function that also returns the array dimensions. With such a smart discovery function, one can specify the array and the column types array name without the related dimensions, i.e. the `rows` and `cols` specifiers in Array queries and File based queries.

10.1.4. Expression related functions

Expressions in OpenCReports is explained in the Expressions chapter.

10.1.4.1. Parse an expression string

This function parses an expression string and creates an expression tree. It returns a pointer to the `ocrpt_expr` structure.

If an error occurs, it returns NULL and optionally returns the error message in `err` pointer if it's not `NULL`.

```
ocrpt_expr *
ocrpt_expr_parse(opencreport *o,
                 const char *expr_string,
                 char **err);
```

The returned pointer must be freed with `ocrpt_expr_free()`.

10.1.4.2. Parse an expression string and bind it to a report

This function parses an expression string, creates an expression tree and binds it to a report. It returns a pointer to the `ocrpt_expr` structure.

If an error occurs, it returns NULL and optionally returns the error message in `err` pointer if it's not `NULL`.

```
ocrpt_expr *
ocrpt_report_expr_parse(ocrpt_report *r,
                        const char *expr_string,
                        char **err);
```

The returned pointer is automatically freed by `ocrpt_free()`

10.1.4.3. Free an expression parse tree

Free an expression parse tree. If it was bound to the passed-in `ocrpt_report`, this association is also deleted. Alternatively, the expression doesn't need to be freed if it was bound to a report when it was parsed, as it will be automatically freed when freeing either the report, or the global `opencreport` structure.

```
void
ocrpt_expr_free(ocrpt_expr *e);
```

10.1.4.4. Resolve expression references

This function resolves variable (identifier) references in the expression. This is needed to bind query columns to expressions that use them.

```
void
ocrpt_expr_resolve(ocrpt_expr *e);
```

10.1.4.5. Optimize an expression

This function optimizes an expression so it may needs fewer computation steps during report execution.

```
void
```

```
ocrpt_expr_optimize(ocrpt_expr *e);
```

10.1.4.6. Evaluate an expression

This function evaluates the expression. It returns the expression's `ocrpt_result` result structure. The result must not be freed with `ocrpt_result_free()`. It will be done by `ocrpt_expr_free()`

For expressions with query column references, this function must be called after `ocrpt_query_navigate_next` otherwise the result is not valid.

```
ocrpt_result *
ocrpt_expr_eval(ocrpt_expr *e);
```

10.1.4.7. Get expression result without evaluation

This function returns the expression result if it was already evaluated. The result *must not* be freed with `ocrpt_result_free()`. It will be done by `ocrpt_expr_free()`. Used by unit tests.

```
ocrpt_result *
ocrpt_expr_get_result(ocrpt_expr *e);
```

10.1.4.8. Print an expression tree

Print an expression tree in its processed form on the standard output. Used by unit tests.

```
void
ocrpt_expr_print(ocrpt_expr *e);
```

10.1.4.9. Print an expression tree with subexpressions and their results

Print an expression tree with subexpressions and their results in its processed form on the standard output. Used by unit tests.

```
void
ocrpt_expr_result_deep_print(ocrpt_expr *e);
```

10.1.4.10. Count the number of expression nodes

This function returns the number of expression nodes. Used by unit tests to validate optimizazion.

```
int32_t
ocrpt_expr_nodes(ocrpt_expr *e);
```

10.1.4.11. Initialize expression result type

OpenCReports keeps track of the last three query rows and computes three result values for expressions for internal reasons. These functions initialize the type for either the current result or all results of the expression.

```
enum ocrpt_result_type {
    OCRPT_RESULT_ERROR,
    OCRPT_RESULT_STRING,
```

```
    OCRPT_RESULT_NUMBER,
    OCRPT_RESULT_DATETIME
};

bool ocrpt_expr_init_result(ocrpt_expr *e,
                            enum ocrpt_result_type type);

void ocrpt_expr_init_results(ocrpt_expr *e,
                             enum ocrpt_result_type type);
```

10.1.4.12. Set an error string as expression result

```
ocrpt_result *
ocrpt_expr_make_error_result(ocrpt_expr *e,
                             const char *format, ...);
```

10.1.4.13. Set start value flag for an iterative expression

Set whether the iterative expression's first value is computed from its base expression or from its result expression.

```
void
ocrpt_expr_set_iterative_start_value(ocrpt_expr *e,
                                     bool start_with_init);
```

10.1.4.14. Get current value of an expression in base type

Get the current value of an expression in a C base type. Used by parsing report description XML files and unit tests.

```
const char *
ocrpt_expr_get_string(ocrpt_expr *e);

long
ocrpt_expr_get_long(ocrpt_expr *e);

double
ocrpt_expr_get_double(ocrpt_expr *e);
```

10.1.4.15. Set current value of an expression in a base type

Used by unit tests.

```
void
ocrpt_expr_set_string(ocrpt_expr *e,
                            const char *s);

void
ocrpt_expr_set_long(ocrpt_expr *e,
                           long l);

void
ocrpt_expr_set_double(ocrpt_expr *e,
                            double d);
```

10.1.4.16. Set nth value of an expression in a base type

Expressions use `OCRPT_EXPR_RESULTS` number of values. With these functions, any of them can be set. Used by unit tests.

```
void
ocrpt_expr_set_nth_result_string(ocrpt_expr *e,
                                 int which,
                                 const char *s);

void
ocrpt_expr_set_nth_result_long(ocrpt_expr *e,
                               int which,
                               long l);

void
ocrpt_expr_set_nth_result_double(ocrpt_expr *e,
                                 int which,
                                 double d);
```

10.1.4.17. Compare the current of an expression with its previous value

Compare the current value of an expression with its previous value and return `true` if they are equal. It's used to implement Report breaks.

```
bool
ocrpt_expr_cmp_results(ocrpt_expr *e);
```

10.1.4.18. Set delayed flag of an expression

```
void
ocrpt_expr_set_delayed(ocrpt_expr *e,
                       bool delayed);
```

10.1.4.19. Set field expression reference for an expression

If `e` contains `r.value`, the expression `rvalue` will be used to resolve this reference.

```
void
ocrpt_expr_set_field_expr(ocrpt_expr *e,
                          ocrpt_expr *rvalue);
```

10.1.5. Column data or expression result related functions

The internal type `ocrpt_result` holds values either for query columns or expression results.

10.1.5.1. Create an expression result

The returned pointer must be freed with `ocrpt_result_free()`.

```
ocrpt_result *
```

```
ocrpt_result_new(opencreport *o);
```

10.1.5.2. Get expression result type

```
enum ocrpt_result_type
ocrpt_result_get_type(ocrpt_result *result);
```

10.1.5.3. Copy an expression result

Copy expression result from source to destination. Both results must have been created for the same `opencreport` structure, either explicitly with `ocrpt_result_new()` or implicitly with an expression parsed for this `opencreport` structure or a report structure owned by it.

```
void
ocrpt_result_copy(ocrpt_result *dst,
                  ocrpt_result *src);
```

10.1.5.4. Print an expression result

Used by unit tests.

```
void
ocrpt_result_print(ocrpt_result *r);
```

10.1.5.5. Free an expression result

```
void
ocrpt_result_free(ocrpt_result *r);
```

10.1.5.6. Detect whether a column result is NULL

Using the `ocrpt_result *` result from a query column or an expression, detect whether the column value is NULL.

```
bool
ocrpt_result_isnull(ocrpt_result *result);
```

10.1.5.7. Detect whether a column result is numeric

Using the `ocrpt_result *` result from a query column or an expression, detect whether the column value is numeric.

```
bool
ocrpt_result_isnumber(ocrpt_result *result);
```

10.1.5.8. Get the numeric value of a column result

Using the `ocrpt_result *` result from a query column or an expression, get the numeric column value. It returns NULL if the column is:

- not a numeric result
- NULL

```
mpfr_ptr
ocrpt_result_get_number(ocrpt_result *result);
```

10.1.5.9. Detect whether a column result is string

Using the `ocrpt_result *` result from a query column or an expression, detect whether the column value is string.

```
bool
ocrpt_result_isstring(ocrpt_result *result);
```

10.1.5.10. Get the string value of a column result

Using the `ocrpt_result *` result from a query column or an expression, get the string column value. It returns NULL if the column is

- not a string result
- NULL

```
ocrpt_string *
ocrpt_result_get_string(ocrpt_result *result);
```

10.1.5.11. Detect whether a column result is datetime

Using the `ocrpt_result *` result from a query column or an expression, detect whether the column value is datetime.

```
bool
ocrpt_result_isdatetime(ocrpt_result *result);
```

10.1.5.12. Get the datetime value of a column result

Using the `ocrpt_result *` result from a query column or an expression, get the datetime column value. It returns NULL if the column is

- not a datetime result
- NULL

```
const struct tm *
ocrpt_result_get_datetime(ocrpt_result *result);
```

10.1.5.13. Detect whether a datetime column result is interval

Using the `ocrpt_result *` result from a query column or an expression, detect whether the datetime column value is interval.

```
bool
ocrpt_result_datetime_is_interval(ocrpt_result *result);
```

10.1.5.14. Detect whether a datetime column result has valid date

Using the `ocrpt_result *` result from a query column or an expression, detect whether the datetime column value has valid date.

```
bool
ocrpt_result_datetime_is_date_valid(ocrpt_result *result);
```

10.1.5.15. Detect whether a datetime column result has valid time

Using the `ocrpt_result *` result from a query column or an expression, detect whether the datetime column value has valid time.

```
bool
ocrpt_result_datetime_is_time_valid(ocrpt_result *result);
```

10.1.6. Variable related functions

Variables can be created for a report using the API.

10.1.6.1. Create a basic variable

Using this function, any variable type except `OCRPT_VARIABLE_CUSTOM` may be created. For a custom variable, see the next function.

```
enum ocrpt_var_type {
    OCRPT_VARIABLE_EXPRESSION,
    OCRPT_VARIABLE_COUNT,
    OCRPT_VARIABLE_COUNTALL,
    OCRPT_VARIABLE_SUM,
    OCRPT_VARIABLE_AVERAGE,
    OCRPT_VARIABLE_AVERAGEALL,
    OCRPT_VARIABLE_LOWEST,
    OCRPT_VARIABLE_HIGHEST,
    OCRPT_VARIABLE_CUSTOM
};
typedef enum ocrpt_var_type ocrpt_var_type;

ocrpt_var *
ocrpt_variable_new(ocrpt_report *r,
                   ocrpt_var_type type,
                   const char *name,
                   const char *expr,
                   const char *reset_on_break_name);
```

10.1.6.2. Create a custom variable

Create a custom variable of the specified type with the specified subexpressions.

```
ocrpt_var *
ocrpt_variable_new_full(ocrpt_report *r,
                        enum ocrpt_result_type type,
                        const char *name,
                        const char *baseexpr,
                        const char *intermedexpr,
                        const char *intermed2expr,
                        const char *resultexpr,
                        const char *reset_on_break_name);
```

10.1.6.3. Get subexpressions of a variable

Get subexpressions of a previously created basic or custom variable.

```
ocrpt_expr *
ocrpt_variable_baseexpr(ocrpt_var *v);

ocrpt_expr *
ocrpt_variable_intermedexpr(ocrpt_var *v);

ocrpt_expr *
ocrpt_variable_intermed2expr(ocrpt_var *v);

ocrpt_expr *
ocrpt_variable_resultexpr(ocrpt_var *v);
```

10.1.6.4. Set precalculate flag for a variable

The expression must evaluate to a numeric (boolean) value.

```
void
ocrpt_variable_set_precalculate(ocrpt_var *var,
                                const char *expr_string);
```

10.1.6.5. Resolve a variable

Resolve subexpressions of a variable so it can be evaluated correctly.

```
void
ocrpt_variable_resolve(ocrpt_var *v);
```

10.1.6.6. Evaluate a variable

After evaluation, the result is in the expression returned by `ocrpt_variable_resultexpr()`.

```
void
ocrpt_variable_evaluate(ocrpt_var *v);
```

10.1.7. Break related functions

10.1.7.1. Create a break

Create a break. No need to free it, `ocrpt_free()` does it.

```
ocrpt_break *
ocrpt_break_new(ocrpt_report *r,
                const char *name);
```

10.1.7.2. Set attribute flag expressions for a break

Set break attributes from expression strings for `headernewpage` and `suppressblank`. There is a 3rd flag accepted in the report XML DTD called `newpage` which is not represented (ignored) in the API, because it's also ignored in RLIB and is only handled for RLIB compatibility.

```
void
ocrpt_break_set_headernewpage(ocrpt_break *br,
                              const char *headernewpage);
```

```
void
ocrpt_break_set_suppressblank(ocrpt_break *br,
                              const char *suppressblank);
```

`headernewpage="yes"` instructs the layout to render `<BreakHeader>` on a new page.

`suppressblank="yes"` instructs the layout to suppress `<BreakHeader>` if any of the `<BreakField>`s are `NULL` value or an empty string, if the break field is of the string type.

10.1.7.3. Get break using its name

Get the pointer to the break using its name.

```
ocrpt_break *
ocrpt_break_get(ocrpt_report *r,
                const char *name);
```

10.1.7.4. Get the name of a break

Get the name of the break using its structure pointer.

```
const char *
ocrpt_break_get_name(ocrpt_break *br);
```

10.1.7.5. Add a watched expression to a break

```
bool
ocrpt_break_add_breakfield(ocrpt_break *br,
                           ocrpt_expr *bf);
```

10.1.7.6. Iterate over breaks of a report

Iterate over breaks of a report. The first call needs the iterator list pointer to be set to NULL.

```
ocrpt_break *
ocrpt_break_get_next(ocrpt_report *r,
                     ocrpt_list **list);
```

10.1.7.7. Resolve and optimize break fields

```
void
ocrpt_break_resolve_fields(ocrpt_break *br);
```

10.1.7.8. Check whether the break triggers

```
bool
ocrpt_break_check_fields(ocrpt_break *br);
```

10.1.7.9. Check whether break field values are blank

The second parameter `evaluate` allows skipping evaluating the breakfield values. (This is an optimization in case it's executed after `ocrpt_break_check_fields()` which already evaluated the breakfields.)

```
bool
ocrpt_break_check_blank(ocrpt_break *br,
                        bool evaluate);
```

10.1.7.10. Reset variables for the break

```
void
ocrpt_break_reset_vars(ocrpt_break *br);
```

10.1.8. Function related functions

10.1.8.1. Add a user defined function

Add a user defined function by specifying the name, the function pointer that contains the implementation, the number of operands (0 or greater for fixed number or operands, -1 is varying number of operands) and the function mathematical properties that help optimizing it.

```
bool
ocrpt_function_add(opencreport *o,
                   const char *fname,
                   ocrpt_function_call func,
                   void *user_data,
                   int32_t n_ops,
                   bool commutative,
                   bool associative,
                   bool left_associative,
                   bool dont_optimize);
```

Adding a user defined function with a name of a pre-existing function will override it.

OpenCReports functions are called with the parameters as declared below.

```
#define OCRPT_FUNCTION_PARAMS \
    ocrpt_expr *e, void *user_data
```

OpenCReports functions may be declared with these convenience symbols below.

```
#define OCRPT_FUNCTION(name) \
    void name(OCRPT_FUNCTION_PARAMS)

#define OCRPT_STATIC_FUNCTION(name) \
    static void name(OCRPT_FUNCTION_PARAMS)
```

The above function (`ocrpt_function_add()`) is called with a function pointer which has this type:

```
typedef void
(*ocrpt_function_call)(OCRPT_FUNCTION_PARAMS);
```

10.1.8.2. Find a named function

```
const ocrpt_function *
ocrpt_function_get(opencreport *o,
                   const char *fname);
```

10.1.8.3. Get number of operands for an expression (function)

In an expression tree, functions are represented as subexpressions with operands. This call may be used by OpenCReports functions to inspect whether the number of operands is in the expected range.

```
int32_t
ocrpt_expr_get_num_operands(ocrpt_expr *e);
```

10.1.8.4. Get current value of a function operand

This function is used by OpenCReports functions internally to compute the result from its operands.

```
ocrpt_result *
ocrpt_expr_operand_get_result(ocrpt_expr *e,
                              int32_t opnum);
```

10.1.9. Report part and report related functions

10.1.9.1. Create a report part

```
ocrpt_part *
ocrpt_part_new(opencreport *o);
```

10.1.9.2. Create a row in a report part

```
ocrpt_part_row *
ocrpt_part_new_row(ocrpt_part *p);
```

10.1.9.3. Create a column in report part row

```
ocrpt_part_column *
ocrpt_part_row_new_column(ocrpt_part_row *pr);
```

10.1.9.4. Create a new report in a part column

```
ocrpt_report *
ocrpt_part_column_new_report(ocrpt_part_column *pd);
```

10.1.9.5. Report part related iterators

Iterators for getting report parts, part rows, columns in rows and reports in columns. Every iterator function must be called the first time with the list pointer set to NULL.

```
ocrpt_part *
ocrpt_part_get_next(opencreport *o,
                    ocrpt_list **list);

ocrpt_part_row *
ocrpt_part_row_get_next(ocrpt_part *p,
                        ocrpt_list **list);

ocrpt_part_column *
```

```
ocrpt_part_column_get_next(ocrpt_part_row *pr,
                           ocrpt_list **list);

ocrpt_report *
ocrpt_report_get_next(ocrpt_part_column *pd,
                      ocrpt_list **list);
```

10.1.9.6. Set the main query for a report

Set the main query for a report either by the query structure pointer, or from expression. The expression must resolve to a string value, with fallback to a plain string.

```
void
ocrpt_report_set_main_query(ocrpt_report *r,
                            const ocrpt_query *query);

void
ocrpt_report_set_main_query_from_expr(ocrpt_report *r,
                                      const char *expr_string);
```

See Report query name. Unlike with the XML description, where the first globally declared query is used for the report if its main query is not set, the default via the low level API is unset.

10.1.9.7. Get the current row number of the main query

The row number starts from 1.

```
long
ocrpt_report_get_query_rownum(ocrpt_report *r);
```

10.1.9.8. Resolve all report variables

```
void
ocrpt_report_resolve_variables(ocrpt_report *r);
```

10.1.9.9. Evaluate all report variables

```
void
ocrpt_report_evaluate_variables(ocrpt_report *r);
```

10.1.9.10. Resolve all report breaks

```
void
ocrpt_report_resolve_breaks(ocrpt_report *r);
```

10.1.9.11. Resolve all report expressions

```
void
ocrpt_report_resolve_expressions(ocrpt_report *r);
```

10.1.9.12. Evaluate all report expressions

```
void
```

```
ocrpt_report_evaluate_expressions(ocrpt_report *r);
```

10.1.10. Layout related functions

10.1.10.1. Global layout options

10.1.10.1.1. Set "size unit" option

See Size unit attribute. The expression string must evaluate to a string value, where `points` will set the layout rendering to use *points* for size units. Any other value will make the layout rendering use the convoluted RLIB compatible size units, mostly based on font sizes.

```
void
ocrpt_set_size_unit(opencreport *o,
                    const char *expr_string);
```

10.1.10.1.2. Set "no query show NoData" option

See No query show NoData attribute. The expression string should evaluate to a boolean value.

```
void
ocrpt_set_noquery_show_nodata(opencreport *o,
                              const char *expr_string);
```

10.1.10.1.3. Set "report height after last" option

See Report height after last attribute. The expression string should evaluate to a boolean value.

```
void
ocrpt_set_report_height_after_last(opencreport *o,
                                   const char *expr_string);
```

10.1.10.1.4. Set "follower match single" option

See Follower match single attribute. The expression string should evaluate to a boolean value.

```
void
ocrpt_set_follower_match_single(opencreport *o,
                                const char *expr_string);
```

10.1.10.1.5. Set "follower match single" option directly

See above and Follower match single attribute. The difference is that the modified behaviour is set directly and immediately. Used by unit tests.

```
void
ocrpt_set_follower_match_single_direct(opencreport *o,
                                       bool value);
```

10.1.10.2. Report part options

10.1.10.2.1. Set part iterations

See Part iterations attribute. The expression string must evaluate to a numeric value.

```
void
ocrpt_part_set_iterations(ocrpt_part *p,
                          const char *expr_string);
```

10.1.10.2.2. Set part font name

See Part font name.

```
void
ocrpt_part_set_font_name(ocrpt_part *p,
                         const char *expr_string);
```

10.1.10.2.3. Set part font size

See Part font size.

```
void
ocrpt_part_set_font_size(ocrpt_part *p,
                         const char *expr_string);
```

10.1.10.2.4. Set part paper type

See Paper type.

```
void
ocrpt_part_set_paper_by_name(ocrpt_part *p,
                             const char *expr_string);
```

10.1.10.2.5. Set part paper's orientation

See Part page orientation. The expression string must evaluate to a string value, with possible options of `portrait` and `landscape`. By default, the part uses `portrait` orientation.

```
void
ocrpt_part_set_orientation(ocrpt_part *p,
                           const char *expr_string);
```

10.1.10.2.6. Set part margins

See Margin settings. The margin values must be passed in via strings as they can be expressions.

```
void
ocrpt_part_set_top_margin(ocrpt_part *p,
                          const char *expr_string);

void
ocrpt_part_set_bottom_margin(ocrpt_part *p,
                             const char *expr_string);

void
ocrpt_part_set_left_margin(ocrpt_part *p,
                           const char *expr_string);

void
ocrpt_part_set_right_margin(ocrpt_part *p,
```

```
                                const char *expr_string);
```

10.1.10.2.7. Set part suppression

See Part suppress attribute. The expression string must evaluate to a numeric (boolean) value.

```
void
ocrpt_part_set_suppress(ocrpt_part *p,
                        const char *expr_string);
```

10.1.10.2.8. Set part's page header suppressed on the first page

See Suppress page header on the first page. The expression string must evaluate to a numeric (boolean) value.

```
void
ocrpt_part_set_suppress_pageheader_firstpage(ocrpt_part *p,
                                             const char *expr_string);
```

10.1.10.3. Part row options

10.1.10.3.1. Set part row suppression

See Part row suppress attribute. The expression string must evaluate to a numeric (boolean) value.

```
void
ocrpt_part_row_set_suppress(ocrpt_part_row *pr,
                            const char *expr_string);
```

10.1.10.3.2. Set part row new page

See Part row new page attribute. The expression string must evaluate to a numeric (boolean) value.

```
void
ocrpt_part_row_set_newpage(ocrpt_part_row *pr,
                           const char *expr_string);
```

10.1.10.3.3. Set part row layout mode

See Part row layout attribute. The expression string must evaluate to a string value, with possible options `flow` and `fixed`. This setting is ignored, it's only accepted for RLIB compatibility.

```
void
ocrpt_part_row_set_layout(ocrpt_part_row *pr,
                          const char *expr_string);
```

10.1.10.4. Part column options

10.1.10.4.1. Set part column suppression

See Part column suppress attribute. The expression must evaluate to a numeric (boolean) value.

```
void
ocrpt_part_column_set_suppress(ocrpt_part_column *pd,
                               const char *expr_string);
```

10.1.10.4.2. Set part column width

See Part column width attribute. The expression must evaluate to a numeric value.

```
void
ocrpt_part_column_set_width(ocrpt_part_column *pd,
                            const char *expr_string);
```

10.1.10.4.3. Set part column height

See Part column height attribute. The expression must evaluate to a numeric value.

```
void
ocrpt_part_column_set_height(ocrpt_part_column *pd,
                             const char *expr_string);
```

10.1.10.4.4. Set part column border width

See Part column border width. The expression must evaluate to a numeric value.

```
void
ocrpt_part_column_set_border_width(ocrpt_part_column *pd,
                                   const char *expr_string);
```

10.1.10.4.5. Set part column border color

See Part column border color. The expression must evaluate to a string value with a valid color name or specification.

```
void
ocrpt_part_column_set_border_color(ocrpt_part_column *pd,
                                   const char *expr_string);
```

10.1.10.4.6. Set part column's number of detail columns

See Detail columns. The expression must evaluate to a numeric value.

```
void
ocrpt_part_column_set_detail_columns(ocrpt_part_column *pd,
                                     const char *expr_string);
```

10.1.10.4.7. Set part column's detail column padding

See Column padding. The expression must evaluate to a numeric value.

```
void
ocrpt_part_column_set_column_padding(ocrpt_part_column *pd,
                                     const char *expr_string);
```

10.1.10.5. Report options

10.1.10.5.1. Set report suppression

See Report suppress attribute. The expression must evaluate to a numeric (boolean) value.

```
void
ocrpt_report_set_suppress(ocrpt_report *r,
```

```
                                const char *expr_string);
```

10.1.10.5.2. Set report iterations

See Report iterations attribute. The expression must evaluate to a numeric value.

```
void
ocrpt_report_set_iterations(ocrpt_report *r,
                            const char *expr_string);
```

10.1.10.5.3. Set report font name

See Report font name. The expression must evaluate to a string value, with fallback to plain string: in case of a parsing error, the value string is taken as is.

```
void
ocrpt_report_set_font_name(ocrpt_report *r,
                           const char *expr_string);
```

10.1.10.5.4. Set report font size

See Report font size. The expression must evaluate to a numeric value.

```
void
ocrpt_report_set_font_size(ocrpt_report *r,
                           const char *expr_string);
```

10.1.10.5.5. Set report height

See Report height. The expression must evaluate to a numeric value.

```
void
ocrpt_report_set_height(ocrpt_report *r,
                        const char *expr_string);
```

10.1.10.5.6. Set report's field header priority

See Report field header priority attribute. The expression must evaluate to a string value with the options of `high` and `low`. Default is `low`.

```
void
ocrpt_report_set_fieldheader_priority(ocrpt_report *r,
                                      const char *expr_string);
```

10.1.10.6. Get part layout sections

Get the part's `<Output>` sections for `<PageHeader>` or `<PageFooter>`.

```
ocrpt_output *
ocrpt_layout_part_page_header(ocrpt_part *p);

ocrpt_output *
ocrpt_layout_part_page_footer(ocrpt_part *p);
```

10.1.10.7. Set report for part layout sections

Set the report pointer for the part's `<Output>` sections for `<PageHeader>` or `<PageFooter>`.

```
void
ocrpt_layout_part_page_header_set_report(ocrpt_part *p,
                                         ocrpt_report *r);

void
ocrpt_layout_part_page_footer_set_report(ocrpt_part *p,
                                         ocrpt_report *r);
```

10.1.10.8. Get report layout sections

Get the report's <Output> sections for <NoData>, <ReportHeader>, <ReportFooter>, <FieldHeaders> or <FieldDetails>.

```
ocrpt_output *
ocrpt_layout_report_nodata(ocrpt_report *r);

ocrpt_output *
ocrpt_layout_report_header(ocrpt_report *r);

ocrpt_output *
ocrpt_layout_report_footer(ocrpt_report *r);

ocrpt_output *
ocrpt_layout_report_field_header(ocrpt_report *r);

ocrpt_output *
ocrpt_layout_report_field_details(ocrpt_report *r);
```

10.1.10.9. Get break layout sections

Get the break's <Output> sections for <BreakHeader> or <BreakFooter>.

```
ocrpt_output *
ocrpt_break_get_header(ocrpt_break *br);

ocrpt_output *
ocrpt_break_get_footer(ocrpt_break *br);
```

10.1.10.10. Set output section global settings

Note that part (page) header and footer, and report header and footer sections must be constant expressions. Other sections may depend on data derived from query columns. See Expressions.

10.1.10.10.1. Set output section suppression

Set suppression from an expression string.

```
void
ocrpt_output_set_suppress(ocrpt_output *output,
                          const char *expr_string);
```

10.1.10.11. Add a text line to an output section

```
ocrpt_line *
ocrpt_output_add_line(ocrpt_output *output);
```

10.1.10.12. Text line settings

Note that settings in the part (page) header and footer sections must be constant expressions. Settings in other sections may depend on data derived from query columns. See Expressions.

10.1.10.12.1. Set line font name

Set the text line's font name from an expression string.

```
void
ocrpt_line_set_font_name(ocrpt_line *line,
                         const char *expr_string);
```

10.1.10.12.2. Set line font size

Set the text line's font size from an expression string.

```
void
ocrpt_line_set_font_size(ocrpt_line *line,
                         const char *expr_string);
```

10.1.10.12.3. Set line bold value

Set the text line's bold value from an expression string.

```
void
ocrpt_line_set_bold(ocrpt_line *line,
                    const char *expr_string);
```

10.1.10.12.4. Set line italic value

Set the text line's italic value from an expression string.

```
void
ocrpt_line_set_italic(ocrpt_line *line,
                      const char *expr_string);
```

10.1.10.12.5. Set line suppression

Set the text line's suppression value from an expression string.

```
void
ocrpt_line_set_suppress(ocrpt_line *line,
                        const char *expr_string);
```

10.1.10.12.6. Set line text color

Set the text line's text color from an expression string.

```
void
ocrpt_line_set_color(ocrpt_line *line,
                     const char *expr_string);
```

10.1.10.12.7. Set line background color

Set the text line's background color from an expression string.

```
void
ocrpt_line_set_bgcolor(ocrpt_line *line,
                       const char *expr_string);
```

10.1.10.13. Add a text element to a text line

```
ocrpt_text *
ocrpt_line_add_text(ocrpt_line *line);
```

10.1.10.14. Text element settings

Note that settings in the part (page) header and footer sections must be constant expressions. Settings in other sections may depend on data derived from query columns. See Expressions.

10.1.10.14.1. Set text element literal value

Set the text element's literal value from a string.

```
void
ocrpt_text_set_value_string(ocrpt_text *text,
                            const char *string);
```

10.1.10.14.2. Set text element value

Set the text element's value from an expression string.

```
void
ocrpt_text_set_value_expr(ocrpt_text *text,
                          const char *expr_string);
```

10.1.10.14.3. Set text element value's delayed property

Set the text element value's delayed property from an expression string.

```
void
ocrpt_text_set_value_delayed(ocrpt_text *text,
                             const char *expr_string);
```

10.1.10.14.4. Set text element format string

Set the text element's format string from an expression string.

```
void
ocrpt_text_set_format(ocrpt_text *text,
                      const char *expr_string);
```

10.1.10.14.5. Set text element translation

Set the text element's translation from an expression string.

```
void
ocrpt_text_set_translate(ocrpt_text *text,
                         const char *expr_string);
```

OpenCReports will attempt to translate both the format string and the text element's value.

10.1.10.14.6. Set text element field width

Set the text element's field width from an expression string.

```
void
ocrpt_text_set_width(ocrpt_text *text,
                     const char *expr_string);
```

10.1.10.14.7. Set text element alignment

Set the text element's alignment from a string or an expression string.

```
void
ocrpt_text_set_alignment(ocrpt_text *text,
                         const char *expr_string);
```

String values `left`, `right`, `center` and `justified` are accepted either as is, or as an expression.

10.1.10.14.8. Set text element text color

Set the text element's text color from an expression string.

```
void
ocrpt_text_set_color(ocrpt_text *text,
                     const char *expr_string);
```

10.1.10.14.9. Set text element background color

Set the text element's background color from an expression string.

```
void
ocrpt_text_set_bgcolor(ocrpt_text *text,
                       const char *expr_string);
```

10.1.10.14.10. Set text element font name

Set the text element's font name from an expression string.

```
void
ocrpt_text_set_font_name(ocrpt_text *text,
                         const char *expr_string);
```

10.1.10.14.11. Set text element font size

Set the text element's font size from an expression string.

```
void
ocrpt_text_set_font_size(ocrpt_text *text,
                         const char *expr_string);
```

10.1.10.14.12. Set text element bold value

Set the text element's bold value from an expression string.

```
void
ocrpt_text_set_bold(ocrpt_text *text,
                    const char *expr_string);
```

10.1.10.14.13. Set text element italic value

Set the text element's italic value from an expression string.

```
void
ocrpt_text_set_italic(ocrpt_text *text,
                      const char *expr_string);
```

10.1.10.14.14. Set text element link URL

Set the text element's link URL from an expression string.

```
void
ocrpt_text_set_link(ocrpt_text *text,
                    const char *expr_string);
```

10.1.10.14.15. Set text element multiline property

Set the text element's multiline property from an expression string. The expression must evaluate to a numeric (boolean) value.

```
void
ocrpt_text_set_memo(ocrpt_text *text,
                    const char *expr_string);
```

10.1.10.14.16. Set text element "wrap at characters" property

Set the text element's "wrap at characters" property from an expression string. The expression must evaluate to a numeric (boolean) value. This setting is only used for multiline fields. When unset or set to `false`, multiline text fields wrap at word boundaries.

```
void
ocrpt_text_set_memo_wrap_chars(ocrpt_text *text,
                               const char *expr_string);
```

10.1.10.14.17. Set text element maximum lines

Set the text element's maximum lines property from an expression string. The expression must evaluate to a numeric value. This setting is only used for multiline fields. When unset or set to `0`, the whole content of the multiline field is rendered. Otherwise, not more than the maximum lines are rendered from the multiline field value. The used font size, the field's width and word/character wrapping influence the number of lines the field value is rendered into.

```
void
ocrpt_text_set_memo_max_lines(ocrpt_text *text,
                              const char *expr_string);
```

10.1.10.15. Add a horizontal line to an output section

```
ocrpt_hline *
ocrpt_output_add_hline(ocrpt_output *output);
```

10.1.10.16. Horizontal line settings

Note that settings in the part (page) header and footer sections must be constant expressions. Settings in other sections may depend on data derived from query columns. See Expressions.

10.1.10.16.1. Set horizontal line size (width)

Set the horizontal line's size (width) from an expression string.

```
void
ocrpt_hline_set_size(ocrpt_hline *hline,
                     const char *expr_string);
```

10.1.10.16.2. Set horizontal line alignment

Set the horizontal line's alignment from an expression string. Possibly values are `left`, `right` and `center`. Default is `left` alignment. The alignment is only applied if the line length is shorter than the designated page or column width without the margins.

```
void
ocrpt_hline_set_align(ocrpt_hline *hline,
                      const char *expr_string);
```

10.1.10.16.3. Set horizontal line indentation

Set the horizontal line's indentation value from an expression string. The indentation is used if `left` alignment is set.

```
void
ocrpt_hline_set_indent(ocrpt_hline *hline,
                       const char *expr_string);
```

10.1.10.16.4. Set horizontal line length

Set the horizontal line's length from an expression string.

```
void
ocrpt_hline_set_length(ocrpt_hline *hline,
                       const char *expr_string);
```

10.1.10.16.5. Set horizontal line font size

Set the horizontal line's font size from an expression string. It's used in indentation and length calculations if Size unit attribute is set to `rlib`.

```
void
ocrpt_hline_set_font_size(ocrpt_hline *hline,
                          const char *expr_string);
```

10.1.10.16.6. Set horizontal line suppression

Set the horizontal line's suppression from an expression string.

```
void
ocrpt_hline_set_suppress(ocrpt_hline *hline,
                         const char *expr_string);
```

10.1.10.16.7. Set horizontal line color

Set the horizontal line's color from an expression string.

```
void
```

```
ocrpt_hline_set_color(ocrpt_hline *hline,
                      const char *expr_string);
```

10.1.10.17. Add a barcode to an output section

```
ocrpt_barcode *
ocrpt_output_add_barcode(ocrpt_output *output);
```

10.1.10.18. Add a barcode to a text line

```
ocrpt_barcode *
ocrpt_line_add_barcode(ocrpt_line *line);
```

10.1.10.19. Barcode settings

10.1.10.19.1. Set barcode value

Set the barcode's value from an expression string. The expression must evaluate to a string, whose value is the string to be encoded as a barcode.

```
void
ocrpt_barcode_set_value(ocrpt_barcode *bc,
                        const char *expr_string);
```

10.1.10.19.2. Set barcode value delayed

Set the barcode's value delayed from an expression string. The expression must evaluate to a boolean value.

```
void
ocrpt_barcode_set_value_delayed(ocrpt_barcode *bc,
                                const char *expr_string);
```

10.1.10.19.3. Set barcode suppression

Set the barcode's suppression value from an expression string. The expression must evaluate to a boolean value.

```
void
ocrpt_barcode_set_suppress(ocrpt_barcode *bc,
                           const char *expr_string);
```

Default value is `false`, i.e. no suppression.

10.1.10.19.4. Set barcode type

Set the barcode's type from an expression string.

```
void
ocrpt_barcode_set_type(ocrpt_barcode *bc,
                       const char *expr_string);
```

The type may be optional, in which case it's autodetected and the barcode is rendered in the format that first allows the `value` string to be rendered. Possible types (in the order of autodetection) are: `upc-a`, `ean-13`, `upc-e`, `ean-8`, `isbn`, `code39`, `code39ext`, `code128b` `code128c`, or `code128`. If `type` is specified, the `value` is rendered in that barcode type if the string is valid for the type. If `value`

is invalid for the specified `type`, or autodetection fails, because the `value` is invalid for any of the above listed types, the barcode is not rendered.

10.1.10.19.5. Set barcode width

Set the barcode's width from an expression string.

```
void
ocrpt_barcode_set_width(ocrpt_barcode *bc,
                        const char *expr_string);
```

The width is set according to Size unit attribute, either in points (1/72th inch) or in (monospace) font width units set by `<Line>`.

10.1.10.19.6. Set barcode width

Set the barcode's height from an expression string.

```
void
ocrpt_barcode_set_height(ocrpt_barcode *bc,
                         const char *expr_string);
```

This setting is always in points, i.e. 1/72th of an inch. The line height will be determined by greatest height of all the `<field>`, `<literal>` and `<Barcode>` fields in the same `<Line>` in a way that the elements of the same line will appear (approximately) centered vertically.

10.1.10.19.7. Set barcode line color

Set the barcode's line color from an expression string.

```
void
ocrpt_barcode_set_color(ocrpt_barcode *bc,
                         const char *expr_string);
```

10.1.10.19.8. Set barcode background color

Set the barcode's background color from an expression string.

```
void
ocrpt_barcode_set_bgcolor(ocrpt_barcode *bc,
                         const char *expr_string);
```

10.1.10.20. Add an image to an output section

```
ocrpt_image *
ocrpt_output_add_image(ocrpt_output *output);
```

10.1.10.21. Add an image to a text line

```
ocrpt_image *
ocrpt_line_add_image(ocrpt_line *line);
```

10.1.10.22. Image settings

Note that settings in the part (page) header and footer sections must be constant expressions. Settings in other sections may depend on data derived from query columns. See Expressions.

10.1.10.22.1. Set image value

Set the image's value (filename) from an expression string.

```
void
ocrpt_image_set_value(ocrpt_image *image,
                      const char *expr_string);
```

10.1.10.22.2. Set image suppression

Set the image's suppression from an expression string.

```
void
ocrpt_image_set_suppress(ocrpt_image *image,
                         const char *expr_string);
```

10.1.10.22.3. Set image type

Set the image's type from an expression string.

```
void
ocrpt_image_set_type(ocrpt_image *image,
                     const char *expr_string);
```

10.1.10.22.4. Set image width

Set the image's width from an expression string. Used when the image is directly added to an output section.

```
void
ocrpt_image_set_width(ocrpt_image *image,
                      const char *expr_string);
```

10.1.10.22.5. Set image height

Set the image's width from an expression string. Used when the image is directly added to an output section.

```
void
ocrpt_image_set_height(ocrpt_image *image,
                       const char *expr_string);
```

10.1.10.22.6. Set image alignment

Set the image's alignment from an expression string. Used when the image is added to text line.

```
void
ocrpt_image_set_align(ocrpt_image *image,
                      const char *expr_string);
```

10.1.10.22.7. Set image background color

Set the image's background color from an expression string.

```
void
ocrpt_image_set_bgcolor(ocrpt_image *image,
                        const char *expr_string);
```

10.1.10.22.8. Set image field width

Set the image's field width from an expression string. Used when the image is added to text line.

```
void
ocrpt_image_set_text_width(ocrpt_image *image,
                           const char *expr_string);
```

10.1.10.23. Add an image end marker to an output section

```
void
ocrpt_output_add_image_end(ocrpt_output *output);
```

10.1.11. Callback related functions

Certain stages of the report execution can notify the application about the stage being executed or finished.

Every "add a callback" function below return `true` for success, `false` for failure.

10.1.11.1. Add a "part added" callback

```
typedef void
(*ocrpt_part_cb)(opencreport *,
                 ocrpt_part *,
                 void *data);

bool
ocrpt_add_part_added_cb(opencreport *o,
                        ocrpt_part_cb func,
                        void *data);
```

10.1.11.2. Add a "report added" callback

```
typedef void
(*ocrpt_report_cb)(opencreport *,
                   ocrpt_report *,
                   void *data);

bool
ocrpt_add_report_added_cb(opencreport *o,
                          ocrpt_report_cb func,
                          void *data);
```

10.1.11.3. Add an "all precalculations done" callback

```
typedef void
(*ocrpt_cb)(opencreport *,
            void *data);

bool
ocrpt_add_precalculation_done_cb(opencreport *o,
                                 ocrpt_cb func,
                                 void *data);
```

10.1.11.4. Add a "part iteration" callback

```
bool
ocrpt_part_add_iteration_cb(ocrpt_part *r,
                            ocrpt_part_cb func,
                            void *data);

bool
ocrpt_part_add_iteration_cb2(opencreport *o,
                             ocrpt_part_cb func,
                             void *data);
```

The second variant adds the callback in the `opencreport` structure context, making the callback apply to every report part. It's for RLIB compatibility.

10.1.11.5. Add a "report started" callback

```
bool
ocrpt_report_add_start_cb(ocrpt_report *r,
                          ocrpt_report_cb func,
                          void *data);

bool
ocrpt_report_add_start_cb2(opencreport *o,
                           ocrpt_report_cb func,
                           void *data);
```

The second variant adds the callback in the `opencreport` structure context, making the callback apply to every report. It's for RLIB compatibility.

10.1.11.6. Add a "report done" callback

```
bool
ocrpt_report_add_done_cb(ocrpt_report *r,
                         ocrpt_report_cb func,
                         void *data);

bool
ocrpt_report_add_done_cb2(opencreport *o,
                          ocrpt_report_cb func,
                          void *data);
```

The second variant adds the callback in the `opencreport` structure context, making the callback apply to every report. It's for RLIB compatibility.

10.1.11.7. Add a "new row" callback

```
bool
ocrpt_report_add_new_row_cb(ocrpt_report *r,
                            ocrpt_report_cb func,
                            void *data);

bool
ocrpt_report_add_new_row_cb2(opencreport *o,
```

```
                                ocrpt_report_cb func,
                                void *data);
```

The second variant adds the callback in the `opencreport` structure context, making the callback apply to every report. It's for RLIB compatibility.

10.1.11.8. Add a "report iteration done" callback

```
bool
ocrpt_report_add_iteration_cb(ocrpt_report *r,
                              ocrpt_report_cb func,
                              void *data);

bool
ocrpt_report_add_iteration_cb2(opencreport *o,
                               ocrpt_report_cb func,
                               void *data);
```

The second variant adds the callback in the `opencreport` structure context, making the callback apply to every report. It's for RLIB compatibility.

10.1.11.9. Add a "report precalculation done" callback

```
bool
ocrpt_report_add_precalculation_done_cb(ocrpt_report *r,
                                        ocrpt_report_cb func,
                                        void *data);

bool
ocrpt_report_add_precalculation_done_cb2(opencreport *o,
                                         ocrpt_report_cb func,
                                         void *data);
```

The second variant adds the callback in the `opencreport` structure context, making the callback apply to every report. It's for RLIB compatibility.

10.1.11.10. Add a "break triggers" callback

```
typedef void
(*ocrpt_break_trigger_cb)(opencreport *,
                          ocrpt_report *,
                          ocrpt_break *,
                          void *);

bool
ocrpt_break_add_trigger_cb(ocrpt_break *br,
                           ocrpt_break_trigger_cb func,
                           void *data);
```

10.1.12. Environment related functions

10.1.12.1. Indirect function to get an environment variable

```
typedef ocrpt_result *
```

```
(*ocrpt_env_query_func)(opencreport *,
                        const char *);

extern ocrpt_env_query_func
ocrpt_env_get;
```

10.1.12.2. Set the environment query function

```
void
ocrpt_env_set_query_func(ocrpt_env_query_func func);
```

10.1.12.3. C API environment query function

```
ocrpt_result *
ocrpt_env_get_c(opencreport *o,
                const char *env);
```

10.1.12.4. Add an "m" domain variable

Set an "m" domain variable. If such a variable `name` didn't exist yet, and `value` is not `NULL`, then the variable is set. If `value` is `NULL`, the variable is removed. Such an explicit variable takes precedence over the environment variable of the same name when used in expressions.

```
void
ocrpt_set_mvariable(opencreport *o,
                    const char *name,
                    const char *value);
```

10.1.13. File handling related functions

10.1.13.1. Return a canonical file path

The returned path contains only single directory separators and doesn't contains symlinks.

```
char *
ocrpt_canonicalize_path(const char *path);
```

10.1.13.2. Add search path

Add a new directory path to the list of search paths. It's useful to find files referenced with relative path.

```
void
ocrpt_add_search_path(opencreport *o,
                      const char *path);
```

10.1.13.3. Add search path (delayed variant)

Add a new directory path from an expression string to the list of search paths. It's useful to find files referenced with relative path. The expression must evaluate to a string value. It is evaluated at the beginning of the report execution. This function may be used explicitly but it's also used when parsing the `<Path>` nodes in a report XML description.

```
void
ocrpt_add_search_path_from_expr(opencreport *o,
```

```
                                    const char *expr_string);
```

10.1.13.4. Resolve search paths

Resolve expressions added by `ocrpt_add_search_path_from_expr()`. It's used internally when executing the report.

```
void
ocrpt_resolve_search_paths(opencreport *o);
```

10.1.13.5. Find a file

Find a file and return the canonicalized path to it. This function takes the search paths into account.

```
char *
ocrpt_find_file(opencreport *o,
                const char *filename);
```

Note that search paths added by `ocrpt_add_search_path()` and `ocrpt_add_search_path_from_expr()` are used in their order of appearance when searching for files during executing the report.

10.1.14. Color related functions

10.1.14.1. Find a color by its name

The function fills in the `ocrpt_color` structure with RGB values in Cairo values (0.0 ... 1.0).

If the color name starts with # or `0x` or `0X` then it must be in HTML notation.

Otherwise, the color name is looked up in the color name database in a case insensitive way. If found, the passed-in ocrpt_color structure is filled with the RGB color value of that name.

If not found or the passed-in color name is NULL, depending on the the expected usage (foreground or background color), the `ocrpt_color` structure is filled with either white or black.

```
void
ocrpt_get_color(opencreport *o,
                const char *cname,
                ocrpt_color *color,
                bool bgcolor);
```

10.1.15. Paper size related functions

Paper size in OpenCReports is handled via libpaper[4].

This structure is used in OpenCReports to represent paper name and size:

```
struct ocrpt_paper {
    const char *name;
    double width;
    double height;
};
```

[4] http://packages.qa.debian.org/libp/libpaper.html

```
typedef struct ocrpt_paper ocrpt_paper;
```

10.1.15.1. Get the system default paper

```
const ocrpt_paper *
ocrpt_get_system_paper(void);
```

10.1.15.2. Get the paper specified by name

```
const ocrpt_paper *
ocrpt_get_paper_by_name(const char *paper);
```

10.1.15.3. Set the global paper

Set global paper using an `ocrpt_paper` structure. The contents of the structure is copied.

```
void
ocrpt_set_paper(opencreport *o,
                const ocrpt_paper *paper);
```

10.1.15.4. Set global paper specified by name

Set paper for the report using a paper name. If the paper name is unknown, the system default paper is set.

```
void
ocrpt_set_paper_by_name(opencreport *o,
                        const char *paper);
```

10.1.15.5. Get currently set global paper

```
const ocrpt_paper *
ocrpt_get_paper(opencreport *o);
```

10.1.15.6. Iterate over paper sizes

Get the next `ocrpt_paper` structure in the iterator. For the first call, the iterator pointer must be NULL. It returns NULL when there are no more papers known to the system.

```
const ocrpt_paper *
ocrpt_paper_next(opencreport *o,
                 void **iter);
```

10.1.16. Memory handling related functions

Memory handling is done through an indirection, to help with bindings (that may do their own memory handling) override the default.

10.1.16.1. Indirect function pointers

```
typedef void *
(*ocrpt_mem_malloc_t)(size_t);

typedef void *
(*ocrpt_mem_realloc_t)(void *,
```

```
                        size_t);

typedef void *
(*ocrpt_mem_reallocarray_t)(void *,
                            size_t,
                            size_t);

typedef void
(*ocrpt_mem_free_t)(const void *);

typedef char *
(*ocrpt_mem_strdup_t)(const char *);

typedef char *
(*ocrpt_mem_strndup_t)(const char *,
                       size_t);

typedef void
(*ocrpt_mem_free_size_t)(void *,
                         size_t);

extern ocrpt_mem_malloc_t ocrpt_mem_malloc0;
extern ocrpt_mem_realloc_t ocrpt_mem_realloc0;
extern ocrpt_mem_reallocarray_t ocrpt_mem_reallocarray0;
extern ocrpt_mem_free_t ocrpt_mem_free0;
extern ocrpt_mem_strdup_t ocrpt_mem_strdup0;
extern ocrpt_mem_strndup_t ocrpt_mem_strndup0;
```

10.1.16.2. Allocate memory

```
void *
ocrpt_mem_malloc(size_t sz);
```

10.1.16.3. Reallocate memory

```
void *
ocrpt_mem_realloc(void *ptr,
                  size_t sz);
```

10.1.16.4. Reallocate array of memory

```
void *
ocrpt_mem_reallocarray(void *ptr,
                       size_t nmemb,
                       size_t sz);
```

10.1.16.5. Free memory

```
void
ocrpt_mem_free(const void *ptr);
```

10.1.16.6. Duplicate C string

```
void *
```

```
ocrpt_mem_strdup(const char *ptr);
```

10.1.16.7. Duplicate C string up to the specified length

```
void *
ocrpt_mem_strndup(const char *ptr,
                  size_t sz);
```

10.1.16.8. Free a C string

It'a convenience alias for `ocrpt_mem_free()`.

```
void
ocrpt_strfree(const char *s);
```

10.1.16.9. Set indirect allocation functions

```
void
ocrpt_mem_set_alloc_funcs(ocrpt_mem_malloc_t rmalloc,
                          ocrpt_mem_realloc_t rrealloc,
                          ocrpt_mem_reallocarray_t rreallocarray,
                          ocrpt_mem_free_t rfree,
                          ocrpt_mem_strdup_t rstrdup,
                          ocrpt_mem_strndup_t rstrndup);
```

10.1.17. List related functions

These functions implement a single linked list. The list element structure is hidden:

```
struct ocrpt_list;
typedef struct ocrpt_list ocrpt_list;
```

10.1.17.1. Get the list length

```
size_t
ocrpt_list_length(ocrpt_list *l);
```

10.1.17.2. Make a list from one element

```
ocrpt_list *
ocrpt_makelist1(const void *data);
```

10.1.17.3. Make a list from multiple elements

This function can be used with variable number of arguments.

```
ocrpt_list *
ocrpt_makelist(const void *data1, ...);
```

10.1.17.4. Get the last element of a list

```
ocrpt_list *
ocrpt_list_last(const ocrpt_list *l);
```

10.1.17.5. Get the nth element of a list

```
ocrpt_list *
ocrpt_list_nth(const ocrpt_list *l, uint32_t n);
```

10.1.17.6. Append a new element to a list

```
ocrpt_list *
ocrpt_list_append(ocrpt_list *l,
                  const void *data);
```

10.1.17.7. Append to list using the last element

This function make appending to the list work *O(1)* instead of *O(n)*.

```
ocrpt_list *
ocrpt_list_end_append(ocrpt_list *l,
                      ocrpt_list **e,
                      const void *data);
```

10.1.17.8. Prepend a new element to a list

```
ocrpt_list *
ocrpt_list_prepend(ocrpt_list *l,
                   const void *data);
```

10.1.17.9. Remove a data element from a list

```
ocrpt_list *
ocrpt_list_remove(ocrpt_list *l,
                  const void *data);
```

10.1.17.10. Remove a data element from a list and update the last link

```
ocrpt_list *
ocrpt_list_end_remove(ocrpt_list *l,
                      ocrpt_list **endptr,
                      const void *data);
```

10.1.17.11. Get next link in the list

This can be used to iterate through a list. It returns `NULL` if the passed-in link is the last list in the list or it's an empty list.

```
ocrpt_list *
ocrpt_list_next(ocrpt_list *l);
```

10.1.17.12. Get the data element from a list

```
void *
ocrpt_list_get_data(ocrpt_list *l);
```

10.1.17.13. Free a list

```
void
ocrpt_list_free(ocrpt_list *l);
```

10.1.17.14. Free a list and its data elements

```
void
ocrpt_list_free_deep(ocrpt_list *l,
                     ocrpt_mem_free_t freefunc);
```

10.1.18. String related functions

For memory safety and higher performance, a wrapper structure is used over C functions.

```
struct ocrpt_string {
    char *str;
    size_t allocated_len;
    size_t len;
};
typedef struct ocrpt_string ocrpt_string;
```

10.1.18.1. Create a new string

Create a new string from a C string. The ownership of the input string may be taken over, or the original string's contents are copied.

```
ocrpt_string *
ocrpt_mem_string_new(const char *str,
                     bool copy);
```

10.1.18.2. Create a new string with specified allocated length

Create a new string with specified allocated length so future growth can be done without reallocation. The input string is always copied.

```
ocrpt_string *
ocrpt_mem_string_new_with_len(const char *str,
                              size_t len);
```

10.1.18.3. Create a string from a formatted string with maximum length

```
ocrpt_string *
ocrpt_mem_string_new_vnprintf(size_t len,
                              const char *format,
                              va_list va);
```

10.1.18.4. Create a string from a formatted string

```
ocrpt_string *
ocrpt_mem_string_new_printf(const char *format, ...);
```

10.1.18.5. Resize a string

Resize the string to the specified allocated length.

```
ocrpt_string *
ocrpt_mem_string_resize(ocrpt_string *string,
                        size_t len);
```

10.1.18.6. Free a string

```
char *
ocrpt_mem_string_free(ocrpt_string *string,
                      bool free_str);
```

10.1.18.7. Append a C string of the specified length to a string

```
void
ocrpt_mem_string_append_len(ocrpt_string *string,
                            const char *str,
                            const size_t len);
```

10.1.18.8. Append a binary string of the specified length to a string

```
void
ocrpt_mem_string_append_len_binary(ocrpt_string *string,
                                   const char *str,
                                   const size_t len);
```

10.1.18.9. Append a C string of unspecified length to a string

```
void
ocrpt_mem_string_append(ocrpt_string *string,
                        const char *str);
```

10.1.18.10. Append a byte to a string

```
void
ocrpt_mem_string_append_c(ocrpt_string *string,
                          const char c);
```

10.1.18.11. Append a formatted string to a string

```
void
ocrpt_mem_string_append_printf(ocrpt_string *string,
                               const char *format, ...);
```

Chapter 11. Implement a datasource input driver

11.1. Datasource input driver registration API

A datasource driver can be implemented and registered with OpenCReports easily. In fact, all the built-in datasource input drivers use the registration interface. A newly registered datasource input driver can also replace the built-in ones.

11.1.1. Register a datasource input driver

```
bool
ocrpt_input_register(const ocrpt_input * const input);
```

11.1.2. Get a datasource input driver

Get a datasource input driver using its name.

```
const ocrpt_input * const
ocrpt_input_get(const char *name);
```

11.2. Datasource input driver details

11.2.1. Datasource input driver interface

Below is the driver interface that defines the driver `names`, the `connect_parameters` used by adding a datasource (see Section 10.1.3.1) and the driver methods.

```
struct ocrpt_input {
    const char **names;
    const ocrpt_input_connect_parameter **connect_parameters;
    bool (*connect)(ocrpt_datasource *ds,
                    const ocrpt_input_connect_parameter *params);
    ocrpt_query *(*query_add_sql)(ocrpt_datasource *ds,
                                  const char *name,
                                  const char *sql);
    ocrpt_query *(*query_add_file)(ocrpt_datasource *ds,
                                   const char *name,
                                   const char *filename,
                                   const int32_t *types,
                                   int32_t types_cols);
    ocrpt_query *(*query_add_data)(ocrpt_datasource *ds,
                                   const char *name,
                                   const void *data,
                                   int32_t rows,
                                   int32_t cols,
                                   const int32_t *types,
                                   int32_t types_cols);
```

```
    ocrpt_query *(*query_add_symbolic_data)(
                                    ocrpt_datasource *ds,
                                    const char *name,
                                    const char *dataname,
                                    int32_t rows,
                                    int32_t cols,
                                    const char *types,
                                    int32_t types_cols);
    void (*describe)(ocrpt_query *query,
                     ocrpt_query_result **result,
                     int32_t *result_cols);
    bool (*refresh)(ocrpt_query *query);
    void (*rewind)(ocrpt_query *query);
    bool (*next)(ocrpt_query *query);
    bool (*populate_result)(ocrpt_query *query);
    bool (*isdone)(ocrpt_query *query);
    void (*free)(ocrpt_query *query);
    bool (*set_encoding)(ocrpt_datasource *ds,
                         const char *encoding);
    void (*close)(const ocrpt_datasource *);
};
typedef struct ocrpt_input ocrpt_input;
```

The driver `names` is a NULL-terminated array of name strings. This allows the driver to be picked up using either name. For example the built-in MariaDB driver does so:

```
static const char *
ocrpt_mariadb_input_names[] = {
    "mariadb", "mysql", NULL
};
```

The `connect_parameters` data pointer and the `connect` method are either both set as valid, or both are NULL.

The `query_add*()` methods are optional. Some datasource drivers support direct or symbolic data, some support file formats, some are SQL based. A datasource input driver must support at least one of the interfaces.

The `describe()` method is mandatory. It returns an array of `ocrpt_query_result` data together with the number of columns in the result set. The result array must contain elements 3 times the number of columns in total due to the internal operation of OpenCReports.

```
#define OCRPT_EXPR_RESULTS (3)
```

The `refresh()` method is optional. See the PHP module source code for its potential uses.

The `rewind()`, `next()`, `populate_result()` and `isdone()` methods are all mandatory as they are required to traverse the result set.

The `free()` method is optional. It's needed if the query uses private data.

The `set_encoding()` method is optional. It's needed if the datasource input driver can use data in encodings other than `UTF-8`.

The `close()` method is optional. It's needed if the datasource connection uses private data.

11.3. Helper functions to implement a datasource input driver

11.3.1. Get the parent pointer of a datasource

```
opencreport *
ocrpt_datasource_get_opencreport(const ocrpt_datasource *ds);
```

11.3.2. Get the name of a datasource

```
const char *
ocrpt_datasource_get_name(const ocrpt_datasource *ds);
```

11.3.3. Get the input driver pointer of a datasource

```
const ocrpt_input *
ocrpt_datasource_get_input(const ocrpt_datasource *ds);
```

11.3.4. Set the private pointer of a datasource

```
void
ocrpt_datasource_set_private(ocrpt_datasource *ds,
                             void *priv);
```

11.3.5. Get the private pointer of a datasource

```
void *
ocrpt_datasource_get_private(ocrpt_datasource *ds);
```

11.3.6. Allocate a query structure

Allocate a query structure and add the query name.

```
ocrpt_query *
ocrpt_query_alloc(const ocrpt_datasource *source,
                  const char *name);
```

11.3.7. Get the query name

```
char *
ocrpt_query_get_name(const ocrpt_query *query);
```

11.3.8. Get the datasource pointer of a query

```
ocrpt_datasource *
ocrpt_query_get_source(const ocrpt_query *query);
```

11.3.9. Set the private pointer of a query

```
void
```

```
ocrpt_query_set_private(ocrpt_query *query,
                        const void *priv);
```

11.3.10. Get the private pointer of a query

```
void *
ocrpt_query_get_private(const ocrpt_query *query);
```

11.3.11. Set current row of a query all NULL

```
void
ocrpt_query_result_set_values_null(ocrpt_query *q);
```

11.3.12. Set a column value of a query

Set the `i`th column value in the current row of a query. The value can be set to NULL if the `isnull` parameter is `true`, or to a valid value using the `str` and the *length* parameters.

```
void
ocrpt_query_result_set_value(ocrpt_query *q,
                             int32_t i,
                             bool isnull,
                             iconv_t conv,
                             const char *str,
                             size_t len);
```

Chapter 12. PHP language API reference

12.1. The OpenCReports PHP module

OpenCReports comes with a PHP module, which must be enabled in the PHP configuration:

```
extension=opencreports.so
```

12.2. The OpenCReport class

The main class in OpenCReports is called `OpenCReport`. (Note that the project name is used as singular.)

```
class OpenCReport {
    public const RESULT_ERROR;
    public const RESULT_STRING;
    public const RESULT_NUMBER;
    public const RESULT_DATETIME;

    public const VARIABLE_EXPRESSION;
    public const VARIABLE_COUNT;
    public const VARIABLE_COUNTALL;
    public const VARIABLE_SUM;
    public const VARIABLE_AVERAGE;
    public const VARIABLE_AVERAGEALL;
    public const VARIABLE_LOWEST;
    public const VARIABLE_HIGHEST;

    public final __construct();

    public final parse_xml(string $filename): bool;
    public final parse_xml_from_buffer(string $buffer): bool;

    public const OUTPUT_PDF;
    public const OUTPUT_HTML;
    public const OUTPUT_TXT;
    public const OUTPUT_CSV;
    public const OUTPUT_XML;
    public const OUTPUT_JSON;
    public final set_output_format(long $format): void;

    public final set_output_parameter(
                    string $param,
                    string $value): void;

    public final execute(): bool;
    public final spool(): void;
    public final get_output(): string|false;
    public final get_content_type(): array|false;
```

```
public static final version(): string;

public final set_numeric_precision_bits(
                string $expr_string): void;
public final get_numeric_precision_bits(): long;
public final set_rounding_mode(
                string $expr_string): void;

public final bindtextdomain(
                string $domainname,
                string $dirname): void;
public final set_locale(string $locale): void;

public final datasource_add(string $source_name,
                            string $source_type,
                            ?array $conn_params = null):
                ?OpenCReport\Datasource;

public final datasource_get(string $source_name):
                ?OpenCReport\Datasource;
public final query_get(string $query_name):
                ?OpenCReport\Query;

public final query_refresh(): void;

public final expr_parse(string $expr_string):
                ?OpenCReport\Expr;
public final expr_error(): ?string;

public final part_new(): OpenCReport\Part;
public final part_get_next(): OpenCReport\Part;

public final function_add(
                string $expr_func_name,
                string $zend_func_name,
                long $n_ops,
                bool $commutative,
                bool $associative,
                bool $left_associative,
                bool $dont_optimize): bool;

public final add_precalculation_done_cb(
                string $callback): void;
public final add_part_added_cb(
                string $callback): void;
public final add_report_added_cb(
                string $callback): void;

public final env_get(string $var_name):
                OpenCReport\Result;

public final result_new():
                OpenCReport\Result;
```

```
    public final set_mvariable(
                    string $name,
                    ?string $value = null): void;

    public final add_search_path(
                    string $path): void;
    public static final canonicalize_path(
                    string $path): string;
    public final find_file(string $path): $string;

    public static final get_color(
                    string $color_name,
                    ?bool $bgcolor = false): array;

    public final set_paper(string $paper): void;

    public final set_size_unit(string $expr_string):
                    void;
    public final set_noquery_show_nodata(
                    string $expr_string): void;
    public final set_report_height_after_last(
                    string $expr_string): void;
    public final set_follower_match_single(
                    string $expr_string): void;
    public final set_follower_match_single_direct(
                    bool $value): void;
}
```

12.3. High level PHP API

Here is an example code using the high level PHP API where everything concerning the report (including the data source) is described in the report XML:

```
<?php
$o = new OpenCReport();

if (!$o->parse_xml(o, "report.xml")) {
    printf("XML parse error\n");
    exit(1);
}

$o->set_output_format(o, OpenCReport::OUTPUT_PDF);
$o->execute();
$->spool();
```

This code will load `report.xml`, set the output format to PDF, runs the report and dumps the result on `stdout`, which ends up in your browser if the PHP code is run behind a webserver.

Most of the class methods are direct wrappers of the corresponding C API functions.

12.3.1. Constructor

The class constructor creates an `OpenCReport` object.

```
public final
OpenCReport::__construct();
```

12.3.2. Load a report XML description

These methods load the report description either from the specified XML file or from the XML content provided in the string. They return `true` for success, `false` for failure.

```
public final
OpenCReport::parse_xml(string $filename): bool;

public final
OpenCReport::parse_xml_from_buffer(string $buffer): bool;
```

12.3.3. Set report output format

Default is `public const OpenCReport::OUTPUT_PDF`.

```
public const OpenCReport::OUTPUT_PDF;
public const OpenCReport::OUTPUT_HTML;
public const OpenCReport::OUTPUT_TXT;
public const OpenCReport::OUTPUT_CSV;
public const OpenCReport::OUTPUT_XML;
public const OpenCReport::OUTPUT_JSON;

public final
OpenCReport::set_output_format(int $format): void;
```

Note that these constants are not to be overridden in subclasses. With PHP 8.1 and newer, the `final` flag is added so overriding these constants will throw an exception.

12.3.4. Set report output parameter

```
public final
OpenCReport::set_output_parameter(
                     string $param,
                     string $value): void;
```

Possible parameters for the HTML output driver:

- `document_root` sets the document root for trimming path prefix from image paths.
- `meta` extends the default `<meta charset="utf-8">`. `literal` (see The passed-in string value may contain the whole `<meta ...>`, in which case the inner parameters are used only. The `charset` specification is ignored. Only the rest is used.
- `suppress_head` suppresses the default `<head> ... </head>` section. Possible values to enable suppressing the default `<head> ... </head>` are `yes`, `true` and `on`. Anything else disables it. Be aware, that the default section contains importand CSS stylesheet settings that are needed for the correct layout.

Possible parameters for the CSV output driver:

- `csv_filename` sets the file name for `Content-Disposition` in the HTTP metadata returned by `ocrpt_get_content_type()`.

- `csv_as_text` sets the MIME type for `Content-Type` in the HTTP metadata returned by `ocrpt_get_content_type()`.
- `csv_delimiter` (also aliased as `csv_delimeter` according to the historical typo in RLIB) sets the CSV field delimiter to the first character of the string. By default it's a comma.
- `no_quotes` will create a CSV output with values unquoted. Possible values to enable it are `yes`, `true`, `on` or any positive non-zero number. Anything else disables it. It takes precedence over `only_quote_strings`
- `only_quote_strings` will create a CSV output with only string values quoted. Possible values to enable it are `yes`, `true`, `on` or any positive non-zero number. Anything else disables it.

Note that some languages (e.g German, Swedish and Hungarian) use comma as the decimal separator instead of decimal point. For these languages, either set `csv_delimiter` or set neither `no_quotes`, nor `only_quote_strings`

Possible parameters for the XML output driver:

- `xml_rlib_compat` sets the flag to create an RLIB compatible XML output. Possible values to enable it are `yes`, `true`, `on` or any positive non-zero number. Anything else disables it.

  When enabled, the toplevel element will be `<rlib>` and `<Report>`s inside `<pd>` won't be embedded in a `report` element.

12.3.5. Run the report

This method executes the report, constructs the result in memory. It returns `true` for success, `false` for failure. It is a failure if the output format is unset.

```
public final
OpenCReport::execute(): bool;
```

12.3.6. Dump report result

Dump the report output on the program's standard output channel.

```
public final
OpenCReport::spool(): void;
```

12.3.7. Get report result

Get the report output. The application then can save it as a file. This method returns the output in a `string` if report execution succeeded, otherwise it returns `false`.

```
public final
OpenCReport::get_output(): string|false;
```

12.3.8. Get report content type

Get the report content type. The application then can add it as HTTP header line(s) to the request. This method returns an array of strings with `Content-Type:`, `Content-Length:` and other header lines if report execution succeeded. Otherwise it returns `false`.

```
public final
```

```
OpenCReport::get_content_type(): array|false;
```

12.3.9. Get library version

This method reports the OpenCReports library version.

```
public final static
OpenCReport::version(): string;
```

12.4. Low level PHP API

The High level PHP API is also part of the low level API. The class methods described below allow creating a report using program code, or simply fine tuning the report behavior by mostly using the High level PHP API.

Note that whenever the method argument is `string $expr_string`, such arguments are treated as Expressions and are only parsed when calling the method. Evaluation of the expressions is delayed to report execution time.

Also note that for class methods that return objects, the parent object must not be `unset()` before using such a derived object. These derived objects are merely wrappers over C pointers in their parent objects' C representation. Such a "use after free" is a sure way to crash the PHP process.

12.4.1. Numeric behavior related methods

12.4.1.1. `Set numeric precision`

The default is 256 bits of floating point precision.

```
public final
OpenCReport::set_numeric_precision_bits(
                     string $expr_string): void;
```

12.4.1.2. `Get numeric precision`

```
public final
OpenCReport::get_numeric_precision_bits(): long;
```

12.4.1.3. Set rounding mode

The rounding modes may be `nearest`, `to_minus_inf`, `to_inf`, `to_zero`, `away_from_zero` and `faithful`. The default is `nearest`.

```
final public
OpenCReport::set_rounding_mode(
                     string $expr_string): void;
```

12.4.2. Locale related methods

12.4.2.1. Set up translation

Setting up the translation needs two parameters: the so called *translation domain* and the toplevel directory for the translations. It relies on GNU Gettext.

```
public final
OpenCReport::bindtextdomain(
                     string $domainname,
                     string $dirname): void;
```

12.4.2.2. Set report locale

Setting the locale for the report does not affect the main program or other threads. Locale setting includes the language, the country. The UTF-8 suffix is necessary. E.g.: `en_GB.UTF-8` or `de_DE.UTF-8`

```
public final
OpenCReport::set_locale(string $locale): void;
```

12.4.3. Data source and query related methods

12.4.3.1. Add a datasource

For the `OpenCReport\Datasource` class methods, see The OpenCReport\Datasource class

```
public final
OpenCReport::datasource_add(string $source_name,
                            string $source_type,
                            ?array $conn_params = null):
                     ?OpenCReport\Datasource;
```

This method adds a datasource of the specified type to the report, using the optional connection parameters.

The possible datasource types are: `array`, `csv`, `json`, `xml`, `mariadb` (also aliased as `mysql`), `postgresql` and `odbc`.

The connection parameter array is an associative array which contains keys and value pairs. The contents of this array is needed to connect to SQL databases. For example:

```
$conn_params = [
    "dbname" => "mydatabase",
    "user" => "myuser"
];
```

The `array`, `csv`, `json`, and `xml` datasource types do not need connection parameters.

The list of connection parameters to establish database connection for `mariadb`, `postgresql`, and `odbc` are listed at Section 10.1.3.1, in the Low level C API Reference.

12.4.3.2. Get a named datasource

For the `OpenCReport\Datasource` class methods, see The OpenCReport\Datasource class.

```
public final
OpenCReport:: datasource_get(string $source_name):
                     ?OpenCReport\Datasource;
```

12.4.3.3. Get a named query

For the `OpenCReport\Query` class methods, see The OpenCReport\Query class.

```
public final
OpenCReport::query_get(string $query_name):
                    ?OpenCReport\Query;
```

12.4.3.4. Refresh the internal representation of array queries

A two dimensional array (actually, a one dimensional array of one dimensional arrays) can be used in PHP as an array query.

The PHP array may be modified during executing the report, e.g. in an event callback called after one iteration of a report part. This method refreshes the the query's internals to be aware of the new contents of the array.

```
public final
query_refresh(): void;
```

There are some limitations what may be done to the source PHP array, though.

- The array contents must not change during a report iteration, i.e. in a new row callback and some others. This would invalidate the contents of the PHP internal representation in a way that OpenCReports may break in subtle ways.
- Changes to the first row of the array (i.e. the column names) are ignored.
- The number of columns in the array must not change.

12.4.4. Expression related methods

Expressions in OpenCReports is explained in the Expressions chapter.

12.4.4.1. Parse an expression

The expression string may not reference report specific identifiers.

```
public final
OpenCReport::expr_parse(string $expr_string):
                    ?OpenCReport\Expr;
```

If the expression is in any way invalid, `OpenCReport::expr_parse()` returns `null`. The error is returned by:

```
public final
OpenCReport::expr_error(): ?string;
```

12.4.4.2. Add a custom report function

```
public final
OpenCReport::function_add(
                    string $expr_func_name,
                    string $zend_func_name,
                    long $n_ops,
                    bool $commutative,
                    bool $associative,
                    bool $left_associative,
                    bool $dont_optimize): bool;
```

After this function returns with success, subsequently parsed expressions may use the function named as the value of `$expr_func_name`. During evaluation of the function, the PHP function named as the value of `$zend_func_name` is called. The expressions that use the new function may call it with either the number of arguments given in `$n_ops`, or if the value is `-1`, any number of arguments.

The remaining `bool` arguments indicate the named properties of the function that the expression optimizer considers.

The declaration of the PHP function named as the value of `$zend_func_name` must follow this:

```
function my_function(OpenCReport\Expr $e)
```

The function implementation may return any PHP base type (`string`, `long`, `double` or `bool`) or it may not return a value at all (i.e. `void`). In the latter case, the function must set the return value in the passed-in `$e` object.

For class methods of `OpenCReport\Expr`, please see The OpenCReport\Expr class.

12.4.5. Layout part related methods

12.4.5.1. Add a new report (layout) part

For class methods of `OpenCReport\Part`, see The OpenCReport\Part class.

```
public final
OpenCReport::part_new(): OpenCReport\Part;
```

12.4.5.2. Get first (layout) part

This function returns an object of the `OpenCReport\Part` class. The object is internally marked as an "iterator object", so `OpenCReport\Part::get_next()` may be called on it again to iterate through every report part of the parent `OpenCReport` object.

```
public final
OpenCReport::part_get_first(): OpenCReport\Part;
```

12.4.5.3. Set paper type

Set the paper type using the paper name, i.e. `'letter'`, `'A4'`, etc.

```
public final
OpenCReport::set_paper(string $paper): void;
```

12.4.5.4. Set size unit

Set the size unit. See Size unit attribute. Possible settings are `points` and `rlib`. Default is `rlib` for RLIB compatibility.

```
public final
OpenCReport::set_size_unit(string $expr_string): void;
```

12.4.5.5. Set "no query show NoData" property

```
public final
```

```
OpenCReport::set_noquery_show_nodata(
                      string $expr_string): void;
```

12.4.5.6. Set "report height after last" property

```
public final
OpenCReport::set_report_height_after_last(
                      string $expr_string): void;
```

12.4.5.7. Set "follower match single" property

See Follower match single attribute.

```
public final
OpenCReport::set_follower_match_single(
                      string $expr_string): void;
public final
OpenCReport::set_follower_match_single_direct(
                      bool $value): void;
```

12.4.6. Callback related methods

These methods add a callback function that are called at certain points during executing the report.

```
public final
OpenCReport::add_precalculation_done_cb(
                      string $callback): void;

public final
OpenCReport::add_part_added_cb(
                      string $callback): void;

public final
OpenCReport::add_report_added_cb(
                      string $callback): void;
```

The "precalculation done" callback is called after the first phase of the report is finished. The interface of the callback function must follow this:

```
function
my_callback(OpenCReport $o)
```

The "part added" callback is called when either `OpenCReport::part_new()` is called, or a report XML description is parsed via either `OpenCReport::parse_xml()` or `OpenCReport::parse_xml_from_buffer()` and a `<Part>` node is being parsed. The interface of the callback function must follow this:

```
function
my_callback(OpenCReport $o,
            OpenCReport\Part $p)
```

The "report added" callback is called when either `OpenCReport\Column::report_new()` is called, or a report XML description is parsed via either `OpenCReport::parse_xml()` or `OpenCReport::parse_xml_from_buffer()` and a `<Report>` node is being parsed. The interface of the callback function must follow this:

```
function
my_callback(OpenCReport $o,
            OpenCReport\Report $r)
```

12.4.7. Environment related methods

In PHP, the "environment" includes both global variables and actual environment variables. If a global variable name exists in the PHP environment, its value is returned as `OpenCReport\Result`. If such a PHP global variable doesn't exist, the variable from operating (e.g. UNIX) environment is used and its value is returned if it exists. Otherwise `NULL` is returned.

```
public final
OpenCReport::env_get(string $var_name):
                     OpenCReport\Result;
```

12.4.8. Add "m" domain variable

Add an "m" domain variable. If such a variable `name` didn't exist yet, and `value` is not `NULL`, then the variable is set. If `value` is `NULL` or omitted, the variable is removed. Such an explicit variable takes precedence over the PHP global variable or the environment variable of the same name when used in expressions.

```
public final
OpenCReport::set_mvariable(
                     string $name,
                     string $value): void;
```

12.4.9. Result related methods

This method creates an uninitialized `OpenCReport\Result` with no value. See The OpenCReport \Result class to set the value.

```
public final
OpenCReport::result_new(): OpenCReport\Result;
```

12.4.10. Path related methods

12.4.10.1. Add a search path

```
public final
OpenCReport::add_search_path(string $path): void;
```

12.4.10.2. Canonicalize path

This method returns (a possibly modified) path that will create a canonical absolute path that doesn't contain `.` and `..` references, symlinks are replaced with the actual target directory, etc.

```
public static final
OpenCReport::canonicalize_path(string $path): string;
```

12.4.10.3. Find a file

Find a (possibly relative) file using the search paths and return the canonical absolute path if found.

```
public final
OpenCReport::find_file(string $path): $string;
```

12.4.11. Color related methods

Get an array with `double` components for the color name or color specification.

```
public static
OpenCReport::final get_color(
                     string $color_name,
                     ?bool $bgcolor = false): array;
```

12.5. The OpenCReport\Datasource class

This class has no constructor, so such an object cannot be created or used on its own. A datasource only is only useful as part of a report. The `OpenCReport::datasource_add_*` methods return an object of this class.

```
class OpenCReport\Datasource {
    public final free(): void;

    public final query_add(string $name,
                           string $array_or_file_or_sql,
                           ?string $coltypes = null):
                           OpenCReport\Query;

    public final set_encoding(string $encoding): void;
}
```

12.5.1. Free a datasource

The datasource is freed for the parent `OpenCReport` object.

```
public final
OpenCReport\Datasource::free(): void;
```

12.5.2. Add a query to the datasource

Add a query to the parent `OpenCReport` object associated with the `OpenCReport\Datasource`.

```
public final
OpenCReport\Datasource::query_add(string $name,
                           string $array_or_file_or_sql,
                           ?string $coltypes = null):
                           OpenCReport\Query;
```

`$name` is the query name that Expressions may use as the identifier domain.

`$array_or_file_or_sql` contains the array name (for an array datasource), the file name (for a file based datasource, like JSON, CSV or XML), or the SQL query statement for SQL based datasources (like MariaDB, PostgreSQL or ODBC).

Passing `$coltypes` is optional and is only valid for array or file based datasources. File based datasources may or may not include column type specification. Array datasources don't. The `$coltypes`

array contains long values `OpenCReport::RESULT_*`. See The OpenCReport class. It helps the engine to add automatic data conversion for query column data. SQL based datasources provide the data type for query columns.

12.5.3. Set datasource encoding

Set encoding for the datasource. By default, UTF-8 is expected.

```
public final
OpenCReport\Datasource::set_encoding(string $encoding): void;
```

12.6. The OpenCReport\Query class

```
class OpenCReport\Query {
    public final get_result():
                    OpenCReport\QueryResult;

    public final navigate_start(): void;
    public final navigate_next(): bool;

    public final navigate_use_prev_row(): void;
    public final navigate_use_next_row(): void;

    public final add_follower(
                    OpenCReport\Query $follower):
                    bool;
    public final add_follower_n_to_1(
                    OpenCReport\Query $follower,
                    OpenCReport\Expr $match):
                    bool;

    public final free(): void;
}
```

12.6.1. Get result for a query's current row

The result is `OpenCReport\QueryResult`. See Section 12.7.

```
public final
OpenCReport\Query::get_result():
                    OpenCReport\QueryResult;
```

12.6.2. Start navigation for a query

Reset query (and all its followers) to go before the first row.

```
public final
OpenCReport\Query::navigate_start(): void;
```

12.6.3. Navigate to the next row

Navigate the query to the next row and return if the new row is valid. The current row of the query's follower queries are also moved to the next valid row.

```
public final
OpenCReport\Query::navigate_next(): bool;
```

Usually queries do not have a uniform way to report the total number of rows, although some datasource types may have such a facility. Instead, they can report that the dataset has ended.

12.6.4. Navigate use previous/next row

These functions expose an implementation detail of the data traversal in OpenCReports. There is a 3-row data cache in which there is always the current row. One past row is kept so e.g. break boundaries can be detected and there is one row read-ahead to detect the end-of-data condition early. These functions allow to switch back and forth in the 3-row data cache, making the previous or next row the "current" one momentarily. The query must always be the primary query of the report. Used by unit tests that don't use `ocrpt_execute()`.

```
public final
OpenCReport\Query::navigate_use_prev_row(): bool;

public final
OpenCReport\Query::navigate_use_next_row(): bool;
```

Usually queries do not have a uniform way to report the total number of rows, although some datasource types may have such a facility. Instead, they can report that the dataset has ended.

12.6.5. Add a query follower

Add a query as an 1:1 follower to the main query object. The method returns whether the call succeeded.

```
public final
OpenCReport\Query::add_follower(
                     OpenCReport\Query $follower):
                     bool;
```

Adding a circular reference between queries would fail.

12.6.6. Add an N:1 query follower

Add a query and the matching expression as a follower to the main query object. The method returns whether the call succeeded.

```
public final
OpenCReport\Query::add_follower_n_to_1(
                     OpenCReport\Query $follower,
                     OpenCReport\Expr $match):
                     bool;
```

Adding a circular reference between queries would fail.

The call takes over ownership of the match object and it must not be explicitly freed.

12.6.7. Free a query

```
public final
```

```
OpenCReport\Query::free(): void;
```

12.7. The OpenCReport\QueryResult class

```
class OpenCReport\QueryResult {
    public final columns(): long;

    public final column_name(long $index): ?string;

    public final column_result(long $index):
                    ?OpenCReport\Result;
}
```

12.7.1. Get number of columns for a query result

This method returns the number of columns for the query result.

```
public final
OpenCReport\QueryResult::columns(): long;
```

12.7.2. Get the nth column name for a query result

This method returns the column name for the query result at `$index`. It returns `NULL` for invalid indices.

```
public final
OpenCReport\QueryResult::column_name(long $index):
                    ?string;
```

12.7.3. Get the nth column result for a query result

This method returns the column result for the query result at `$index`. It returns `NULL` for invalid indices.

```
public final
OpenCReport\QueryResult::column_result(long $index):
                    ?OpenCReport\Result;
```

12.8. The OpenCReport\Expr class

```
class OpenCReport\Expr {
    public final free(): void;

    public final print(): void;

    public final nodes(): long;

    public final resolve(): void;
    public final optimize(): void;
    public final eval():
                    ?OpenCReport\Result;

    public final get_result():
                    ?OpenCReport\Result;
```

```
    public final set_string(
                    string $value): void;
    public final set_long(
                    long $value): void;
    public final set_double(
                    double $value): void;
    public final set_number(
                    string $value): void;

    public final get_num_operands(): long;

    public final operand_get_result(
                    long $opidx):
                    ?OpenCReport\Result;

    public final cmp_results(): bool;

    public final init_results(long $result_type):
                    void;
    public final get_string(): ?string;
    public final get_long(): long;
    public final get_double(): double;
    public final get_number(): ?string;

    public final set_nth_result_string(
                    long $which,
                    string $value): void;

    public final set_nth_result_long(
                    long $which,
                    long $value): void;

    public final set_nth_result_double(
                    long $which,
                    double $value): void;

    public final set_iterative_start_value(
                    bool $value): void;

    public final set_delayed(
                    bool $value): void;
}
```

12.8.1. Free an expression

Used by unit tests.

```
public final
OpenCReport\Expr::free(): void;
```

12.8.2. Print an expression

Used by unit tests.

```
public final
OpenCReport\Expr::print(): void;
```

12.8.3. Get the number of expression tree nodes

Used by unit tests to compare the expression tree before and after optimization.

```
public final
OpenCReport\Expr::nodes(): long;
```

12.8.4. Resolve an expression

```
public final
OpenCReport\Expr::resolve(): void;
```

12.8.5. Optimize an expression

```
public final
OpenCReport\Expr::optimize(): void;
```

12.8.6. Evaluate an expression

```
public final
OpenCReport\Expr::eval():
       ?OpenCReport\Result;
```

12.8.7. Get the result of an expression

```
public final
OpenCReport\Expr::get_result():
       ?OpenCReport\Result;
```

12.8.8. Set expression result to a string value

Useful for user functions.

```
public final
OpenCReport\Expr::set_string(
       string $value): void;
```

12.8.9. Set expression result to a long value

Useful for user functions.

```
public final
OpenCReport\Expr::set_long(
       long $value): void;
```

12.8.10. Set expression result to a double value

Useful for user functions.

```
public final
OpenCReport\Expr::set_double(
       double $value): void;
```

12.8.11. Set expression result to a numeric value from string

Useful for user functions. This allows using BC Math[1]

```
public final
OpenCReport\Expr::set_number_from_string(
       string $value): void;
```

12.8.12. Get number of operands of a expression

Useful for user functions.

```
public final
OpenCReport\Expr::get_num_operands(): long;
```

12.8.13. Get nth operands' result of a expression

Useful for user functions.

```
public final
OpenCReport\Expr::operand_get_result(
       long $opidx):
       ?OpenCReport\Result;
```

12.8.14. Compare the expression's current and previous results

Used internally by the report executor and unit tests. Useful for implementing a custom report executor with breaks.

```
public final
OpenCReport\Expr::cmp_results(): bool;
```

12.8.15. Initialize expression results

Used internally by the report executor and unit tests. Useful for implementing a custom report executor.

```
public final
OpenCReport\Expr::init_results(long $result_type):
       void;
```

12.8.16. Get string value of an expression

Used by unit tests.

[1] https://www.php.net/manual/en/book.bc.php

```
public final
OpenCReport\Expr::get_string(): ?string;
```

12.8.17. Get long value of an expression

Used by unit tests.

```
public final
OpenCReport\Expr::get_long(): long;
```

12.8.18. Get double value of an expression

Used by unit tests.

```
public final
OpenCReport\Expr::get_double(): double;
```

12.8.19. Get numeric value of an expression as a string

Used internally by unit tests.

```
public final
OpenCReport\Expr::get_number():
                          ?string;
```

12.8.20. Set nth result of an expression to a string value

Used by unit tests.

```
public final
OpenCReport\Expr::set_nth_result_string(
       long $which,
       string $value): void;
```

12.8.21. Set nth result of an expression to a long value

Used by unit tests.

```
public final
OpenCReport\Expr::set_nth_result_long(
       long $which,
       long $value): void;
```

12.8.22. Set nth result of an expression to a double value

Used by unit tests.

```
public final
OpenCReport\Expr::set_nth_result_double(
       long $which,
       double $value): void;
```

12.8.23. Set iterative start flag of an expression

Used internally by the report executor and by unit tests.

```
public final
OpenCReport\Expr::set_iterative_start_value(
       bool $value): void;
```

12.8.24. Set expression to delayed

A delayed expression's final value is precalculated, and this value is used in the output in every row of the report.

```
public final
OpenCReport\Expr::set_delayed(
       bool $value): void;
```

12.9. The OpenCReport\Result class

```
class OpenCReport\Result {
    public final free(): void;

    public final copy(
                    OpenCReport\Result $src_result):
                    void;

    public final print(): void;

    public final get_type(): long;

    public final is_null(): bool;
    public final is_string(): bool;
    public final is_number(): bool;
    public final get_string(): ?string;
    public final get_number(?string $format): ?string;
}
```

12.9.1. Free a result object

Only use it for separately created result objects, like via `OpenCReport::env_get()` and `OpenCReport::result_new()`. Not needed for freeing an expression.

```
public final
OpenCReport\Result::free(): void;
```

12.9.2. Copy a result object

Used by unit tests.

```
public final
OpenCReport\Result::copy(
                    OpenCReport\Result $src_result):
                    void;
```

12.9.3. Print a result object

Used by unit tests.

```
public final
OpenCReport\Result::print(): void;
```

12.9.4. Get result object value type

Useful for user functions.

```
public final
OpenCReport\Result::get_type(): long;
```

12.9.5. Detect whether result object value is NULL

Useful for user functions.

```
public final
OpenCReport\Result::is_null(): bool;
```

12.9.6. Detect whether result object value is a string

Useful for user functions.

```
public final
OpenCReport\Result::is_string(): bool;
```

12.9.7. Detect whether result object value is a number

Useful for user functions.

```
public final
OpenCReport\Result::is_number(): bool;
```

12.9.8. Get string value of a result object

Useful for user functions.

```
public final
OpenCReport\Result::get_string(): ?string;
```

12.9.9. Get numeric value of a result object as a string

Useful for user functions. The method may optionally use a format string to specify the number of decimal digits. See MPFR format strings[2]. The returned value may be used with BC Math[3] in PHP or (if the precision is small enough) converted to `double` or `long`.

```
public final
OpenCReport\Result::get_number(?string $format): ?string;
```

[2] https://www.mpfr.org/mpfr-current/mpfr.html#Format-String
[3] https://www.php.net/manual/en/book.bc.php

12.10. The OpenCReport\Part class

```
class OpenCReport\Part {
    public final get_next():
                    ?OpenCReport\Part;

    public final row_new():
                    OpenCReport\Row;

    public final row_get_first():
                    ?OpenCReport\Row;

    public final add_iteration_cb(
                    string $callback): void;

    public final equals(
                    OpenCReport\Part $part): bool;

    public final set_iterations(
                    ?string $expr_string = null): void;

    public final set_font_name(
                    ?string $expr_string = null): void;

    public final set_font_size(
                    ?string $expr_string = null): void;

    public final set_paper(
                    ?string $expr_string = null): void;

    public final set_orientation(
                    ?string $expr_string = null): void;

    public final set_top_margin(
                    ?string $expr_string = null): void;

    public final set_bottom_margin(
                    ?string $expr_string = null): void;

    public final set_left_margin(
                    ?string $expr_string = null): void;

    public final set_right_margin(
                    ?string $expr_string = null): void;

    public final set_suppress(
                    ?string $expr_string = null): void;

    public final set_suppress_pageheader_firstpage(
                    ?string $expr_string = null): void;

    public final page_header():
                    ?OpenCReport\Output;
```

```
    public final page_header_set_report(
                    OpenCReport\Report $report):
                    void;

    public final page_footer():
                    ?OpenCReport\Output;

    public final page_footer_set_report(
                    OpenCReport\Report $report):
                    void;
}
```

12.10.1. Get the next report part

Get the next object in the chain of report parts. This method may only be used on an object created with `OpenCReport::part_get_first()`, i.e. one that was internally marked as an iterator object.

```
public final
OpenCReport\Part::get_next():
                    ?OpenCReport\Part;
```

12.10.2. Create a new report part row

For class methods of `OpenCReport\Row`, see Section 12.11

```
public final
OpenCReport\Part::row_new():
                    OpenCReport\Row;
```

12.10.3. Get the first report part row

Get the first part row from the part. The object is marked internally as an iterator. For class methods of `OpenCReport\Row`, see Section 12.11

```
public final
OpenCReport\Part::row_get_first():
                    ?OpenCReport\Row;
```

12.10.4. Add iteration callback for the part

Add an "iteration done" event callback for the part object.

```
public final
OpenCReport\Part::add_iteration_cb(
                    string $callback): void;
```

12.10.5. Check whether two parts are identical

Check whether two part objects refer to the same internal part structure of the report. Used by unit tests.

```
public final
```

```
OpenCReport\Part::equals(
                    OpenCReport\Part $part): bool;
```

12.10.6. Check whether two parts are identical

Set the number of iterations for the part. The expression must evaluate to a numeric (integer) value. The part and all of its subsections will be calculated and rendered this many times. Default is 1.

```
public final
OpenCReport\Part::set_iterations(
                    ?string $expr_string = null): void;
```

12.10.7. Set part font name

```
public final
OpenCReport\Part::set_font_name(
                    ?string $expr_string = null): void;
```

12.10.8. Set part font size

```
public final
OpenCReport\Part::set_font_size(
                    ?string $expr_string = null): void;
```

12.10.9. Set part font size

```
public final
OpenCReport\Part::set_paper(
                    ?string $expr_string = null): void;
```

12.10.10. Set part orientation

The expression must evaluate to a string value. The possible values are `portrait` and `landscape`. Default is `portrait`.

```
public final
OpenCReport\Part::set_orientation(
                    ?string $expr_string = null): void;
```

12.10.11. Set part top margin

```
public final
OpenCReport\Part::set_top_margin(
                    ?string $expr_string = null): void;
```

12.10.12. Set part bottom margin

```
public final
OpenCReport\Part::set_bottom_margin(
                    ?string $expr_string = null): void;
```

12.10.13. Set part left margin

```
public final
OpenCReport\Part::set_left_margin(
                    ?string $expr_string = null): void;
```

12.10.14. Set part right margin

```
public final
OpenCReport\Part::set_right_margin(
                    ?string $expr_string = null): void;
```

12.10.15. Set part suppression

Set whether the part is suppressed, i.e. all its subsections are omitted from calculating and rendering. Default is `false`.

```
public final
OpenCReport\Part::set_suppress(
                    ?string $expr_string = null): void;
```

12.10.16. Set suppression of the page header on the first page

Set whether the page header of the part is suppressed on the first page. The expression must evaluate to a numeric value, which is treated as a boolean (i.e. 0 or non-0). Default is `false`.

```
public final
OpenCReport\Part::set_suppress_pageheader_firstpage(
                    ?string $expr_string = null): void;
```

12.10.17. Get the part's page header

Get the part's page header `<Output>` section. See Section 12.16 and Output node.

```
public final
OpenCReport\Part::page_header():
                    ?OpenCReport\Output;
```

12.10.18. Set the report object for the part's page header

Set the report object for the part's page header. This will add the internal association between the part's page header and the report, and expressions in the part page header may reference report query column identifiers and report user variables. Therefore it is only recommended for single-part, single-report reports.

```
public final
OpenCReport\Part::page_header_set_report(
                    OpenCReport\Report $report):
                    void;
```

12.10.19. Get the part's page footer

Get the part's page footer `<Output>` section. See Section 12.16 and Output node.

```
public final
OpenCReport\Part::page_footer():
                    ?OpenCReport\Output;
```

12.10.20. Set the report object for the part's page footer

Set the report object for the part's page footer. This will add the internal association between the part's page footer and the report, and expressions in the part page footer may reference report query column identifiers and report user variables. Therefore it is only recommended for single-part, single-report reports.

```
public final
OpenCReport\Part::page_footer_set_report(
                    OpenCReport\Report $report):
                    void;
```

12.11. The OpenCReport\Row class

```
class OpenCReport\Row {
    public final get_next():
                    ?OpenCReport\Row;

    public final column_new():
                    OpenCReport\Column;

    public final column_get_first():
                    ?OpenCReport\Column;

    public final set_suppress(
                    ?string $expr_string = null): void;

    public final set_newpage(
                    ?string $expr_string = null): void;

    public final set_layout(
                    ?string $expr_string = null): void;
}
```

12.11.1. Get the next part row

Get the next object in the chain of part rows. This method may only be used on an object created with `OpenCReport\Part::row_get_first()`, i.e. one that was internally marked as an iterator object.

```
public final
OpenCReport\Row::get_next():
                    ?OpenCReport\Row;
```

12.11.2. Create a new part column for the row

For class methods of `OpenCReport\Column`, see Section 12.12.

```
public final
OpenCReport\Row::column_new():
                    OpenCReport\Column;
```

12.11.3. Get first column of a part row

Get the first column from the part row. The object is marked internally as an iterator. For class methods of `OpenCReport\Column`, see Section 12.12

```
public final
OpenCReport\Row::column_get_first():
                    ?OpenCReport\Column;
```

12.11.4. Set suppression for the part row

```
public final
OpenCReport\Row:set_suppress(
                    ?string $expr_string = null): void;
```

12.11.5. Set new page for the part row

When set to `yes`, the part row will start on a new page.

```
public final
OpenCReport\Row:set_newpage(
                    ?string $expr_string = null): void;
```

12.11.6. Set layout type for the part row

```
public final
OpenCReport\Row::set_layout(
                    ?string $expr_string = null): void;
```

12.12. The OpenCReport\Column class

```
class OpenCReport\Column {
    public final get_next():
                    ?OpenCReport\Column;

    public final report_new():
                    OpenCReport\Report;

    public final report_get_first():
                    ?OpenCReport\Report;

    public final set_suppress(
                    ?string $expr_string = null): void;

    public final set_width(
                    ?string $expr_string = null): void;

    public final set_width(
```

```
                    ?string $expr_string = null): void;

    public final set_border_width(
                    ?string $expr_string = null): void;

    public final set_border_color(
                    ?string $expr_string = null): void;

    public final set_detail_columns(
                    ?string $expr_string = null): void;

    public final set_column_padding(
                    ?string $expr_string = null): void;
}
```

12.12.1. Get next column

Get the next object in the chain of part columns. This method may only be used on an object created with `OpenCReport\Row::column_get_first()`, i.e. one that was internally marked as an iterator object.

```
public final
OpenCReport\Column::get_next():
                    ?OpenCReport\Column;
```

12.12.2. Create a new report in the column

For class methods of `OpenCReport\Report`, see Section 12.13.

```
public final
OpenCReport\Column::report_new():
                    OpenCReport\Report;
```

12.12.3. Get first report of a part column

Get the first report from the part column. The object is marked internally as an iterator. For class methods of `OpenCReport\Report`, see Section 12.13

```
public final
OpenCReport\Column::report_get_first():
                    ?OpenCReport\Report;
```

12.12.4. Set part column suppression

```
public final
OpenCReport\Column::set_suppress(
                    ?string $expr_string = null): void;
```

12.12.5. Set part column width

Set the width of the whole part column. If an inner report is wider than the column width, it's rendering is truncated.

```
public final
OpenCReport\Column::set_width(
                    ?string $expr_string = null): void;
```

12.12.6. Set part column height

Set the part column height. During report execution, the column height is calculated for rendering. Inner reports and the height of their lines that would be rendered are added. New lines of a report that would exceed the part column height are not rendered and the report is rendered partially. The data shown in rendered lines are identical in both cases, whether or not the pre-set height is set. When the set column height is reached, further inner reports are not rendered. Default is unset, i.e. every inner report is fully rendered.

```
public final
OpenCReport\Column::set_height(
                    ?string $expr_string = null): void;
```

12.12.7. Set border width

Set the border width around the part column. The width is in points (1/72 inches). Default is 0, i.e. a border is not rendered around the part column.

```
public final
OpenCReport\Column::set_border_width(
                    ?string $expr_string = null): void;
```

12.12.8. Set border color

Set the border color around the part column. Only used if the border width is set.

```
public final
OpenCReport\Column::set_border_color(
                    ?string $expr_string = null): void;
```

12.12.9. Set number of detail columns

Set the number of detail columns in the part column. Inner reports inside the part column may be narrow and visually wasteful with empty areas on the page. In this case, when a page break would occur, a column break would occur instead. Only reaching the last column would result in a page break.

```
public final
OpenCReport\Column::set_detail_columns(
                    ?string $expr_string = null): void;
```

12.12.10. Set column padding

Set the padding between detail columns. It is used if the number of detail columns is greater than 1.

```
public final
OpenCReport\Column::set_column_padding(
                    ?string $expr_string = null): void;
```

12.13. The OpenCReport\Report class

```
class OpenCReport\Report {
    public final get_next():
                    ?OpenCReport\Report;

    public final variable_new(
                    long $variable_type,
                    string $name,
                    string $expr,
                    ?string $reset_on_break_name = null):
                    OpenCReport\Variable;

    public final variable_new_full(
                    long $result_type,
                    string $name,
                    ?string $baseexpr = null,
                    ?string $intermedexpr = null,
                    ?string $intermed2expr = null,
                    ?string $resultexpr = null,
                    ?string $reset_on_break_name = null):
                    OpenCReport\Variable;

    public final expr_parse(
                    string $expr_string):
                    ?OpenCReport\Expr;

    public final expr_error(): ?string;

    public final resolve_variables(): void;

    public final evaluate_variables(): void;

    public final break_new(
                    ?string $name):
                    OpenCReport\ReportBreak;

    public final break_get(
                    string $break_name):
                    OpenCReport\ReportBreak;

    public final break_get_first():
                    ?OpenCReport\ReportBreak;

    public final resolve_breaks(): void;

    public final get_query_rownum(): long;

    public final add_start_cb(
                    string $callback): void;

    public final add_done_cb(
                    string $callback): void;
```

```
    public final add_new_row_cb(
                    string $callback): void;

    public final add_iteration_cb(
                    string $callback): void;

    public final add_precalculation_done_cb(
                    string $callback): void;

    public final equals(
                    OpenCReport\Report $report):
                    bool;

    public final set_main_query(
                    OpenCReport\Query $query): void;

    public final set_main_query_by_name(
                    string $query_name): void;

    public final set_suppress(
                    ?string $expr_string = null): void;

    public final set_iterations(
                    ?string $expr_string = null): void;

    public final set_font_name(
                    ?string $expr_string = null): void;

    public final set_font_size(
                    ?string $expr_string = null): void;

    public final set_height(
                    ?string $expr_string = null): void;

    public final set_fieldheader_priority(
                    ?string $expr_string = null): void;

    public final nodata(): OpenCReport\Output;
    public final header(): OpenCReport\Output;
    public final footer(): OpenCReport\Output;
    public final field_header(): OpenCReport\Output;
    public final field_details(): OpenCReport\Output;
}
```

12.13.1. Get the next report

Get the next object in the chain of reports. This method may only be used on an object created with `OpenCReport\Column::report_get_first()`, i.e. one that was internally marked as an iterator object.

```
public final
OpenCReport\Report::get_next():
                    ?OpenCReport\Report;
```

12.13.2. Create a new report variable

Create a new variable of the specified type and name, using the expression to produce the value. Optionally a break name (see Report breaks) may be specified, where, upon a break change, the variable is reset. See Report variables. For class methods of `OpenCReport\Variable`, see Section 12.14.

```
public const OpenCReport\Report::VARIABLE_EXPRESSION;
public const OpenCReport\Report::VARIABLE_COUNT;
public const OpenCReport\Report::VARIABLE_COUNTALL;
public const OpenCReport\Report::VARIABLE_SUM;
public const OpenCReport\Report::VARIABLE_AVERAGE;
public const OpenCReport\Report::VARIABLE_AVERAGEALL;
public const OpenCReport\Report::VARIABLE_LOWEST;
public const OpenCReport\Report::VARIABLE_HIGHEST;

public final
OpenCReport\Report::variable_new(
                    long $variable_type,
                    string $name,
                    string $expr,
                    ?string $reset_on_break_name = null):
                    OpenCReport\Variable;
```

12.13.3. Create a new custom report variable

Create a new custom variable of the specified name, with total control over the base expression, intermediary expression(s) and the result expression. Optionally a break name (see Report breaks) may be specified, where, upon a break change, the variable is reset. See Report variables. For class methods of `OpenCReport\Variable`, see Section 12.14.

```
public final
OpenCReport\Report::variable_new_full(
                    long $result_type,
                    string $name,
                    ?string $baseexpr = null,
                    ?string $intermedexpr = null,
                    ?string $intermed2expr = null,
                    ?string $resultexpr = null,
                    ?string $reset_on_break_name = null):
                    OpenCReport\Variable;
```

12.13.4. Parse and expression for the report

Parse and expression for the report. If the expression fails to parse, the method returns `NULL` and the error is found in `OpenCReport\Report::expr_parse()`.

```
public final
OpenCReport\Report::expr_parse(
                    string $expr_string):
                    ?OpenCReport\Expr;
```

The main difference between `OpenCReport::expr_parse()` (see Section 12.4.4.1) and this method is that the former may not reference a report variable identifier. Since the expression for the former method is not associated with a report, report variable identifiers in the expression may not be resolved. The same

applies to any function that is related to report internal details, e.g. the `brrownum()` function (see Break row number function: the expression is not associated with a report with breaks, the break name will not be found.

12.13.5. Get the error after a failed expression parsing

```
public final
OpenCReport\Report::expr_error(): ?string;
```

12.13.6. Resolve variables of the report

Resolve all variables of the report. This method may be useful to implement a custom report executor. The equivalent C function is used internally. This method is used by unit tests.

```
public final
OpenCReport\Report::resolve_variables(): void;
```

12.13.7. Evaluate variables of the report

This method may be useful to implement a custom report executor. The equivalent C function is used internally. This method is used by unit tests.

```
public final
OpenCReport\Report::evaluate_variables(): void;
```

12.13.8. Create a new report break

Create a new report break. A break is the basis for grouping data. See Report breaks. For the class methods of `OpenCReport\ReportBreak`, see Section 12.15.

```
public final
OpenCReport\Report::break_new(
                    ?string $name):
                    OpenCReport\ReportBreak;
```

12.13.9. Get a report break by its name

Get a previously created break using its name. The object that's created this way is *not* marked as an iterator, so `OpenCReport\ReportBreak::get_next()` may not be used on it.

```
public final
OpenCReport\Report::break_get(
                    string $break_name):
                    OpenCReport\ReportBreak;
```

12.13.10. Get the first report break

Get the first break object in the chain of breaks of the report. The object is marked internally as an iterator, so `OpenCReport\ReportBreak::get_next()` may be used on it.

```
public final
OpenCReport\Report::break_get_first():
                    ?OpenCReport\ReportBreak;
```

12.13.11. Resolve breaks of the report

Resolve all breaks of the report. It may be useful to create a custom report executor. The equivalent C function is used internally. Used by unit tests.

```
public final
OpenCReport\Report::resolve_breaks(): void;
```

12.13.12. Get the current row number of the main query

Get the current row number of the report's main query. Used by unit tests.

```
public final
OpenCReport\Report::get_query_rownum(): long;
```

12.13.13. Add a "report start" callback

Add a "report start" callback to the report. The callback is called when the report starts during report execution.

```
public final
OpenCReport\Report::add_start_cb(
                      string $callback): void;
```

The callback function interface must follow this:

```
function
my_callback(OpenCReport $o, OpenCReport\Report $r): void;
```

12.13.14. Add a "report done" callback

Add a "report done" callback to the report. The callback is called when the report is done during report execution.

```
public final
OpenCReport\Report::add_done_cb(
                      string $callback): void;
```

The callback function interface must follow this:

```
function
my_callback(OpenCReport $o, OpenCReport\Report $r): void;
```

12.13.15. Add a "new row" callback

Add a "new row" callback to the report. The callback is called for every data row for the report during report execution.

```
public final
OpenCReport\Report::add_new_row_cb(
                      string $callback): void;
```

The callback function interface must follow this:

```
function
```

```
my_callback(OpenCReport $o, OpenCReport\Report $r): void;
```

12.13.16. Add an "iteration done" callback

Add an "iteration done" callback to the report. The callback is called after every iteration for the report during report execution.

```
public final
OpenCReport\Report::add_iteration_cb(
                     string $callback): void;
```

The callback function interface must follow this:

```
function
my_callback(OpenCReport $o, OpenCReport\Report $r): void;
```

12.13.17. Add a "precalculation done" callback

Add a "precalculation done" callback to the report. The callback is called after precalculation is done for the report during report execution.

```
public final
OpenCReport\Report::add_precalculation_done_cb(
                     string $callback): void;
```

The callback function interface must follow this:

```
function
my_callback(OpenCReport $o, OpenCReport\Report $r): void;
```

12.13.18. Check whether two report objects are the same

Check whether the main object's internal C representation is the same as the passed-in object's internal representation.

```
public final
OpenCReport\Report::equals(
                     OpenCReport\Report $report):
                     bool;
```

12.13.19. Set the report's main query

Set the report's main query to the passed-in `OpenCReport\Query`.

```
public final
OpenCReport\Report::set_main_query(
                     OpenCReport\Query $query): void;
```

12.13.20. Set the report's main query by name

Set the report's main query using the query name.

```
public final
OpenCReport\Report::set_main_query_by_name(
```

```
                        string $query_name): void;
```

12.13.21. Set the report suppression

Set the report's suppression. The expression must evaluate too a numeric value. It's zero or non-zero value will decide whether the report is suppressed, i.e. not calculated and not rendered in the output.

```
public final
OpenCReport\Report::public final set_suppress(
                      ?string $expr_string = null): void;
```

12.13.22. Set number of iterations for the report

Set the number of iterations for the report. The report will be calculated and rendered this many times. Default is 1.

```
public final
OpenCReport\Report::set_iterations(
                      ?string $expr_string = null): void;
```

12.13.23. Set the font name for the report

Set the font name for the report. The report font name will be used for any child elements that don't specify the font name themselves.

```
public final
OpenCReport\Report::set_font_name(
                      ?string $expr_string = null): void;
```

12.13.24. Set the font size for the report

Set the font size for the report. The report font size will be used for any child elements that don't specify the font size themselves.

```
public final
OpenCReport\Report::set_font_size(
                      ?string $expr_string = null): void;
```

12.13.25. Set the report height

Set the report height. During report execution, the report height is calculated for rendering. Height of lines that would be rendered are added. New lines that would exceed the report height are not rendered. The data shown in rendered lines are identical in both cased, whether or not the report height is set. Default is unset, i.e. every line is rendered and the number of lines determine the report height,

```
public final
OpenCReport\Report::set_height(
                      ?string $expr_string = null): void;
```

12.13.26. Set the report's field header prioroty

Set the report's field header priority. See Report field header priority attribute for explanation.

```
public final
```

```
OpenCReport\Report::set_fieldheader_priority(
                    ?string $expr_string = null): void;
```

12.13.27. Get output sections of the report

Get the output sections of the report. See NoData node, Report header, Report footer and Detail node. For class methods of , see Section 12.16.

```
public final
OpenCReport\Report::nodata(): OpenCReport\Output;

public final
OpenCReport\Report::header(): OpenCReport\Output;

public final
OpenCReport\Report::footer(): OpenCReport\Output;

public final
OpenCReport\Report::field_header(): OpenCReport\Output;

public final
OpenCReport\Report::field_details(): OpenCReport\Output;
```

12.14. The OpenCReport\Variable class

```
class OpenCReport\Variable {
    public final baseexpr():
                    ?OpenCReport\Expr;

    public final intermedexpr():
                    ?OpenCReport\Expr;

    public final intermed2expr():
                    ?OpenCReport\Expr;

    public final resultexpr():
                    ?OpenCReport\Expr;

    public final set_precalculate(
                    ?string $expr_string = null):
                    void;

    public final resolve(): void;
    public final eval(): void;
}
```

12.14.1. Get the base expression of a variable

Used by unit tests. For class methods of `OpenCReport\Expr`, see The OpenCReport\Expr class

```
public final
OpenCReport\Variable::baseexpr():
                    ?OpenCReport\Expr;
```

12.14.2. Get the first intermediary expression of a variable

Used by unit tests. For class methods of `OpenCReport\Expr`, see The OpenCReport\Expr class

```
public final
OpenCReport\Variable::intermedexpr():
                     ?OpenCReport\Expr;
```

12.14.3. Get the second intermediary expression of a variable

Used by unit tests. For class methods of `OpenCReport\Expr`, see The OpenCReport\Expr class

```
public final
OpenCReport\Variable::intermed2expr():
                     ?OpenCReport\Expr;
```

12.14.4. Get the result expression of a variable

Used by unit tests. For class methods of `OpenCReport\Expr`, see The OpenCReport\Expr class

```
public final
OpenCReport\Variable::resultexpr():
                     ?OpenCReport\Expr;
```

12.14.5. Set the variable precalculated

Set the variable precalculated. A precalculated variable's value (or set of values) is calculated during the precalculation phase of report execution. When the report is being rendered, the precalculated values are used. This allows using an end value in a header, e.g. a report header may contain a summary of bottom line values. Similarly, break headers may show values that would otherwise be shown only in break footer sections for variables that are reset on a break.

```
public final
OpenCReport\Variable::set_precalculate(
                     ?string $expr_string = null):
                     void;
```

12.14.6. Resolve expressions of a variable

Resolve the base, intermediary and result expressions of a single variable. Used by unit tests.

```
public final
OpenCReport\Variable::resolve(): void;
```

12.14.7. Evaluate expressions of a variable

Evaluate the base, intermediary and result expressions of a single variable. Used by unit tests.

```
public final
OpenCReport\Variable::eval(): void;
```

12.15. The OpenCReport\ReportBreak class

```
class OpenCReport\ReportBreak {
    public final get_next():
                    ?OpenCReport\ReportBreak;

    public final breakfield_add(
                    OpenCReport\Expr $breakfield_expr):
                    void;

    public final check_fields(): bool;

    public final reset_vars(): void;

    public final add_trigger_cb(
                    ?string $callback):
                    void;

    public final name(): string;

    public final header(): OpenCReport\Output;
    public final footer(): OpenCReport\Output;
}
```

12.15.1. Get next break

Get the next break object from the chain of breaks in the report this break belongs to. This method may only be called on an object that was marked as an iterator, i.e. one that was created by `OpenCReport\Report::break_get_first()`.

```
public final
OpenCReport\ReportBreak::get_next():
                    ?OpenCReport\ReportBreak;
```

12.15.2. Add a breakfield to a break

Add a breakfield to a break. A break may consists of multiple breakfields. A break triggers if any of the breakfields change from one data line to another.

```
public final
OpenCReport\ReportBreak::breakfield_add(
                    OpenCReport\Expr $breakfield_expr):
                    void;
```

12.15.3. Check breakfields

Check breakfields of a break. This method returns `true` if the break triggers, i.e. field values for the current data row do not match the values for the previous data row. It also the triggers for the first row when there is no previous row. It is used internally by the report executor and also used by unit tests. It may be useful to implement a custom report executor.

```
public final
OpenCReport\ReportBreak::check_fields(): bool;
```

12.15.4. Reset variables associated with a break

Reset report variables associated with a break. Such variables were created with specifying the "reset on break" break name. These variables restart from their initial values. It is used internally by the report executor and also used by unit tests. It may be useful to implement a custom report executor.

```
public final
OpenCReport\ReportBreak::reset_vars(): void;
```

12.15.5. Add a "trigger" callback to a break

Add a "trigger" callback to the break.

```
public final
OpenCReport\ReportBreak::add_trigger_cb(
                    ?string $callback):
                    void;
```

12.15.6. Get the name of a break

Get the name of a break. It may be useful if the breaks were added via a report XML descriptor but variables are added afterwards from code.

```
public final
OpenCReport\ReportBreak::name(): string;
```

12.15.7. Get output sections of a break

Get the header and footer sections of a break. See also BreakHeader and BreakFooter. For class methods of `OpenCReport\Output`, see Section 12.16

```
public final
OpenCReport\ReportBreak::header(): OpenCReport\Output;

public final
OpenCReport\ReportBreak::footer(): OpenCReport\Output;
```

12.16. The OpenCReport\Output class

```
class OpenCReport\Output {
    public final set_suppress(
                    ?string $expr_string = null): void;

    public final add_line():
                    ?OpenCReport\Line;

    public final add_hline():
                    ?OpenCReport\HorizontalLine;

    public final add_image():
                    ?OpenCReport\Image;

    public final add_image_end(): void;
```

```
}
```

12.16.1. Set suppression of the output section

Set suppression of the output section. The expression must evaluate to a numeric value which will be treated as a boolean, i.e. 0 or non-0. The default is `false`, i.e. the section is not suppressed.

```
public final
OpenCReport\Output::set_suppress(
                    ?string $expr_string = null): void;
```

12.16.2. Add a (text) line

Add a (text) line to the output section. A line may have children elements, like `OpenCReport\Text`, `OpenCReport\Image` and `OpenCReport\Barcode`. (See Section 12.20, Section 12.19 and Section 12.21.) For class methods of `OpenCReport\Line`, see Section 12.17.

```
public final
OpenCReport\Output::add_line():
                    ?OpenCReport\Line;
```

12.16.3. Add a horizontal line

Add a horizontal line (a visual separator) to the output section. For class methods of `OpenCReport\HorizontalLine`, see Section 12.17.

```
public final
OpenCReport\Output::add_hline():
                    ?OpenCReport\HorizontalLine;
```

12.16.4. Add an image

Add an image to the output section. The image will indent every subsequent elements in the section, except other images and barcodes (see below). For class methods of `OpenCReport\Image`, see Section 12.17.

```
public final
OpenCReport\Output::add_image():
                    ?OpenCReport\Image;
```

12.16.5. Add a barcode

Add a barcode to the output section. The barcode behaves just like an image, i.e. it will indent every subsequent elements in the section, except other images and barcodes. For class methods of `OpenCReport\Barcode`, see Section 12.17.

```
public final
OpenCReport\Output::add_barcode():
                    ?OpenCReport\Barcode;
```

12.16.6. Add an image end marker

Add an image end marker to the output section. Subsequent elements in the section won't be indented and will be drawn vertically below the previous image.

```
public final
OpenCReport\Output::add_image_end(): void;
```

12.17. The OpenCReport\Line class

```
class OpenCReport\Line {
    public final set_font_name(
                    ?string $expr_string = null): void;

    public final set_font_size(
                    ?string $expr_string = null): void;

    public final set_bold(
                    ?string $expr_string = null): void;

    public final set_italic(
                    ?string $expr_string = null): void;

    public final set_suppress(
                    ?string $expr_string = null): void;

    public final set_color(
                    ?string $expr_string = null): void;

    public final set_bgcolor(
                    ?string $expr_string = null): void;

    public final add_text():
                    ?OpenCReport\Text;

    public final add_image():
                    ?OpenCReport\Image;

    public final add_barcode():
                    ?OpenCReport\Barcode;
}
```

12.17.1. Set the font name for the line

Set the font name for the line. This font will be used for child text elements that don't set the font name themselves.

```
public final
OpenCReport\Line::set_font_name(
                    ?string $expr_string = null): void;
```

12.17.2. Set the font size for the line

Set the font size for the line. This font size will be used for child text elements that don't set the font size themselves.

```
public final
OpenCReport\Line::set_font_size(
```

```
                        ?string $expr_string = null): void;
```

12.17.3. Set the font's bold flag for the line

Set the font's bold flag for the line. The expression must evaluate to a numeric value that is treated as a boolean, i.e. 0 or non-0. Default is `false`. This bold flag value will be used for child text elements that don't set it themselves.

```
public final
OpenCReport\Line::set_bold(
                        ?string $expr_string = null): void;
```

12.17.4. Set the font's italic flag for the line

Set the font's italic flag for the line. The expression must evaluate to a numeric value that is treated as a boolean, i.e. 0 or non-0. Default is `false`. This italic flag value will be used for child text elements that don't set it themselves.

```
public final
OpenCReport\Line::set_italic(
                        ?string $expr_string = null): void;
```

12.17.5. Set line suppression

Set the suppression flag for the line. The expression must evaluate to a numeric value that is treated as a boolean, i.e. 0 or non-0. Default is `false`, i.e. not suppressed. When set to a non-0 value (i.e. `true`), the whole line with all its child elements (text or image) will be suppressed, i.e. not rendered.

```
public final
OpenCReport\Line::set_suppress(
                        ?string $expr_string = null): void;
```

12.17.6. Set text color for the line

Set text color for the line. See Color specification. This text color will be used for child elements that don't set the text color themselves.

```
public final
OpenCReport\Line::set_color(
                        ?string $expr_string = null): void;
```

12.17.7. Set background color for the line

Set background color for the line. See Color specification. This background color will be used for child elements that don't set the background color themselves.

```
public final
OpenCReport\Line::set_bgcolor(
                        ?string $expr_string = null): void;
```

12.17.8. Add a text element to the line

Add a child text element to the line. For class methods of `OpenCReport\Text`, see Section 12.20.

```
public final
OpenCReport\Line::add_text():
                    ?OpenCReport\Text;
```

12.17.9. Add an image element to the line

Add a child image element to the line. For class methods of `OpenCReport\Image`, see Section 12.19.

```
public final
OpenCReport\Line::add_image():
                    ?OpenCReport\Image;
```

12.18. The OpenCReport\HorizontalLine class

```
class OpenCReport\HorizontalLine {
    public final set_size(
                    ?string $expr_string = null): void;

    public final set_align(
                    ?string $expr_string = null): void;

    public final set_indent(
                    ?string $expr_string = null): void;

    public final set_length(
                    ?string $expr_string = null): void;

    public final set_font_size(
                    ?string $expr_string = null): void;

    public final set_suppress(
                    ?string $expr_string = null): void;

    public final set_color(
                    ?string $expr_string = null): void;
}
```

12.18.1. Set the line width

Set the line width in points. Also see Section 8.18.1.1

```
public final
OpenCReport\HorizontalLine::set_size(
                    ?string $expr_string = null): void;
```

12.18.2. Set the line alignment

Set the line alignment. Also see Section 8.18.1.2

```
public final
OpenCReport\HorizontalLine::set_align(
                    ?string $expr_string = null): void;
```

12.18.3. Set the line indentation

Set the line indentation, i.e. starting point to the right of the left side of the report. Also see Section 8.18.1.3

```
public final
OpenCReport\HorizontalLine::set_indent(
                    ?string $expr_string = null): void;
```

12.18.4. Set the line length

Set the line length. See HorizontalLine length and Size unit attribute.

```
public final
OpenCReport\HorizontalLine::set_length(
                    ?string $expr_string = null): void;
```

12.18.5. Set the line's font size

Set the line's font size. This font size is used in calculating the line length. See HorizontalLine font size

```
public final
OpenCReport\HorizontalLine::set_font_size(
                    ?string $expr_string = null): void;
```

12.18.6. Set the suppression flag for the line

Set the suppression flag for the line. The expression must evaluate to a numeric value that is treated as a boolean, i.e. 0 or non-0. When set to `true`, the line is not rendered. Default is `false`.

```
public final
OpenCReport\HorizontalLine::set_suppress(
                    ?string $expr_string = null): void;
```

12.18.7. Set the line color

Set the line color. See Color specification.

```
public final
OpenCReport\HorizontalLine::set_color(
                    ?string $expr_string = null): void;
```

12.19. The OpenCReport\Image class

```
class OpenCReport\Image {
    public final set_value(
                    ?string $expr_string = null): void;

    public final set_suppress(
                    ?string $expr_string = null): void;

    public final set_type(
```

```
                    ?string $expr_string = null): void;

    public final set_width(
                    ?string $expr_string = null): void;

    public final set_height(
                    ?string $expr_string = null): void;

    public final set_alignment(
                    ?string $expr_string = null): void;

    public final set_bgcolor(
                    ?string $expr_string = null): void;

    public final set_text_width(
                    ?string $expr_string = null): void;
}
```

12.19.1. Set the file name of the image

Set the file name of the image. The file name may be and absolute path, relative to the work directory of the application, or relative to any of the paths added with `OpenCReport::add_search_path()`. (See Section 12.4.10.1.)

```
public final
OpenCReport\Image::set_value(
                    ?string $expr_string = null): void;
```

12.19.2. Set the suppression flag for the image

Set the suppression flag for the image. The expression must evaluate to a numeric value that is treated as a boolean, i.e. 0 or non-0. Default is `false`.

```
public final
OpenCReport\Image::set_suppress(
                    ?string $expr_string = null): void;
```

12.19.3. Set the image type

Set the image file type. Usually it's auto-detected and not needed.

```
public final
OpenCReport\Image::set_type(
                    ?string $expr_string = null): void;
```

12.19.4. Set the image width

Set the image width. This setting is used when the image element is a direct child of an output section. See Section 8.19.1.4.

```
public final
OpenCReport\Image::set_width(
                    ?string $expr_string = null): void;
```

12.19.5. Set the image height

Set the image height. This setting is used when the image element is a direct child of an output section. See Section 8.19.1.4.

```
public final
OpenCReport\Image::set_height(
                    ?string $expr_string = null): void;
```

12.19.6. Set the image alignment

Set the image alignment. This setting is used when the image element is a child of a text line. See Section 8.19.1.8.

```
public final
OpenCReport\Image::set_alignment(
                    ?string $expr_string = null): void;
```

12.19.7. Set the image background color

Set the image background color. This setting is used when the image element is a child of a text line. See Section 8.19.1.7.

```
public final
OpenCReport\Image::set_bgcolor(
                    ?string $expr_string = null): void;
```

12.19.8. Set the image "text width"

Set the image "text width". This setting is used when the image element is a child of a text line. See Section 8.19.1.6.

```
public final
OpenCReport\Image::set_text_width(
                    ?string $expr_string = null): void;
```

12.20. The OpenCReport\Text class

```
class OpenCReport\Text {
    public final set_value_string(
                    ?string $expr_string = null): void;

    public final set_value_expr(
                    ?string $expr_string = null): void;

    public final set_value_delayed(
                    ?string $expr_string = null): void;

    public final set_format(
                    ?string $expr_string = null): void;

    public final set_translate(
```

```
                    ?string $expr_string = null): void;

    public final set_width(
                    ?string $expr_string = null): void;

    public final set_alignment(
                    ?string $expr_string = null): void;

    public final set_color(
                    ?string $expr_string = null): void;

    public final set_bgcolor(
                    ?string $expr_string = null): void;

    public final set_font_name(
                    ?string $expr_string = null): void;

    public final set_font_size(
                    ?string $expr_string = null): void;

    public final set_bold(
                    ?string $expr_string = null): void;

    public final set_italic(
                    ?string $expr_string = null): void;

    public final set_link(
                    ?string $expr_string = null): void;

    public final set_memo(
                    ?string $expr_string = null): void;

    public final set_memo_wrap_chars(
                    ?string $expr_string = null): void;

    public final set_memo_max_lines(
                    ?string $expr_string = null): void;
}
```

12.20.1. Set literal value

Set the literal value for the text element.

```
public final
OpenCReport\Text::set_value_string(
                    ?string $expr_string = null): void;
```

12.20.2. Set expression value

Set the expression value for the text element. And expression may depend on data row values. See Expressions.

```
public final
```

```
OpenCReport\Text::set_value_expr(
                      ?string $expr_string = null): void;
```

12.20.3. Set delayed flag for the field expression

Set delayed flag for the field expression. When set to `true`, the field expression's last value is calculated during the precalculation phase of executing the report and this precalculated value is used during rendering the report.

```
public final
OpenCReport\Text::set_value_delayed(
                      ?string $expr_string = null): void;
```

12.20.4. Set the format string for the field expression

Set the format string for the field expression. This format string will be used instead of the default formats for specific types. See Formatting data

```
public final
OpenCReport\Text::set_format(
                      ?string $expr_string = null): void;
```

12.20.5. Set the translation flag for the field expression

Set the translation flag for the field expression. When set to `true`, the field value will be translated according to the locale and translation settings. See Section 12.4.2

```
public final
OpenCReport\Text::set_translate(
                      ?string $expr_string = null): void;
```

12.20.6. Set the field width

Set the field width. See Text element width

```
public final
OpenCReport\Text::set_width(
                      ?string $expr_string = null): void;
```

12.20.7. Set the field alignment

Set the field alignment. See Text element alignment

```
public final
OpenCReport\Text::set_alignment(
                      ?string $expr_string = null): void;
```

12.20.8. Set the field text color

Set the field text color. See Section 8.17.1.6

```
public final
```

```
OpenCReport\Text::set_color(
                      ?string $expr_string = null): void;
```

12.20.9. Set the field background color

Set the field background color. See Section 8.17.1.7

```
public final
OpenCReport\Text::set_bgcolor(
                      ?string $expr_string = null): void;
```

12.20.10. Set the field font name

Set the field font name. See Text element font name

```
public final
OpenCReport\Text::set_font_name(
                      ?string $expr_string = null): void;
```

12.20.11. Set the field font size

Set the field font size. See Text element font size

```
public final
OpenCReport\Text::set_font_size(
                      ?string $expr_string = null): void;
```

12.20.12. Set the field's bold flag

Set the field's bold flag. See Section 8.17.1.10

```
public final
OpenCReport\Text::set_bold(
                      ?string $expr_string = null): void;
```

12.20.13. Set the field's italic flag

Set the field's italic flag. See Section 8.17.1.11

```
public final
OpenCReport\Text::set_italic(
                      ?string $expr_string = null): void;
```

12.20.14. Set the field's link

Set the field's link URL. When set, the text field becomes a link with the specified URL. See Section 8.17.1.12

```
public final
OpenCReport\Text::set_link(
                      ?string $expr_string = null): void;
```

12.20.15. Set the field's memo flag

Set the field's memo (multi-line text) flag. When set to `true`, the text field becomes a multi-line field. See Multi-line (memo) field

```
public final
OpenCReport\Text::set_memo(
                    ?string $expr_string = null): void;
```

12.20.16. Set the field's "wrap at characters" flag

Set the field's "wrap at characters" flag. Only used when the memo flag is set to `true`. Default is `false`, the text is wrapped at word boundaries. When set to `true`, text is wrapped at character boundaries with hyphenation. See Section 8.17.1.14

```
public final
OpenCReport\Text::set_memo_wrap_chars(
                    ?string $expr_string = null): void;
```

12.20.17. Set the field's maximum number of lines

Set the field's maximum number of lines. Only used when the memo flag is set to `true`. The text field's value is only rendered up to the set number of lines. Default is unset, the text is rendered fully. See Section 8.17.1.15

```
public final
OpenCReport\Text::set_memo_max_lines(
                    ?string $expr_string = null): void;
```

12.21. The OpenCReport\Barcode class

```
class OpenCReport\Barcode {
    public final set_value(
                    ?string $expr_string = null): void;

    public final set_value_delayed(
                    ?string $expr_string = null): void;

    public final set_suppress(
                    ?string $expr_string = null): void;

    public final set_type(
                    ?string $expr_string = null): void;

    public final set_width(
                    ?string $expr_string = null): void;

    public final set_height(
                    ?string $expr_string = null): void;

    public final set_color(
                    ?string $expr_string = null): void;
```

```
    public final set_bgcolor(
                    ?string $expr_string = null): void;
}
```

12.21.1. Set the barcode value

Set the barcode's value from an expression string. The expression must evaluate to a string, whose value is the string to be encoded as a barcode.

```
public final
OpenCReport\Barcode::set_value(
                    ?string $expr_string = null): void;
```

12.21.2. Set the barcode value delayed

Set the barcode's value delayed from an expression string. The expression must evaluate to a boolean value.

```
public final
OpenCReport\Barcode::set_value_delayed(
                    ?string $expr_string = null): void;
```

12.21.3. Set the barcode suppression

Set the barcode's suppression value from an expression string. The expression must evaluate to a boolean value.

```
public final
OpenCReport\Barcode::set_suppress(
                    ?string $expr_string = null): void;
```

Default value is `false`, i.e. no suppression.

12.21.4. Set the barcode type

Set the barcode type.

```
public final
OpenCReport\Barcode::set_type(
                    ?string $expr_string = null): void;
```

The type may be optional, in which case it's autodetected and the barcode is rendered in the format that first allows the `value` string to be rendered. Possible types (in the order of autodetection) are: `upc-a`, `ean-13`, `upc-e`, `ean-8`, `isbn`, `code39`, `code39ext`, `code128b`, `code128c`, or `code128`. If `type` is specified, the `value` is rendered in that barcode type if the string is valid for the type. If `value` is invalid for the specified `type`, or autodetection fails, because the `value` is invalid for any of the above listed types, the barcode is not rendered.

12.21.5. Set the barcode width

Set the barcode image width.

```
public final
```

```
OpenCReport\Barcode::set_width(
                    ?string $expr_string = null): void;
```

The width is set according to Size unit attribute, either in points (1/72th inch) or in (monospace) font width units set by `<Line>`.

12.21.6. Set the barcode height

Set the barcode image height.

```
public final
OpenCReport\Barcode::set_height(
                    ?string $expr_string = null): void;
```

12.21.7. Set the barcode image line color

Set the barcode image line color.

```
public final
OpenCReport\Barcode::set_color(
                    ?string $expr_string = null): void;
```

12.21.8. Set the barcode image background color

Set the barcode image background color.

```
public final
OpenCReport\Barcode::set_bgcolor(
                    ?string $expr_string = null): void;
```

12.22. RLIB compatibility API

These functions mimic the behaviour of the RLIB PHP API but their declaration differ in a way that the RLIB compatibility API in OpenCReports create and use `OpenCReport` objects, making the OpenCReports methods and RLIB compatibility functions inter-operable.

12.22.1. Initialize a report

```
function
rlib_init(): ?OpenCReport;
```

Note that initializing the report using this function automatically enables some RLIB compatibility settings, like the output parameter "xml_rlib_compat".

12.22.2. Destroy a report

```
function
rlib_free(OpenCReport $r): void;
```

12.22.3. Get library version

```
function
```

```
rlib_version(void): string;
```

12.22.4. Add a MySQL/MariaDB datasource

This function is mostly equivalent to `OpenCReport::datasource_add_mariadb()` except that this function does not have a `port` parameter and it doesn't handle the port the way RLIB handled it as an afterthought, i.e. the value of `$host` could have a `:port` suffix. Only the default port will be used, which may be set in the MySQL or MariaDB configuration.

```
function
rlib_add_datasource_mysql(
                      OpenCReport $r,
                      string $source_name,
                      string $host,
                      string $user,
                      string $password,
                      string $dbname):
                      OpenCReport\Datasource;
```

12.22.5. Add a MySQL/MariaDB datasource from an INI group

This function is equivalent to `OpenCReport::datasource_add_mariadb2()`.

```
function
rlib_add_datasource_mysql_from_group(
                      OpenCReport $r,
                      string $source_name,
                      string $group,
                      ?string $option_file = null):
                      OpenCReport\Datasource;
```

12.22.6. Add a PostgreSQL datasource

This function is equivalent to `OpenCReport::datasource_add_postgresql2()`.

```
function
rlib_add_datasource_postgres(
                      OpenCReport $r,
                      string $source_name,
                      ?string $connection_info = null):
                      OpenCReport\Datasource;
```

12.22.7. Add an ODBC datasource

This function is equivalent to `OpenCReport::datasource_add_odbc()`.

```
function
rlib_add_datasource_odbc(
                      OpenCReport $r,
                      string $source_name,
                      string $dbname,
```

```
                        ?string $user, = null,
                        ?string $password = null):
                        OpenCReport\Datasource;
```

12.22.8. Add an array datasource

This function is equivalent to `OpenCReport::datasource_add_array()`.

```
function
rlib_add_datasource_array(
                        OpenCReport $r,
                        string $source_name):
                        OpenCReport\Datasource;
```

12.22.9. Add an XML datasource

This function is equivalent to `OpenCReport::datasource_add_xml()`.

```
function
rlib_add_datasource_xml(
                        OpenCReport $r,
                        string $source_name):
                        OpenCReport\Datasource;
```

12.22.10. Add a CSV datasource

This function is equivalent to `OpenCReport::datasource_add_csv()`.

```
function
rlib_add_datasource_csv(
                        OpenCReport $r,
                        string $source_name):
                        OpenCReport\Datasource;
```

12.22.11. Add a query

This function is equivalent to `OpenCReport\Datasource::query_add()` with a different order of parameters. The query name is the last parameter.

```
function
rlib_add_query_as(
                        OpenCReport $r,
                        string $source_name,
                        string $array_or_file_or_sql,
                        string $name):
                        OpenCReport\Datasource;
```

12.22.12. Add a resultset follower

This function is about equivalent to `OpenCReport\Query::add_follower()`. The `$leader` and `$follower` are query names.

```
function
```

```
rlib_add_resultset_follower(
                      OpenCReport $r,
                      string $leader,
                      string $follower): bool;
```

12.22.13. Add a resultset N:1 follower

This function is about equivalent to `OpenCReport\Query::add_follower_n_to_1()`. The former allows an arbitrary match expression, while the RLIB compatibility function will use the `$leader_field = $follower_field` expression. Similarly to the above function, `$leader` and `$follower` are query names.

```
function
rlib_add_resultset_follower_n_to_1(
                      OpenCReport $r,
                      string $leader,
                      string $leader_field,
                      string $follower,
                      string $follower_field): bool;
```

12.22.14. Set datasource encoding

This function is equivalent to `OpenCReport\Datasource::set_encoding()`. See Section 12.5.3

```
function
rlib_set_datasource_encoding(
                      OpenCReport $r,
                      string $name,
                      string $encoding): void;
```

12.22.15. Add a report XML

This function is equivalent to `OpenCReport::parse_xml()`.

```
function
rlib_add_report(
                      OpenCReport $r,
                      string $filename): bool;
```

12.22.16. Add a report XML from buffer

This function is equivalent to `OpenCReport::parse_xml_from_buffer()`.

```
function
rlib_add_report_from_buffer(
                      OpenCReport $r,
                      string $buffer): bool;
```

12.22.17. Add a search path

This function is equivalent to `OpenCReport::add_search_path()`.

```
function
rlib_add_search_path(
                     OpenCReport $r,
                     string $path): bool;
```

12.22.18. Set locale

This function is equivalent to `OpenCReport::set_locale()`.

```
function
rlib_set_locale(
                     OpenCReport $r,
                     string $locale): void;
```

12.22.19. Setup translation

This function is equivalent to `OpenCReport::bindtextdomain()`.

```
function
rlib_bindtextdomain(
                     OpenCReport $r,
                     string $domain,
                     string $dirname): void;
```

12.22.20. Set output format

This function is about equivalent to `OpenCReport::set_output_format()` but accepts textual format names (like `pdf` instead of the numeric constants like `OpenCReport::OUTPUT_PDF`

```
function
rlib_set_output_format_from_text(
                     OpenCReport $r,
                     string $format): void;
```

12.22.21. Add a custom report function

This function is the RLIB compatible variant of `OpenCReport::function_add()`. Unlike the OpenCReports API, the function added by this function does not have the control knobs to optimize it properly. After this function returns, subsequently parsed expressions may use a function name passed in with `$name`. The PHP function name is in `$function`

```
function
rlib_add_function(
                     OpenCReport $r,
                     string $name,
                     string $function,
                     long $params): void;
```

The interface of the PHP function must follow the below prototype. It must contain the exact number of arguments passed in via `$params`, i.e. it may not pass `-1` to indicate variadic arguments.

```
function my_function($arg1, $arg2, ...)
```

The function implementation may return any PHP base type (`string`, `long`, `double` or `bool`).

12.22.22. Set output encoding

This function silently does nothing. For PDF, it's not relevant. Other (CURRENTLY NOT IMPLEMENTED) output formats will all use UTF-8.

```
function
rlib_set_output_encoding(
                     OpenCReport $r,
                     string $encoding): void;
```

12.22.23. Add a report parameter

This function is equivalent to OpenCReport::set_mvariable().

```
function
rlib_add_parameter(
                     OpenCReport $r,
                     string $param,
                     ?string $value = null): void;
```

12.22.24. Set an output parameter

Set output parameters for the report. For accepted parameters, see Section 12.3.4

```
function
rlib_set_output_parameter(
                     OpenCReport $r,
                     string $param,
                     string $value): void;
```

12.22.25. Refresh array query contents

This function is equivalent to executing OpenCReport::query_refresh(). The same limitations apply.

```
function
rlib_query_refresh(OpenCReport $r): void;
```

12.22.26. Add an event callback

This function adds a callback for the specified `$signal` in an RLIB compatible way. The signal name may be `row_change`, `report_done`, `report_start`, `report_iteration`, `part_iteration` or `precalculation_done`.

```
function
rlib_signal_connect(
                     OpenCReport $r,
                     string $signal,
                     string $function): void;
```

The PHP function prototype must follow this:

```
function my_callback()
```

This function is different from the methods that add specific callback types for parts, reports, breaks, etc. in that the callback is added to the toplevel `OpenCReport` object context, meaning that a `report_start` callback will be called for every report in case there are multiple reports in the same context. Similarly, the same `part_iteration` callback will be called for every part in a multi-part report.

Since there is no way to know which part or which report triggers the callback, it is recommended to use `rlib_signal_connect()` for single-part single-report reports. For more special purposes, the callback creation class methods are recommended.

12.22.27. Execute the report

It is equivalent to `OpenCReport::execute()`

```
function
rlib_execute(OpenCReport $r): bool;
```

12.22.28. Dump the report output

It is equivalent to `OpenCReport::spool()`

```
function
rlib_spool(OpenCReport $r): ?string;
```

12.22.29. Get content type

It is equivalent to `OpenCReport::get_content_type()`

```
function
rlib_get_content_type(OpenCReport $r): ?string;
```

12.22.30. Set radix character

This function silently does nothing. Formatting numbers correctly follow the locale information regarding the decimal separator.

```
function
rlib_set_radix_character(OpenCReport $r): void;
```

12.22.31. Compile and evaluate an expression

```
function
rlib_compile_infix(string $expr_string):
                     string|double|null;
```

Since only the expression string is passed but not the `$r` resource in RLIB, the compatibility implementation of this function is equivalent to the sequence of creating an internal `OpenCReport` object, parsing, optimizing and evaluating the expression, converting its result to a PHP base type, then destroying the internal object. For this reason, the expression may not reference any query columns or report variables.

12.22.32. Add graph background region

This function silently does nothing. GRAPHING IS NOT IMPLEMENTED YET.

```
function
rlib_graph_add_bg_region(
                      OpenCReport $r,
                      string $graph,
                      string $region,
                      string $color,
                      double $start,
                      double $end): void;
```

12.22.33. Clear graph background region

This function silently does nothing. GRAPHING IS NOT IMPLEMENTED YET.

```
function
rlib_graph_clear_bg_region(
                      OpenCReport $r,
                      string $graph): void;
```

12.22.34. Set graph minor tick

This function silently does nothing. GRAPHING IS NOT IMPLEMENTED YET.

```
function
rlib_graph_set_x_minor_tick(
                      OpenCReport $r,
                      string $graph,
                      string $x): void;
```

12.22.35. Set graph minor tick by location

This function silently does nothing. GRAPHING IS NOT IMPLEMENTED YET.

```
function
rlib_graph_set_x_minor_tick_by_location(
                      OpenCReport $r,
                      string $graph,
                      double $location): void;
```

Chapter 13. Examples

13.1. Simple report example

This example below uses a PostgreSQL query to generate a report in PDF output format, with many settings used as default:

- Courier font
- 12 points font size
- automatically calculated field width where it's not specified (note the header and footer fields)
- black font color
- white background
- default paper size

  Note that this particular default setting depends on your location, or rather, the computer's country settings. For example, the U.S. uses the Letter page size as default. On the other hand, most of Europe uses the A4 page size.

and so on.

13.1.1. Data

Data is created as follows in a database called `ocrpttest` using the user `ocrpt`

```
create table flintstones (id serial, name text, property text, age
 int, adult bool);
insert into flintstones (name, property, age, adult)
values
('Fred Flintstone','strong',31,true),
('Wilma Flintstone','charming',28,true),
('Pebbles Flintstone','young',0.5,false);
```

The data looks like this when queried:

```
ocrpttest=> select * from flintstones;
 id |        name        | property | age | adult
----+--------------------+----------+-----+-------
  1 | Fred Flintstone    | strong   |  31 | t
  2 | Wilma Flintstone   | charming |  28 | t
  3 | Pebbles Flintstone | young    |   1 | f
(3 rows)
```

13.1.2. C program code

The program code uses a minimalistic approach, putting everything into the report XML instead.

```
#include <stdio.h>
#include <opencreport.h>

int main(int argc, char **argv) {
```

```
    opencreport *o = ocrpt_init();

    if (!ocrpt_parse_xml(o, "example1.xml")) {
        printf("XML parse error\n");
        ocrpt_free(o);
        return 0;
    }

    ocrpt_set_output_format(o, OCRPT_OUTPUT_PDF);
    ocrpt_execute(o);
    ocrpt_spool(o);
    ocrpt_free(o);

    return 0;
}
```

13.1.3. PHP program code

Here's the equivalent program code in PHP.

```
<?php
$o = new OpenCReport();

if (!$o->parse_xml("example1.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

$o->execute();
$o->spool();
```

13.1.4. RLIB compatible PHP program code

Here's the equivalent program code in PHP, using the RLIB compatibility functions.

```
<?php
$r = rlib_init();

if (!rlib_add_report($r, "example1.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

rlib_execute($r);
rlib_spool($r);
```

13.1.5. Report description

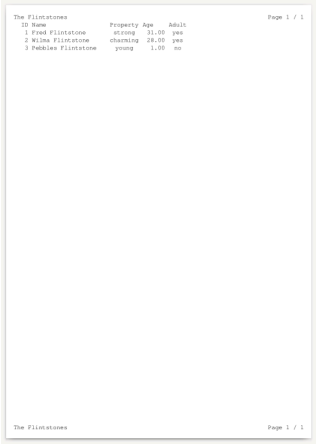
The program code uses this file contents from `example1.xml`.

```
<?xml version="1.0"?>
<!DOCTYPE OpenCReport SYSTEM "opencreport.dtd">
<OpenCReport>
    <Datasources>
```

```
        <Datasource name="pgsql" type="postgresql" dbname="ocrpttest"
 user="ocrpt" />
    </Datasources>

    <Queries>
        <Query name="q" datasource="pgsql">select * from
 flintstones;</Query>
    </Queries>

    <Report query="q">
        <PageHeader>
            <Output>
                <Line>
                    <literal width="20">The Flintstones</literal>
                    <field value="printf('Page %d / %d', r.pageno,
 r.totpages)" align="right" />
                </Line>
            </Output>
        </PageHeader>

        <PageFooter>
            <Output>
                <Line>
                    <literal>The Flintstones</literal>
                    <field value="printf('Page %d / %d', r.pageno,
 r.totpages)" align="right" />
                </Line>
            </Output>
        </PageFooter>

        <Detail>
            <FieldHeaders>
                <Output>
                    <Line>
                        <literal width="4" align="'right'">ID</
literal>
                        <literal width="1"/>
                        <literal width="20">Name</literal>
                        <literal width="1"/>
                        <literal width="8" align="'center'">Property</
literal>
                        <literal width="1"/>
                        <literal width="6">Age</literal>
                        <literal width="1"/>
                        <literal width="5" align="'center'">Adult</
literal>
                    </Line>
                </Output>
            </FieldHeaders>

            <FieldDetails>
                <Output>
                    <Line>
                        <field width="4" align="right" value="id" />
```

```
                        <literal width="1"/>
                        <field width="20" value="name" />
                        <literal width="1"/>
                        <field width="8" align="'center'"
 value="property" />
                        <literal width="1"/>
                        <field width="6" align="'right'" value="age"
 format="'%.2d'" />
                        <literal width="1"/>
                        <field value="adult ? 'yes' : 'no'" width="5"
 align="'center'"/>
                    </Line>
                </Output>
            </FieldDetails>
        </Detail>
    </Report>
</OpenCReport>
```

13.1.6. Report PDF result



13.2. Simple report example with data access in code

This example below is mostly the same as the previous one, with one exception: the database access is done from program code instead of putting it into the report XML description file.

13.2.1. Data

As the same data is used as in the previous example, it's not duplicated here.

13.2.2. C program code

The program code adds the datasource and the query before loading the report XML description. The order of these are not important, as the `ocrpt_execute()` call performs matching expressions with query column names internally.

```
#include <stdio.h>
```

```
#include <opencreport.h>

int main(int argc, char **argv) {
    opencreport *o = ocrpt_init();
    ocrpt_datasource *ds = ocrpt_datasource_add_postgresql(o, "pgsql",
 NULL, NULL, "ocrpttest", "ocrpt", NULL);

    ocrpt_query_add_postgresql(ds, "q", "select * from flintstones;");

    if (!ocrpt_parse_xml(o, "example2.xml")) {
        printf("XML parse error\n");
        ocrpt_free(o);
        return 0;
    }

    ocrpt_set_output_format(o, OCRPT_OUTPUT_PDF);
    ocrpt_execute(o);
    ocrpt_spool(o);
    ocrpt_free(o);

    return 0;
}
```

13.2.3. PHP program code

Here's the equivalent program code in PHP.

```
<?php
$o = new OpenCReport();
$ds = $o->datasource_add_postgresql("pgsql", NULL, NULL, "ocrpttest",
 "ocrpt", NULL);

$ds->query_add("q", "select * from flintstones;");

if (!$o->parse_xml("example2.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

$o->execute();
$o->spool();
```

13.2.4. RLIB compatible PHP program code

Here's the equivalent program code in PHP, using the RLIB compatibility functions.

```
<?php
$r = rlib_init();

rlib_add_datasource_postgres($r, "pgsql", "dbname=ocrpttest
 user=ocrpt");
rlib_add_query_as($r, "pgsql", "select * from flintstones;", "q");

if (!rlib_add_report($r, "example2.xml")) {
```

```
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

rlib_execute($r);
rlib_spool($r);
```

13.2.5. Report description

The program code uses this file contents from `example2.xml`. Note that the `<Datasources>` and `<Queries>` nodes that describe the database access and the query in the previous example are missing here. The equivalent code was added to the different program codes above.

```
<?xml version="1.0"?>
<!DOCTYPE OpenCReport SYSTEM "opencreport.dtd">
<OpenCReport>
    <Report query="q">
        <PageHeader>
            <Output>
                <Line>
                    <literal width="20">The Flintstones</literal>
                    <field value="printf('Page %d / %d', r.pageno,
 r.totpages)" align="right" />
                </Line>
            </Output>
        </PageHeader>

        <PageFooter>
            <Output>
                <Line>
                    <literal>The Flintstones</literal>
                    <field value="printf('Page %d / %d', r.pageno,
 r.totpages)" align="right" />
                </Line>
            </Output>
        </PageFooter>

        <Detail>
            <FieldHeaders>
                <Output>
                    <Line>
                        <literal width="4" align="'right'">ID</
literal>
                        <literal width="1"/>
                        <literal width="20">Name</literal>
                        <literal width="1"/>
                        <literal width="8" align="'center'">Property</
literal>
                        <literal width="1"/>
                        <literal width="6">Age</literal>
                        <literal width="1"/>
                        <literal width="5" align="'center'">Adult</
literal>
                    </Line>
```

```
            </Output>
        </FieldHeaders>

        <FieldDetails>
            <Output>
                <Line>
                    <field width="4" align="right" value="id" />
                    <literal width="1"/>
                    <field width="20" value="name" />
                    <literal width="1"/>
                    <field width="8" align="'center'"
 value="property" />
                    <literal width="1"/>
                    <field width="6" align="'right'" value="age"
 format="'%.2d'" />
                    <literal width="1"/>
                    <field value="adult ? 'yes' : 'no'" width="5"
 align="'center'"/>
                </Line>
            </Output>
        </FieldDetails>
    </Detail>
  </Report>
</OpenCReport>
```

13.2.6. Report PDF result

The result is identical to the previous example, it's not duplicated here.

13.3. Colors, images, horizontal lines and fonts

This example below shows that reports may be more exciting, with colors and images and other visual elements and settings.

13.3.1. Data

Data is created as follows in the same database as the first example.

```
create table flintstones2
(id serial primary key, name text, filename text);

insert into flintstones2 (name, filename)
values
('Fred Flintstone', 'FredFlintstone.png'),
('Wilma Flintstone', 'WilmaFlintstone.png'),
('Pebbles Flintstone', 'PebblesFlintstone.png'),
('Barney Rubble', 'BarneyRubble.png'),
('Betty Rubble', 'BettyRubble.png'),
('Bamm-Bamm Rubble', 'BammBammRubble.png'),
('The Great Gazoo', 'TheGreatGazoo.png');
```

The data looks like this when queried:

```
ocrpttest=> select * from flintstones2;
```

```
 id |        name        |       filename
----+--------------------+----------------------
  1 | Fred Flintstone    | FredFlintstone.png
  2 | Wilma Flintstone   | WilmaFlintstone.png
  3 | Pebbles Flintstone | PebblesFlintstone.png
  4 | Barney Rubble      | BarneyRubble.png
  5 | Betty Rubble       | BettyRubble.png
  6 | Bamm-Bamm Rubble   | BammBammRubble.png
  7 | The Great Gazoo    | TheGreatGazoo.png
(7 rows)
```

13.3.2. C program code

The program code is almost identical to the second example with the database connection and the query added to program code, but it loads a different report XML description.

```
#include <stdio.h>
#include <opencreport.h>

int main(int argc, char **argv) {
    opencreport *o = ocrpt_init();
    ocrpt_datasource *ds = ocrpt_datasource_add_postgresql(o, "pgsql",
 NULL, NULL, "ocrpttest", "ocrpt", NULL);

    ocrpt_query_add_postgresql(ds, "q", "select * from
 flintstones2;");

    if (!ocrpt_parse_xml(o, "example3.xml")) {
        printf("XML parse error\n");
        ocrpt_free(o);
        return 0;
    }

    ocrpt_set_output_format(o, OCRPT_OUTPUT_PDF);
    ocrpt_execute(o);
    ocrpt_spool(o);
    ocrpt_free(o);

    return 0;
}
```

13.3.3. PHP program code

Here's the equivalent program code in PHP.

```
<?php
$o = new OpenCReport();
$ds = $o->datasource_add_postgresql("pgsql", NULL, NULL, "ocrpttest",
 "ocrpt", NULL);

$ds->query_add("q", "select * from flintstones2;");

if (!$o->parse_xml("example3.xml")) {
    echo "XML parse error" . PHP_EOL;
```

```
    exit(0);
}

$o->execute();
$o->spool();
```

13.3.4. RLIB compatible PHP program code

Here's the equivalent program code in PHP, using the RLIB compatibility functions.

```
<?php
$r = rlib_init();

rlib_add_datasource_postgres($r, "pgsql", "dbname=ocrpttest
 user=ocrpt");
rlib_add_query_as($r, "pgsql", "select * from flintstones2;", "q");

if (!rlib_add_report($r, "example3.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

rlib_execute($r);
rlib_spool($r);
```

13.3.5. Report description

The program code uses this file contents from `example3.xml`.

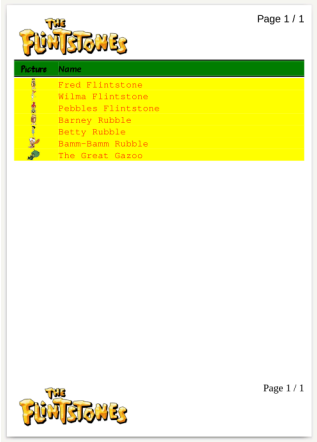
Note the new settings: `fontName="..."`, `fontSize="..."`, `bold="..."`, `italic="..."`, `color="..."`, `bgcolor="..."` and others.

Also note that the `value="..."` setting indicates the file names that are used with `<Image>` elements in the report XML description. These files must be present in the report application work directory, or can be found in Search paths added either in the report XML description or via programming code.

```
<?xml version="1.0"?>
<!DOCTYPE OpenCReport SYSTEM "opencreport.dtd">
<OpenCReport>
    <Report query="q">
        <PageHeader>
            <Output>
                <Image width="227" height="92"
 value="'A_Flintstones_logo.png'" />
                <Line>
                    <field fontName="'Arial'" fontSize="20"
 value="printf('Page %d / %d', r.pageno, r.totpages)" align="right" />
                </Line>
            </Output>
        </PageHeader>

        <PageFooter>
            <Output>
                <Image width="227" height="92"
 value="'A_Flintstones_logo.png'" />
```

```
                <Line>
                    <field fontName="'Times New Roman'" fontSize="20"
value="printf('Page %d / %d', r.pageno, r.totpages)" align="right" />
                </Line>
            </Output>
        </PageFooter>

        <Detail>
            <FieldHeaders>
                <Output>
                    <HorizontalLine size="2" color="'black'" />
                    <HorizontalLine size="2" color="'green'" />
                    <Line bgcolor="'green'" bold="yes" fontSize="18">
                        <literal fontName="'Petaluma Script'"
width="7" align="'center'">Picture</literal>
                        <literal width="1"/>
                        <literal fontName="'Carlito'"
italic="yes">Name</literal>
                    </Line>
                    <HorizontalLine size="2" color="'green'" />
                    <HorizontalLine size="2" color="'black'" />
                    <HorizontalLine size="2" color="'white'" />
                </Output>
            </FieldHeaders>

            <FieldDetails>
                <Output>
                    <Line fontSize="18">
                        <Image textWidth="7" bgcolor="'yellow'"
align="'center'" value="filename" />
                        <literal width="1" bgcolor="'yellow'" />
                        <field color="'red'" bgcolor="'yellow'"
value="name" />
                    </Line>
                </Output>
            </FieldDetails>
        </Detail>
    </Report>
</OpenCReport>
```

13.3.6. Report PDF result



13.4. Report variables and breaks

This example below exercises report variables and breaks. Breaks use changes in a data series, like a different last name. For more information, see Breaks.

13.4.1. Data

Data is created as follows in the same database using the same user as the first example.

```
create table flintstones3 (id serial, firstname text, lastname text,
 age int);

insert into flintstones3 (firstname, lastname, age)
values
('Fred', 'Flintstone', 31),
('Wilma', 'Flintstone', 28),
('Pebbles', 'Flintstone', 2),
('Barney', 'Rubble', 28),
('Betty', 'Rubble', 27),
('Bamm-Bamm', 'Rubble', 2),
('The Great', 'Gazoo', 600);
```

The data looks like this when queried:

```
ocrpttest=> select * from flintstones3;
 id | firstname |  lastname  | age
----+-----------+------------+-----
  1 | Fred      | Flintstone |  31
  2 | Wilma     | Flintstone |  28
  3 | Pebbles   | Flintstone |   2
  4 | Barney    | Rubble     |  28
  5 | Betty     | Rubble     |  27
  6 | Bamm-Bamm | Rubble     |   2
  7 | The Great | Gazoo      | 600
(7 rows)
```

13.4.2. C program code

The program code is identical to the second and third examples, except that it uses a different report XML description.

```
#include <stdio.h>
#include <opencreport.h>

int main(int argc, char **argv) {
    opencreport *o = ocrpt_init();
    ocrpt_datasource *ds = ocrpt_datasource_add_postgresql(o, "pgsql",
 NULL, NULL, "ocrpttest", "ocrpt", NULL);

    ocrpt_query_add_postgresql(ds, "q", "select * from
 flintstones3;");

    if (!ocrpt_parse_xml(o, "example4.xml")) {
        printf("XML parse error\n");
        ocrpt_free(o);
        return 0;
    }

    ocrpt_set_output_format(o, OCRPT_OUTPUT_PDF);
    ocrpt_execute(o);
    ocrpt_spool(o);
    ocrpt_free(o);

    return 0;
}
```

13.4.3. PHP program code

Here's the equivalent program code in PHP.

```
<?php
$o = new OpenCReport();
$ds = $o->datasource_add_postgresql("pgsql", NULL, NULL, "ocrpttest",
 "ocrpt", NULL);

$ds->query_add("q", "select * from flintstones3;");

if (!$o->parse_xml("example4.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

$o->execute();
$o->spool();
```

13.4.4. RLIB compatible PHP program code

Here's the equivalent program code in PHP, using the RLIB compatibility functions.

```
<?php
```

```
$r = rlib_init();

rlib_add_datasource_postgres($r, "pgsql", "dbname=ocrpttest
 user=ocrpt");
rlib_add_query_as($r, "pgsql", "select * from flintstones3;", "q");

if (!rlib_add_report($r, "example4.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

rlib_execute($r);
rlib_spool($r);
```

13.4.5. Report description

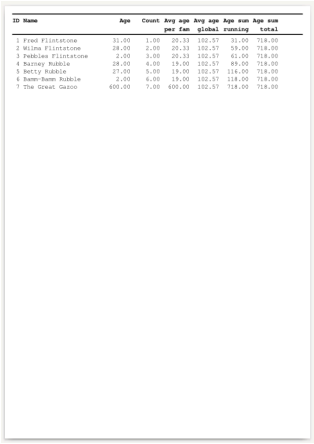
The program code uses this file contents from `example4.xml`.

```
<?xml version="1.0"?>
<!DOCTYPE OpenCReport SYSTEM "opencreport.dtd">
<OpenCReport>
    <Report query="q">
        <Variables>
            <Variable name="var1" value="id" type="count" />
            <Variable name="var2" value="age" type="average"
 precalculate="yes" resetonbreak="family" />
            <Variable name="var3" value="age" type="average"
 precalculate="yes" />
            <Variable name="var4" value="age" type="sum" />
            <Variable name="var5" value="age" type="sum"
 precalculate="yes" />
        </Variables>

        <Breaks>
            <Break name="family">
                <BreakFields>
                    <BreakField value="lastname" />
                </BreakFields>
            </Break>
        </Breaks>

        <Detail>
            <FieldHeaders>
                <Output>
                    <HorizontalLine size="2" color="'black'" />
                    <HorizontalLine size="2" color="'white'" />
                    <Line bold="yes">
                        <literal width="2" align="'center'">ID</
literal>
                        <literal width="1"/>
                        <literal width="20">Name</literal>
                        <literal width="1"/>
                        <literal width="8" align="'right'">Age</
literal>
```

```
                        <literal width="8" align="'right'">Count</
literal>
                        <literal width="8" align="'right'">Avg age</
literal>
                        <literal width="8" align="'right'">Avg age</
literal>
                        <literal width="8" align="'right'">Age sum</
literal>
                        <literal width="8" align="'right'">Age sum</
literal>
                    </Line>
                    <Line bold="yes">
                        <literal width="2"/>
                        <literal width="1"/>
                        <literal width="20"/>
                        <literal width="1"/>
                        <literal width="8"/>
                        <literal width="8"/>
                        <literal width="8" align="'right'">per fam</
literal>
                        <literal width="8" align="'right'">global</
literal>
                        <literal width="8" align="'right'">running</
literal>
                        <literal width="8" align="'right'">total</
literal>
                    </Line>
                    <HorizontalLine size="2" color="'white'" />
                    <HorizontalLine size="2" color="'black'" />
                    <HorizontalLine size="2" color="'white'" />
                </Output>
            </FieldHeaders>

            <FieldDetails>
                <Output>
                    <Line>
                        <field width="2" align="'right'" value="id" />
                        <literal width="1" />
                        <field width="20" value="firstname + ' ' +
 lastname" />
                        <literal width="1"/>
                        <field width="8" value="age" format="'%.2d'"
 align="'right'" />
                        <field width="8" value="v.var1"
 format="'%.2d'" align="'right'" />
                        <field width="8" value="v.var2"
 format="'%.2d'" align="'right'" />
                        <field width="8" value="v.var3"
 format="'%.2d'" align="'right'" />
                        <field width="8" value="v.var4"
 format="'%.2d'" align="'right'" />
                        <field width="8" value="v.var5"
 format="'%.2d'" align="'right'" />
                    </Line>
```

```
                    </Output>
                </FieldDetails>
            </Detail>
        </Report>
    </OpenCReport>
```

13.4.6. Report PDF result



ID	Name	Age	Count	Avg age per fam	Avg age global	Age sum running	Age sum total
1	Fred Flintstone	31.00	1.00	20.33	102.57	31.00	718.00
2	Wilma Flintstone	28.00	2.00	20.33	102.57	59.00	718.00
3	Pebbles Flintstone	2.00	3.00	20.33	102.57	61.00	718.00
4	Barney Rubble	28.00	4.00	19.00	102.57	89.00	718.00
5	Betty Rubble	27.00	5.00	19.00	102.57	116.00	718.00
6	Bamm-Bamm Rubble	2.00	6.00	19.00	102.57	118.00	718.00
7	The Great Gazoo	600.00	7.00	600.00	102.57	718.00	718.00

13.5. Follower queries

This example below exercises a basic follower query along with the main query. For more information, see Follower queries.

13.5.1. Data

Data is created as follows in the same database using the same user as the first example.

```
create table flintstones4 (id serial, firstname text);
create table flintstones5 (id serial, lastname text);

insert into flintstones4 (firstname)
values
('Fred'),
('Wilma'),
('Pebbles'),
('Barney'),
('Betty'),
('Bamm-Bamm'),
('The Great');

insert into flintstones5 (lastname)
values
('Flintstone'),
('Flintstone'),
('Flintstone'),
('Rubble'),
('Rubble'),
('Rubble'),
```

```
('Gazoo');
```

The data looks like this when queried:

```
ocrpttest=> select * from flintstones4;
 id | firstname
----+-----------
  1 | Fred
  2 | Wilma
  3 | Pebbles
  4 | Barney
  5 | Betty
  6 | Bamm-Bamm
  7 | The Great
(7 rows)

ocrpttest=> select * from flintstones5;
 id |  lastname
----+------------
  1 | Flintstone
  2 | Flintstone
  3 | Flintstone
  4 | Rubble
  5 | Rubble
  6 | Rubble
  7 | Gazoo
(7 rows)
```

13.5.2. C program code

The program code adds the two queries and establishes the follower link between them.

```
#include <stdio.h>
#include <opencreport.h>

int main(int argc, char **argv) {
    opencreport *o = ocrpt_init();
    ocrpt_datasource *ds = ocrpt_datasource_add_postgresql(o, "pgsql",
 NULL, NULL, "ocrpttest", "ocrpt", NULL);
    ocrpt_query *q1 = ocrpt_query_add_postgresql(ds, "q1", "select *
 from flintstones4;");
    ocrpt_query *q2 = ocrpt_query_add_postgresql(ds, "q2", "select *
 from flintstones5;");

    ocrpt_query_add_follower(q1, q2);

    if (!ocrpt_parse_xml(o, "example5.xml")) {
        printf("XML parse error\n");
        ocrpt_free(o);
        return 0;
    }

    ocrpt_set_output_format(o, OCRPT_OUTPUT_PDF);
    ocrpt_execute(o);
```

```
    ocrpt_spool(o);
    ocrpt_free(o);

    return 0;
}
```

13.5.3. PHP program code

Here's the equivalent program code in PHP.

```
<?php
$o = new OpenCReport();
$ds = $o->datasource_add_postgresql("pgsql", NULL, NULL, "ocrpttest",
 "ocrpt", NULL);
$q1 = $ds->query_add("q1", "select * from flintstones4;");
$q2 = $ds->query_add("q2", "select * from flintstones5;");

$q1->add_follower($q2);

if (!$o->parse_xml("example5.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

$o->execute();
$o->spool();
```

13.5.4. RLIB compatible PHP program code

Here's the equivalent program code in PHP, using the RLIB compatibility functions.

```
<?php
$r = rlib_init();

rlib_add_datasource_postgres($r, "pgsql", "dbname=ocrpttest
 user=ocrpt");

rlib_add_query_as($r, "pgsql", "select * from flintstones4;", "q1");
rlib_add_query_as($r, "pgsql", "select * from flintstones5;", "q2");

rlib_add_resultset_follower($r, "q1", "q2");

if (!rlib_add_report($r, "example5.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

rlib_execute($r);
rlib_spool($r);
```

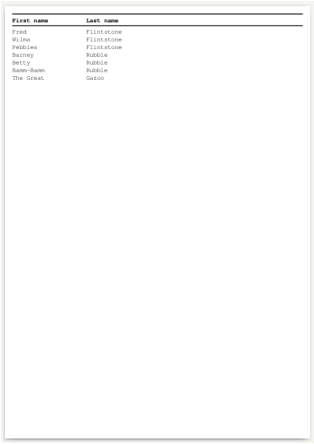
13.5.5. Report description

The program code uses this file contents from `example5.xml`.

Note that when using multiple queries in the same report, column names may be identical. Because of this, using `queryname.columnname` will indicate which one is needed. When using `columnname` then it will mean the first query's column.

```
<?xml version="1.0"?>
<!DOCTYPE OpenCReport SYSTEM "opencreport.dtd">
<OpenCReport>
    <Report query="q1">
        <Detail>
            <FieldHeaders>
                <Output>
                    <HorizontalLine size="2" color="'black'" />
                    <HorizontalLine size="2" color="'white'" />
                    <Line bold="yes">
                        <literal width="20">First name</literal>
                        <literal width="20">Last name</literal>
                    </Line>
                    <HorizontalLine size="2" color="'white'" />
                    <HorizontalLine size="2" color="'black'" />
                    <HorizontalLine size="2" color="'white'" />
                </Output>
            </FieldHeaders>

            <FieldDetails>
                <Output>
                    <Line>
                        <field width="20" value="q1.firstname" />
                        <field width="20" value="q2.lastname" />
                    </Line>
                </Output>
            </FieldDetails>
        </Detail>
    </Report>
</OpenCReport>
```

13.5.6. Report PDF result



First name	Last name
Fred	Flintstone
Wilma	Flintstone
Pebbles	Flintstone
Barney	Rubble
Betty	Rubble
Bamm-Bamm	Rubble
The Great	Gazoo

Note that compared to RLIB[1], OpenCReports may or may not produce the same output. This is due to the incomplete and faulty implementation of follower queries in RLIB.

13.6. N:1 follower queries

This example below exercises two N:1 (N-to-one) follower queries along with the main query. For more information, see Follower queries.

13.6.1. Data

Data is created as follows in the same database using the same user as the first example.

```
create table data (id serial unique, name text);

create table more_data (
id serial unique,
boss_id int,
name text,
foreign key (boss_id) references data (id));

create table moar_data (
sk_id int,
name text,
foreign key (sk_id) references more_data (id));

insert into data (name)
values
('Snow White'),
('Batman'),
('Cinderella'),
('Hansel'),
('Little Red Riding Hood'),
('Robin Hood');

insert into more_data (boss_id, name)
values
(1, 'Doc'),
(1, 'Dopey'),
(1, 'Sneezy'),
(1, 'Happy'),
(1, 'Bashful'),
(1, 'Sleepy'),
(1, 'Grumpy'),
(2, 'Robin'),
(3, 'Fairy Godmother'),
(3, 'Mice'),
(3, 'Pidgeons'),
(4, 'Gretel'),
(6, 'Little John');

insert into moar_data (sk_id, name)
```

[1] https://sourceforge.net/projects/rlib/

```
values
(3, 'Coughy'),
(3, 'Crippley'),
(9, 'Prince Charming'),
(9, 'Shrek'),
(13, 'Will Scarlet'),
(13, 'Brother Tuck');
```

The query that the N:1 followers in this report simulate is:

```
ocrpttest=> select * from data left outer join more_data on (data.id =
 more_data.boss_id)
ocrpttest-> left outer join moar_data on (more_data.id =
 moar_data.sk_id)
ocrpttest-> order by data.id, more_data.id;
 id |          name          | id | boss_id |      name       | sk_id
 |      name
----+------------------------+----+---------+-----------------+-------
+-----------------
  1 | Snow White             |  1 |       1 | Doc             |
 |
  1 | Snow White             |  2 |       1 | Dopey           |
 |
  1 | Snow White             |  3 |       1 | Sneezy          |     3
 | Coughy
  1 | Snow White             |  3 |       1 | Sneezy          |     3
 | Crippley
  1 | Snow White             |  4 |       1 | Happy           |
 |
  1 | Snow White             |  5 |       1 | Bashful         |
 |
  1 | Snow White             |  6 |       1 | Sleepy          |
 |
  1 | Snow White             |  7 |       1 | Grumpy          |
 |
  2 | Batman                 |  8 |       2 | Robin           |
 |
  3 | Cinderella             |  9 |       3 | Fairy Godmother |     9
 | Shrek
  3 | Cinderella             |  9 |       3 | Fairy Godmother |     9
 | Prince Charming
  3 | Cinderella             | 10 |       3 | Mice            |
 |
  3 | Cinderella             | 11 |       3 | Pidgeons        |
 |
  4 | Hansel                 | 12 |       4 | Gretel          |
 |
  5 | Little Red Riding Hood |    |         |                 |
 |
  6 | Robin Hood             | 13 |       6 | Little John     |    13
 | Will Scarlet
  6 | Robin Hood             | 13 |       6 | Little John     |    13
 | Brother Tuck
(17 rows)
```

13.6.2. C program code

The program code adds the three queries and establishes the follower links between them. Note that the match expressions can be anything, just like in SQL using the `LEFT OUTER JOIN ON ( ... )` clause.

```
#include <stdio.h>
#include <opencreport.h>

int main(int argc, char **argv) {
    opencreport *o = ocrpt_init();
    ocrpt_datasource *ds = ocrpt_datasource_add_postgresql(o, "pgsql",
 NULL, NULL, "ocrpttest", "ocrpt", NULL);
    ocrpt_query *q1 = ocrpt_query_add_postgresql(ds, "q1", "select *
 from data order by id;");
    ocrpt_query *q2 = ocrpt_query_add_postgresql(ds, "q2", "select *
 from more_data order by id;");
    ocrpt_query *q3 = ocrpt_query_add_postgresql(ds, "q3", "select *
 from moar_data order by sk_id;");

    ocrpt_expr *match = ocrpt_expr_parse(o, "q1.id = q2.boss_id",
 NULL);
    ocrpt_query_add_follower_n_to_1(q1, q2, match);

    ocrpt_expr *match2 = ocrpt_expr_parse(o, "q2.id = q3.sk_id",
 NULL);
    ocrpt_query_add_follower_n_to_1(q2, q3, match2);

    if (!ocrpt_parse_xml(o, "example6.xml")) {
        printf("XML parse error\n");
        ocrpt_free(o);
        return 0;
    }

    ocrpt_set_output_format(o, OCRPT_OUTPUT_PDF);
    ocrpt_execute(o);
    ocrpt_spool(o);
    ocrpt_free(o);

    return 0;
}}
```

13.6.3. PHP program code

Here's the equivalent program code in PHP.

```
<?php
$o = new OpenCReport();
$ds = $o->datasource_add_postgresql("pgsql", NULL, NULL, "ocrpttest",
 "ocrpt", NULL);
$q1 = $ds->query_add("q1", "select * from data order by id;");
$q2 = $ds->query_add("q2", "select * from more_data order by id;");
$q3 = $ds->query_add("q3", "select * from moar_data order by sk_id;");
```

```
$match1 = $o->expr_parse("q1.id = q2.boss_id");
$q1->add_follower_n_to_1($q2, $match1);

$match2 = $o->expr_parse("q2.id = q3.sk_id");
$q2->add_follower_n_to_1($q3, $match2);

if (!$o->parse_xml("example6.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

$o->execute();
$o->spool();
```

13.6.4. RLIB compatible PHP program code

Here's the equivalent program code in PHP, using the RLIB compatibility functions. Note that the RLIB compatible API is more limited as it expects a single field name matching.

```
<?php
$r = rlib_init();

rlib_add_datasource_postgres($r, "pgsql", "dbname=ocrpttest
 user=ocrpt");
rlib_add_query_as($r, "pgsql", "select * from data order by id;",
 "q1");
rlib_add_query_as($r, "pgsql", "select * from more_data order by id;",
 "q2");
rlib_add_query_as($r, "pgsql", "select * from moar_data order by
 sk_id;", "q3");

rlib_add_resultset_follower_n_to_1($r, "q1", "id", "q2", "boss_id");
rlib_add_resultset_follower_n_to_1($r, "q2", "id", "q3", "sk_id");

if (!rlib_add_report($r, "example6.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

rlib_execute($r);
rlib_spool($r);
```

13.6.5. Report description

The program code uses this file contents from `example6.xml`.

Note that when using multiple queries in the same report, column names may be identical. Because of this, using `queryname.columnname` will indicate which one is needed. When using `columnname` then it will mean the first query's column.

```
<?xml version="1.0"?>
<!DOCTYPE report >
<OpenCReport>
<Report orientation="landscape">
```

```
    <Detail>
        <FieldHeaders>
            <Output>
                <Line>
                    <literal width="30">Boss name</literal>
                    <literal width="1"/>
                    <literal width="30">Sidekick name</literal>
                    <literal width="1"/>
                    <literal width="30">Sidekick's sidekick name</
literal>
                </Line>
            </Output>
        </FieldHeaders>
        <FieldDetails>
            <Output>
                <Line>
                    <field value="q1.name" width="30" align="left" />
                    <literal width="1"/>
                    <field value="q2.name" width="30" align="left" />
                    <literal width="1"/>
                    <field value="q3.name" width="30" align="left" />
                </Line>
            </Output>
        </FieldDetails>
    </Detail>
</Report>
</OpenCReport>
```

13.6.6. Report PDF result

Boss name	Sidekick name	Sidekick's sidekick name
Snow White	Doc	
Snow White	Dopey	
Snow White	Sneezy	Coughy
Snow White	Sneezy	Crippley
Snow White	Happy	
Snow White	Bashful	
Snow White	Sleepy	
Snow White	Grumpy	
Batman	Robin	
Cinderella	Fairy Godmother	Prince Charming
Cinderella	Fairy Godmother	Shrek
Cinderella	Mice	
Cinderella	Pidgeons	
Hansel	Gretel	
Little Red Riding Hood		
Robin Hood	Little John	Will Scarlet
Robin Hood	Little John	Brother Tuck

Note that compared to RLIB[2], OpenCReports likely do not produce the same output. This is due to the incomplete and faulty implementation of follower queries in RLIB. OpenCReports faithfully implements `LEFT OUTER JOIN`.

13.7. N:1 follower queries (RLIB compatibility limits)

This example below exercises two N:1 (N-to-one) follower queries along with the main query. For more information, see Follower queries.

[2] https://sourceforge.net/projects/rlib/

13.7.1. Data

The same data is used as in the previous example.

The query that the RLIB compatible method for N:1 followers in this report simulates is:

```
ocrpttest=> select * from data
ocrpttest-> left outer join lateral (select * from more_data
ocrpttest->      where data.id = more_data.boss_id
ocrpttest->      order by more_data.id limit 1) x on (true)
ocrpttest-> left outer join lateral (select * from moar_data
ocrpttest->      where x.id = moar_data.sk_id
ocrpttest->      order by moar_data.sk_id limit 1) y on (true);
 id |          name          | id | boss_id |      name       | sk_id
 |      name
----+------------------------+----+---------+-----------------+-------
+-----------------
  1 | Snow White             |  1 |       1 | Doc             |
 |
  2 | Batman                 |  8 |       2 | Robin           |
 |
  3 | Cinderella             |  9 |       3 | Fairy Godmother |     9
 | Prince Charming
  4 | Hansel                 | 12 |       4 | Gretel          |
 |
  5 | Little Red Riding Hood |    |         |                 |
 |
  6 | Robin Hood             | 13 |       6 | Little John     |    13
 | Will Scarlet
(6 rows)
```

Note the amount of hoops the SQL query has to jump through to implement the `LIMIT 1` clause on both lateral derived queries that results in limiting the number of rows to the main query's number of rows.

13.7.2. C program code

The program code is identical to the previous example, except that it uses a different report XML description.

```
#include <stdio.h>
#include <opencreport.h>

int main(int argc, char **argv) {
    opencreport *o = ocrpt_init();
    ocrpt_datasource *ds = ocrpt_datasource_add_postgresql(o, "pgsql",
 NULL, NULL, "ocrpttest", "ocrpt", NULL);
    ocrpt_query *q1 = ocrpt_query_add_postgresql(ds, "q1", "select *
 from data order by id;");
    ocrpt_query *q2 = ocrpt_query_add_postgresql(ds, "q2", "select *
 from more_data order by id;");
    ocrpt_query *q3 = ocrpt_query_add_postgresql(ds, "q3", "select *
 from moar_data order by sk_id;");
```

```
   ocrpt_expr *match = ocrpt_expr_parse(o, "q1.id = q2.boss_id",
 NULL);
   ocrpt_query_add_follower_n_to_1(q1, q2, match);

   ocrpt_expr *match2 = ocrpt_expr_parse(o, "q2.id = q3.sk_id",
 NULL);
   ocrpt_query_add_follower_n_to_1(q2, q3, match2);

   if (!ocrpt_parse_xml(o, "example7.xml")) {
       printf("XML parse error\n");
       ocrpt_free(o);
       return 0;
   }

   ocrpt_set_output_format(o, OCRPT_OUTPUT_PDF);
   ocrpt_execute(o);
   ocrpt_spool(o);
   ocrpt_free(o);

   return 0;
}}
```

13.7.3. PHP program code

Here's the equivalent program code in PHP.

```
<?php
$o = new OpenCReport();
$ds = $o->datasource_add_postgresql("pgsql", NULL, NULL, "ocrpttest",
 "ocrpt", NULL);
$q1 = $ds->query_add("q1", "select * from data order by id;");
$q2 = $ds->query_add("q2", "select * from more_data order by id;");
$q3 = $ds->query_add("q3", "select * from moar_data order by sk_id;");

$match1 = $o->expr_parse("q1.id = q2.boss_id");
$q1->add_follower_n_to_1($q2, $match1);

$match2 = $o->expr_parse("q2.id = q3.sk_id");
$q2->add_follower_n_to_1($q3, $match2);

if (!$o->parse_xml("example7.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

$o->execute();
$o->spool();
```

13.7.4. RLIB compatible PHP program code

Here's the equivalent program code in PHP, using the RLIB compatibility functions. Note that the RLIB compatible API is more limited as it expects a single field name matching.

```
<?php
```

```
$r = rlib_init();

rlib_add_datasource_postgres($r, "pgsql", "dbname=ocrpttest
 user=ocrpt");
rlib_add_query_as($r, "pgsql", "select * from data order by id;",
 "q1");
rlib_add_query_as($r, "pgsql", "select * from more_data order by id;",
 "q2");
rlib_add_query_as($r, "pgsql", "select * from moar_data order by
 sk_id;", "q3");

rlib_add_resultset_follower_n_to_1($r, "q1", "id", "q2", "boss_id");
rlib_add_resultset_follower_n_to_1($r, "q2", "id", "q3", "sk_id");

if (!rlib_add_report($r, "example7.xml")) {
    echo "XML parse error" . PHP_EOL;
    exit(0);
}

rlib_execute($r);
rlib_spool($r);
```

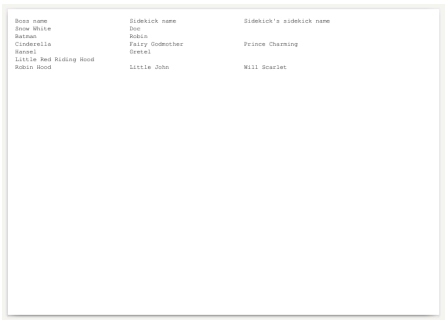
13.7.5. Report description

The program code uses this file contents from `example7.xml`. It is different in one detail from the previous example: the toplevel XML node is `<Report>` instead of `<OpenCReport>`. This results in the RLIB compatibility flag to be enabled automatically. See the Follower match single attribute or the equivalent calls in the C and PHP API documentation.

```
<?xml version="1.0"?>
<!DOCTYPE report >
<Report orientation="landscape">
    <Detail>
        <FieldHeaders>
            <Output>
                <Line>
                    <literal width="30">Boss name</literal>
                    <literal width="1"/>
                    <literal width="30">Sidekick name</literal>
                    <literal width="1"/>
                    <literal width="30">Sidekick's sidekick name</
literal>
                </Line>
            </Output>
        </FieldHeaders>
        <FieldDetails>
            <Output>
                <Line>
                    <field value="q1.name" width="30" align="left" />
                    <literal width="1"/>
                    <field value="q2.name" width="30" align="left" />
                    <literal width="1"/>
                    <field value="q3.name" width="30" align="left" />
                </Line>
```

```
            </Output>
        </FieldDetails>
    </Detail>
</Report>
```

13.7.6. Report PDF result



Boss name	Sidekick name	Sidekick's sidekick name
Snow White	Doc	
Batman	Robin	
Cinderella	Fairy Godmother	Prince Charming
Hansel	Gretel	
Little Red Riding Hood		
Robin Hood	Little John	Will Scarlet

Note that compared to RLIB[3], OpenCReports likely do not produce the same output. This is due to the incomplete and faulty implementation of follower queries in RLIB. OpenCReports faithfully implements `LEFT OUTER JOIN` with limiting the number of dependent matching rows to 1 that *approximates* the RLIB behaviour.

[3] https://sourceforge.net/projects/rlib/

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