Database Independent Abstraction Layer for C

libdbi Programmer's Guide (OUTDATED SEE README!)

David A. Parker
Neon Goat Productions

david@neongoat.com

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by David A. Parker

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libdbi implements a database-independent abstraction layer in C, similar to the DBI/DBD layer in Perl. Writing one generic set of code, programmers can leverage the power of multiple databases and multiple simultaneous database connections by using this framework.

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Chapter 1. Introduction

1.1. Description

libdbi provides application developers with a database independent abstraction layer for C. It handles the database-specific implementations for each type of database, so that you can use the same exact code with any type of database server that libdbi supports. You can initiate and use multiple database connections simultaneously, regardless of the types of database servers you are connecting to. The plugin architecture allows for new database drivers to be easily added dynamically by a third party.

1.2. libdbi Concepts and Terminology

In this guide, the terms “user” and “programmer” are used interchangably, since the target audience is the software developer using libdbi in his program. The libdbi architecture provides serveral “drivers”, one for each type of database server. All drivers are loaded into memory upon libdbi initiallization and are made available to the programmer. Once a driver is *instantiated*, it represents a distinct database session and is called a “connection”. Multiple connections may exist for a single driver, and all will function independently of each other. A star character (*) represents a wildcard matching any letters. For example, “dbi_conn_*” would represent all functions beginning with “dbi_conn_”.

1.3. Modifications and redistribution of libdbi

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1.4. Contact Info

Please email us with any bugs, ideas, feature requests, or questions. The libdbi website has the latest version of this documentation and the libdbi software, as well as a central database of third-party drivers.

- http://libdbi.sourceforge.net
- David Parker <david@neongoat.com>
- Mark Tobenkin <mark@brentwoodradio.com>

Chapter 2. libdbi in a Nutshell (Quickstart Guide)

2.1. Quick Overview

libdbi uses a plugin system that allows various databases to be supported simultaneously, and can dynamically load or unload drivers that are supplied by libdbi or a third party. The library is initiallized by calling dbi_initialize and a connection instance is started by calling either dbi_conn_new or both dbi_driver_open and dbi_conn_open.

The connection's options (username, password, hostname, etc.) are set with dbi_conn_set_option and dbi_conn_set_option_numeric. Once all options are set, dbi_conn_connect will connect to the database, waiting to handle a dbi_conn_query. After a successful query, you can retrieve rows with dbi_result_first_row, dbi_result_last_row, dbi_result_prev_row, dbi_result_next_row, and dbi_result_seek_row.

There are two methods for fetching field data, and two ways to perform each method. You can either "pull" the data from DBI using the `dbi_result_get_*` family of functions, or have DBI automatically "push" the data into predefined variables with the `dbi_result_bind_*` family of functions.

Pulling the data from the database can be done with one of the "get" functions such as dbi_result_get_long or dbi_result_get_string, which simply return the data in the field you asked for. You can also get more than one field at a time with dbi_result_get_fields, which uses a printf-like syntax.

If you want DBI to automatically fill your program's variables with field values whenever a new row is fetched, you can "bind" fields to your variables. Bindings are set up with dbi_result_bind_long, dbi_result_bind_string, and the rest of the bind family of functions. Like the associated "get" function, you can set up multiple bindings at once with the dbi_result_bind_fields function.

Caveats:

- For fields holding integers (not fractional numbers), DBI differentiates between signed and unsigned variables. By default, DBI returns signed values. If you want an unsigned value, prepend a "u" to the name of the target type. For example, dbi_result_bind_short becomes dbi_result_bind_ushort.
- You must set up any bindings AFTER a successful query but BEFORE you fetch any rows. Even if you are using field bindings, you can still use the dbi_result_get_* functions as usual. (actually, I lied... setting up a binding should theoretically work at any time, but don't plan on this behavior in future versions)
- All string and binary data returned or bound from DBI is READ-ONLY. If you want your own local copy that can be modified at will, use dbi_result_get_string_copy, dbi_result_get_binary_copy, dbi_result_bind_string_copy, or dbi_result_bind_binary_copy. You will be responsible for freeing the memory allocated by these functions.

dbi_result_next_row and the other row-seeking functions will return zero when there are no more rows available. Before the next database operation is performed, you must call dbi_result_free. Before the program terminates, the connection must be disconnected and unloaded with dbi_conn_close and libdbi must be unloaded with dbi_shutdown.

2.2. Generic Example Program

```
#include <stdio.h>
#include <dbi/dbi.h>

int main() {
    dbi_conn conn;
    dbi_result result;

    double threshold = 4.333333;
    unsigned long idnumber;
    const char *fullname;
```

```
    dbi_initialize(NULL);
    conn = dbi_conn_new("mysql");

    dbi_conn_set_option(conn, "host", "localhost");
    dbi_conn_set_option(conn, "username", "chug");
    dbi_conn_set_option(conn, "password", "dIP!");
    dbi_conn_set_option(conn, "dbname", "db_name");

    dbi_conn_connect(conn);
    result = dbi_conn_query(conn, "SELECT id, name FROM coders "
                                  "WHERE hours_of_sleep > %0.2f", threshold);

    while (dbi_result_next_row(result)) {
        idnumber = dbi_result_get_ulong(result, "id");
        fullname = dbi_result_get_string(result, "name");
        printf("%i. %s\n", idnumber, fullname);
    }

    dbi_result_free(result);
    dbi_conn_close(conn);
    dbi_shutdown();

    return 0;
}
```

Compile with: gcc -lm -ldl -ldbi -o foo foo.c

Of course, a complete program should be checking for errors. This example omits error-checking for the sake of clarity. There are also other ways to retrieve data after a successful query. Keep reading on to see the rest.

Chapter 3. libdbi API Reference

3.1. Core Library Functions

3.1.1. dbi_initialize

```
int dbi_initialize(const char *driverdir)
```

Locates all available shared modules (drivers) and loads them into memory.

Arguments

`driverdir`: The directory to search for drivers. If NULL, DBI_DRIVER_DIR (defined at compile time) will be used instead.

Returns

The number of drivers successfully loaded, or -1 if there was an error.

3.1.2. dbi_shutdown

```
void dbi_shutdown()
```

Frees all loaded drivers and terminates the DBI system. You should close each connection you opened before shutting down, but libdbi will clean up after you if you don’t.

3.1.3. dbi_version

```
const char *dbi_version()
```

Requests the version of libdbi. The calling program must not attempt to free the returned string.

Returns

A string containing the library’s name and version.

3.2. Driver Infrastructure

3.2.1. dbi_driver_list

```
dbi_driver dbi_driver_list(dbi_driver Current)
```

Enumerates all loaded drivers. If Current is NULL, the first available driver will be returned. If Current is a valid driver, the next available driver will be returned.

Arguments

`Current`: The current driver in the list of drivers.

Returns

The next available driver, or NULL if there is an error or no more are available.

3.2.2. dbi_driver_open

```
dbi_driver dbi_driver_open(const char *name)
```

Locate the driver with the specified name.

Arguments

`name`: The name of the driver to open.

Returns

The requested driver, or NULL if there is an error or it is not found.

3.2.3. dbi_driver_is_reserved_word

```
int dbi_driver_is_reserved_word(dbi_driver Driver, const char *word)
```

Looks for the specified word in the list of reserved words. The result of this function may vary between databases. Case does not matter.

Arguments

`Driver`: The target driver.

`word`: The word to check against the reserved word list.

Returns

-1 if an error occurs, 0 if the word is not reserved, 1 otherwise.

3.2.4. dbi_driver_specific_function

```
void *dbi_driver_specific_function(dbi_driver Driver, const char *name)
```

Returns a function pointer to the specifed custom function. This can be used to access database-specific functionality, but it will restrict your code to one particular database, lessening the benefits of using libdbi.

Arguments

`Driver`: The target driver.

`name`: The name of the custom function.

Returns

If the custom function is found, a pointer to that function. If not, returns NULL.

3.2.5. dbi_driver_quote_string

```
int dbi_driver_quote_string(dbi_driver Driver, char **orig)
```

Encloses the target string in the types of quotes that the database expects, and escapes any special characters. The original string will be freed and will point to a newly allocated one (which you still must free on your own).

Arguments

`Driver`: The target driver.

`orig`: A pointer to the string to quote and escape.

Returns

The new string's length.

3.2.6. Driver Information

3.2.6.1. dbi_driver_get_name

```
const char *dbi_driver_get_name(dbi_driver Driver)
```

Requests the name of the specified driver. The calling program must not attempt to free the returned string.

Arguments

`Driver`: The target driver.

Returns

A string containing the driver's name.

3.2.6.2. dbi_driver_get_filename

```
const char *dbi_driver_get_filename(dbi_driver Driver)
```

Requests the filename of the specified driver. The calling program must not attempt to free the returned string.

Arguments

`Driver`: The target driver.

Returns

A string containing the driver's full path and file name.

3.2.6.3. dbi_driver_get_description

```
const char *dbi_driver_get_description(dbi_driver Driver)
```

Requests a description of the specified driver. The calling program must not attempt to free the returned string.

Arguments

`Driver`: The target driver.

Returns

A string containing the driver's description. It will be one or two short sentences with no newlines.

3.2.6.4. dbi_driver_get_maintainer

```
const char *dbi_driver_get_maintainer(dbi_driver Driver)
```

Requests the maintainer of the specified driver. The calling program must not attempt to free the returned string.

Arguments

`Driver`: The target driver.

Returns

A string containing the driver maintainer's full name and email address.

3.2.6.5. dbi_driver_get_url

```
const char *dbi_driver_get_url(dbi_driver Driver)
```

Requests the maintainer's URL for the specified driver. This is useful for drivers maintained by a third party. The calling program must not attempt to free the returned string.

Arguments

`Driver`: The target driver.

3.2.6.6. dbi_driver_get_version

```
const char *dbi_driver_get_version(dbi_driver Driver)
```

Requests the version of the specified driver. The calling program must not attempt to free the returned string.

Arguments

`Driver`: The target driver.

Returns

A string containing the driver's version.

3.2.6.7. dbi_driver_get_date_compiled

```
const char *dbi_driver_get_date_compiled(dbi_driver Driver)
```

Requests the compilation date of the specified driver. The calling program must not attempt to free the returned string.

Arguments

`Driver`: The target driver.

Returns

A string containing the date the driver was compiled.

3.3. Connection Infrastructure

3.3.1. dbi_conn_new

```
dbi_conn dbi_conn_new(const char *name)
```

Creates a connection instance of the driver specified by "name". This is a shortcut for calling dbi_driver_open() and passing the result to dbi_conn_open().

Arguments

`name`: The name of the desired driver.

Returns

A connection instance of the specified driver, or NULL if there was an error.

3.3.2. dbi_conn_open

```
dbi_conn dbi_conn_open(dbi_driver Driver)
```

Creates a connection instance of the specified driver. This connection can be used to perform queries and set options.

Arguments

`Driver`: The target driver.

Returns

A connection instance of the specified driver, or NULL if there was an error.

3.3.3. dbi_conn_get_driver

```
dbi_driver dbi_conn_get_driver(dbi_conn Conn)
```

Returns the driver type of the specified connection.

Arguments

`Conn`: The target connection.

Returns

The driver type of the target connection.

3.3.4. dbi_conn_set_option

```
int dbi_conn_set_option(dbi_conn Conn, const char *key, char *value)
```

Sets a specified connection option to a string value.

Arguments

`Conn`: The target connection.

`key`: The name of the target setting. Must only contain alphanumerics and the underscore character.

`value`: The string value of the target setting.

Returns

-1 on error, 0 on success.

3.3.5. dbi_conn_set_option_numeric

```
int dbi_conn_set_option_numeric(dbi_conn Conn, const char *key, int value)
```

Sets a specified connection option to a numeric value.

Arguments

`Conn`: The target connection.

`key`: The name of the target setting. Must only contain alphanumerics and the underscore character.

`value`: The numeric value of the target setting.

Returns

-1 on error, 0 on success.

3.3.6. dbi_conn_get_option

```
const char *dbi_conn_get_option(dbi_conn Conn, const char *key)
```

Retrieves the string value of the specified option set for a connection.

Arguments

`Conn`: The target connection.

`key`: The name of the target setting.

Returns

A read-only string with the setting, or NULL if it is not available.

3.3.7. dbi_conn_get_option_numeric

```
int dbi_conn_get_option_numeric(dbi_conn Conn, const char *key)
```

Retrieves the integer value of the specified option set for a connection.

Arguments

`Conn`: The target connection.

`key`: The name of the target setting.

Returns

The value of the setting, or -1 if it is not available.

3.3.8. dbi_conn_get_option_list

```
const char *dbi_conn_get_option_list(dbi_conn Conn, const char *current)
```

Enumerates the list of available options for a connection. If current is NULL, the first available option will be returned. If current is a valid option name, the next available option will be returned.

Arguments

`Conn`: The target connection.

`current`: The key name of the target option.

Returns

The key name of the next option, or NULL if there was an error or there are no more options.

3.3.9. dbi_conn_clear_option

```
void dbi_conn_clear_option(dbi_conn Conn, const char *key)
```

Removes the target option setting from a connection.

Arguments

`Conn`: The target connection.

`key`: The name of the target setting.

3.3.10. dbi_conn_clear_options

```
void dbi_conn_clear_options(dbi_conn Conn)
```

Removes all option settings from a connection.

Arguments

`Conn`: The target connection.

3.3.11. dbi_conn_get_socket

```
int dbi_conn_get_socket(dbi_conn Conn)
```

Obtain the file descriptor number for the backend connection socket.

Arguments

`Conn`: The target connection

Returns

-1 on failure, the file descriptor number on success

3.3.12. dbi_conn_close

```
void dbi_conn_close(dbi_conn Conn)
```

Disconnects the specified connection connection from the database and cleans up the connection session.

Arguments

`Conn`: The target connection.

3.3.13. Error Handling

3.3.13.1. dbi_conn_error

```
int dbi_conn_error(dbi_conn Conn, const char **errmsg_dest)
```

Returns a formatted message with the error number and description resulting from the previous database operation.

Arguments

`Conn`: The target connection.

`errmsg_dest`: The target string pointer, which will point to the error message. If NULL, no error message will be created, but the error number will still be returned. This string is managed by libdbi, so it must not be modified or freed.

Returns

The error number of the most recent database operation if it resulted in an error. If not, this will return -1.

3.3.13.2. dbi_conn_error_handler

```
void dbi_conn_error_handler(dbi_conn Conn, dbi_conn_error_handler_func function, void *user_argument)
```

Registers an error handler callback to be triggered whenever the database encounters an error. The callback function should perform as little work as possible, since the state in which it is called can be uncertain. The actual function declaration must accept two parameters (and return nothing):

- dbi_conn Conn: the connection object that triggered the error, from which dbi_conn_error() can be called, and
- void *user_argument: a pointer to whatever data (if any) was registered along with the handler.

To remove the error handler callback, specify NULL as the function and user_argument.

Arguments

`Conn`: The target connection.

`function`: A pointer to the function to call when the error handler should be triggered.

`user_argument`: Any data to pass along to the function when it is triggered. Set to NULL if unused.

3.4. SQL and Database Infrastructure

3.4.1. dbi_conn_connect

```
int dbi_conn_connect(dbi_conn Conn)
```

Connects to the database using the options (host, username, password, port, (etc.) set with dbi_set_option() and dbi_set_option_numeric(). See the documentation for each specific database driver for the options it recognizes and requires.

Arguments

`Conn`: The target connection.

Returns

-1 on failure, zero on success.

3.4.2. dbi_conn_get_db_list

```
dbi_result dbi_conn_get_db_list(dbi_conn Conn, const char *pattern)
```

Queries the list of available databases on the server.

Arguments

`Conn`: The target connection.

`pattern`: A string pattern that each name must match.

Returns

A query result object, which will contain database names in the first (zeroth) field (for use with the by-index field functions).

3.4.3. dbi_conn_get_table_list

```
dbi_result dbi_conn_get_table_list(dbi_conn Conn, const char *db, const char *pattern)
```

Queries the list of available tables in a particular database.

Arguments

`Conn`: The target connection.

`db`: The target database name.

`pattern`: A string pattern that each name must match.

Returns

A query result object, which will contain table names in the first (zeroth) field (for use with the by-index field functions).

3.4.4. dbi_conn_query

```
dbi_result dbi_conn_query(dbi_conn Conn, const char *formatstr, ...)
```

Execute the specified SQL query statement.

Arguments

`Conn`: The target connection.

`formatstr`: The format string for the SQL statement. It uses the same format as printf().

`ARG`: (...) Any variables that correspond to the printf-like format string.

Returns

A query result object, or NULL if there was an error.

3.4.5. dbi_conn_query_null

```
dbi_result dbi_conn_query_null(dbi_conn Conn, const unsigned char *statement, unsigned long st_length
```

Execute the specified SQL query statement, which may contain valid NULL characters.

Arguments

`Conn`: The target connection.

`statement`: The SQL statement, which may contain binary data.

`st_length`: The number of characters in the non-null-terminated statement string.

Returns

A query result object, or NULL if there was an error.

3.4.6. dbi_conn_select_db

```
int dbi_conn_select_db(dbi_conn Conn, const char *db)
```

Switches to a different database on the server.

Arguments

`Conn`: The target connection.

`db`: The target database name.

Returns

-1 on failure, zero on success.

3.4.7. dbi_result_get_conn

```
dbi_conn dbi_result_get_conn(dbi_result Result)
```

Returns the connection belonging to the specified result object.

Arguments

`Result`: The target query result.

Returns

The connection belonging to the target query result.

3.4.8. dbi_result_free

```
int dbi_result_free(dbi_result Result)
```

Frees the result's query, disables all stored field bindings, and releases internally stored variables.

Arguments

`Result`: The target query result.

Returns

-1 on failure, zero on success.

3.4.9. dbi_result_seek_row

```
int dbi_result_seek_row(dbi_result Result, unsigned int row)
```

Jump to a specific row in a result set.

Arguments

`Result`: The target query result.

`row`: The ordinal number of the row to seek to. The first row is at position 1, not zero.

Returns

The row number that was fetched, or 0 if there is an error.

3.4.10. dbi_result_first_row

```
int dbi_result_first_row(dbi_result Result)
```

Jump to the first row in a result set.

Arguments

`Result`: The target query result.

Returns

The row number that was fetched, or 0 if there is an error.

3.4.11. dbi_result_last_row

```
int dbi_result_last_row(dbi_result Result)
```

Jump to the last row in a result set.

Arguments

`Result`: The target query result.

Returns

The row number that was fetched, or 0 if there is an error.

3.4.12. dbi_result_prev_row

```
int dbi_result_prev_row(dbi_result Result)
```

Jump to the previous row in a result set.

Arguments

`Result`: The target query result.

Returns

The row number that was fetched, or 0 if there is an error.

3.4.13. dbi_result_next_row

```
int dbi_result_next_row(dbi_result Result)
```

Jump to the next row in a result set.

Arguments

`Result`: The target query result.

Returns

The row number that was fetched, or 0 if there is an error.

3.4.14. dbi_result_get_numrows

```
unsigned int dbi_result_get_numrows(dbi_result Result)
```

Returns the number of rows in the specified result set.

Arguments

`Result`: The target query result.

Returns

The number of rows in the result set.

3.4.15. dbi_result_get_numrows_affected

```
unsigned int dbi_result_get_numrows_affected(dbi_result Result)
```

Returns the number of rows in the specified result set that were actually modified. Note that not all database servers support this, in which case it will always be zero. See the documentation for each specific driver for details.

Arguments

`Result`: The target query result.

Returns

The number of modified rows in the result set.

3.5. Retrieving field data

3.5.1. dbi_result_get_field_size

```
unsigned int dbi_result_get_field_size(dbi_result Result, const char *fieldname)
```

Returns the size in bytes of the value stored in the specified field. This is especially useful for string and binary data fields, which may have a dynamic size.

Arguments

`Result`: The target query result.

`fieldname`: The name of the target field.

Returns

The size in bytes of the target field data.

3.5.2. dbi_result_get_field_size_idx

```
unsigned int dbi_result_get_field_size_idx(dbi_result Result, unsigned int idx)
```

Returns the size in bytes of the value stored in the specified field. This is especially useful for string and binary data fields, which may have a dynamic size.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The size in bytes of the target field data.

3.5.3. dbi_result_get_field_length

```
unsigned int dbi_result_get_field_length(dbi_result Result, const char *fieldname)
```

Returns the length in bytes of the value stored in the specified field. This is always one less than the size, and is probably only useful for fields containing strings.

Arguments

`Result`: The target query result.

`fieldname`: The name of the target field.

Returns

The length in bytes of the target field data.

3.5.4. dbi_result_get_field_length_idx

```
unsigned int dbi_result_get_field_length_idx(dbi_result Result, unsigned int idx)
```

Returns the length in bytes of the value stored in the specified field. This is always one less than the size, and is probably only useful for fields containing strings.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The length in bytes of the target field data.

3.5.5. dbi_result_get_field_idx

```
int dbi_result_get_field_idx(dbi_result Result, const char *fieldname)
```

Given a field’s name, return that field’s numeric index.

Arguments

`Result`: The target query result.

`fieldname`: The name of the target field.

Returns

The index (starting at 1) of the target field.

3.5.6. dbi_result_get_field_name

```
const char *dbi_result_get_field_name(dbi_result Result, unsigned int idx)
```

Given a field's numeric index, return that field's name.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The target field's name.

3.5.7. dbi_result_get_numfields

```
unsigned int dbi_result_get_numfields(dbi_result Result)
```

Returns the number of fields in the query result.

Arguments

`Result`: The target query result.

Returns

The number of fields in the query result.

3.5.8. dbi_result_get_field_type

```
unsigned short dbi_result_get_field_type(dbi_result Result, const char *fieldname)
```

Returns the target field's data type. The constants returned by this function are defined in dbi.h with the prefix "DBI_TYPE_".

Arguments

`Result`: The target query result.

`fieldname`: The target field's name.

Returns

The target field’s data type.

3.5.9. dbi_result_get_field_type_idx

```
unsigned short dbi_result_get_field_type_idx(dbi_result Result, unsigned int idx)
```

Returns the target field’s data type. The constants returned by this function are defined in dbi.h with the prefix "DBI_TYPE_".

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The target field’s data type.

3.5.10. dbi_result_get_field_attrib

```
unsigned long dbi_result_get_field_attrib(dbi_result Result, const char *fieldname, unsigned long att
```

Returns the target field’s data type attributes in the specified range. The constants returned by this function are defined in dbi.h with the prefix "DBI_", followed by the name of the field’s datatype.

Arguments

`Result`: The target query result.

`fieldname`: The target field’s name.

`attribmin`: The first attribute value in the range of attributes to extract.

`attribmax`: The last attribute value in the range of attributes to extract. This may be the same as attribmin if you are only trying to extract a single attribute value.

Returns

The target field’s requested attribute range.

3.5.11. dbi_result_get_field_attrib_idx

```
unsigned long dbi_result_get_field_attrib_idx(dbi_result Result, unsigned int idx, unsigned long attr
```

Returns the target field’s data type attributes in the specified range. The constants returned by this function are defined in dbi.h with the prefix "DBI_", followed by the name of the field’s datatype.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

`attribmin`: The first attribute value in the range of attributes to extract.

`attribmax`: The last attribute value in the range of attributes to extract. This may be the same as attribmin if you are only trying to extract a single attribute value.

Returns

The target field's requested attribute range.

3.5.12. dbi_result_get_field_attribs

```
unsigned long dbi_result_get_field_attribs(dbi_result Result, const char *fieldname)
```

Returns the target field's data type attributes. The constants returned by this function are defined in dbi.h with the prefix "DBI_", followed by the name of the field's datatype.

Arguments

`Result`: The target query result.

`fieldname`: The target field's name.

Returns

The target field's attributes.

3.5.13. dbi_result_get_field_attribs_idx

```
unsigned long dbi_result_get_field_attribs_idx(dbi_result Result, unsigned int idx)
```

Returns the target field's data type attributes. The constants returned by this function are defined in dbi.h with the prefix "DBI_", followed by the name of the field's datatype.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The target field's attributes.

3.5.14. dbi_result_get_fields

```
int dbi_result_get_fields(dbi_result Result, const char *format, ...)
```

Fetch multiple fields from the current result set, using a printf-like syntax. The formatter string specified field names and types, and each field's associated destination variable is passed as an argument following the format string. Fields in the formatter string are separated by spaces, and follow the format `"a.%b"`, where "a" is the name of the field, and "b" is the field type specifier. Make sure you pass the destination variables' memory addresses by prepending the & operator to each variable's name.

Field type specifiers:

- `%c / %uc`: A signed/unsigned character
- `%h / %uh`: A signed/unsigned short integer
- `%l / %ul`: A signed/unsigned long integer
- `%i / %ui`: A signed/unsigned long integer
- `%L / %uL`: A signed/unsigned long long integer
- `%f`: A floating point number
- `%d`: A double-precision number
- `%s`: A read-only string
- `%S`: A local copy of a string (must be freed by program)
- `%b`: A read-only pointer to binary data
- `%B`: A local copy of binary data (must be freed by program)
- `%m`: A time_t value representing a DATE and/or TIME

Example usage: `dbi_result_get_fields(result, "idnum.%ul lastname.%s", &id_number, &name)`

Arguments

`Result`: The target query result.

`format`: The field format string as described above.

`ARG`: (...) Pointers to the destination variables corresponding with each field in the format string.

Returns

The number of fields fetched, or -1 if there was an error. If an invalid field name was specified it will not cause -1 to be returned, and the other fetched fields will work as usual.

3.5.15. dbi_result_bind_fields

```
int dbi_result_bind_fields(dbi_result Result, const char *format, ...)
```

Bind multiple fields in the current result set, using a printf-like syntax. See dbi_result_get_fields for a detailed explanation of the syntax.

Arguments

`Result`: The target query result.

`format`: The field format string as described above.

`ARG`: (...) Pointers to the destination variables corresponding with each field in the format string.

Returns

The number of field binding set up, or -1 if there was an error.

3.5.16. dbi_result_get_char

```
signed char dbi_result_get_char(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains a character.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.17. dbi_result_get_uchar

```
unsigned char dbi_result_get_uchar(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains an unsigned character.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.18. dbi_result_get_short

```
short dbi_result_get_short(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains a short integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.19. dbi_result_get_ushort

```
unsigned short dbi_result_get_ushort(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains an unsigned short integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.20. dbi_result_get_long

```
long dbi_result_get_long(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains a long integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.21. dbi_result_get_ulong

```
unsigned long dbi_result_get_ulong(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains an unsigned long integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.22. dbi_result_get_longlong

```
long long dbi_result_get_longlong(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains a long long integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.23. dbi_result_get_ulonglong

```
unsigned long long dbi_result_get_ulonglong(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains an unsigned long long integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.24. dbi_result_get_float

```
float dbi_result_get_float(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains a floating-point number.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.25. dbi_result_get_double

```
double dbi_result_get_double(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains a double-precision fractional number.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.26. dbi_result_get_string

```
const char *dbi_result_get_string(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains a string. The string may not be modified, and may not necessairly persist between row fetches.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.27. dbi_result_get_binary

```
const unsigned char *dbi_result_get_binary(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains binary BLOB data. The data may not be modified, and may not necessarily persist between row fetches.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.28. dbi_result_get_string_copy

```
char *dbi_result_get_string_copy(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains a string. The newly allocated string may be modified by the host program, but the program is responsible for freeing the string.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.29. dbi_result_get_binary_copy

```
unsigned char *dbi_result_get_binary_copy(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the speficied field, which contains binary BLOB data. The newly allocated memory may be modified by the host program, but the program is responsible for freeing the data.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.30. dbi_result_get_datetime

```
time_t dbi_result_get_datetime(dbi_result Result, const char *fieldname)
```

Fetch the data stored in the specified field, which contains a DATE and/or TIME value.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to fetch.

Returns

The data stored in the specified field.

3.5.31. dbi_result_bind_char

```
int dbi_result_bind_char(dbi_result Result, const char *fieldname, char *bindto)
```

Bind the specified variable to the specified field, which holds a character.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.32. dbi_result_bind_uchar

```
int dbi_result_bind_uchar(dbi_result Result, const char *fieldname, unsigned char *bindto)
```

Bind the specified variable to the specified field, which holds an unsigned character.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.33. dbi_result_bind_short

```
int dbi_result_bind_short(dbi_result Result, const char *fieldname, short *bindto)
```

Bind the specified variable to the specified field, which holds a short integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.34. dbi_result_bind_ushort

```
int dbi_result_bind_ushort(dbi_result Result, const char *fieldname, unsigned short *bindto)
```

Bind the specified variable to the specified field, which holds an unsigned short integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.35. dbi_result_bind_long

```
int dbi_result_bind_long(dbi_result Result, const char *fieldname, long *bindto)
```

Bind the specified variable to the specified field, which holds a long integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.36. dbi_result_bind_ulong

```
int dbi_result_bind_ulong(dbi_result Result, const char *fieldname, unsigned long *bindto)
```

Bind the specified variable to the specified field, which holds an unsigned long integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.37. dbi_result_bind_longlong

```
int dbi_result_bind_longlong(dbi_result Result, const char *fieldname, long long *bindto)
```

Bind the specified variable to the specified field, which holds a long long integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.38. dbi_result_bind_ulonglong

```
int dbi_result_bind_ulonglong(dbi_result Result, const char *fieldname, unsigned long long *bindto)
```

Bind the specified variable to the specified field, which holds an unsigned long long integer.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.39. dbi_result_bind_float

```
int dbi_result_bind_float(dbi_result Result, const char *fieldname, float *bindto)
```

Bind the specified variable to the specified field, which holds a floating-point number.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.40. dbi_result_bind_double

```
int dbi_result_bind_double(dbi_result Result, const char *fieldname, double *bindto)
```

Bind the specified variable to the specified field, which holds a double-precision fractional number.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.41. dbi_result_bind_string

```
int dbi_result_bind_string(dbi_result Result, const char *fieldname, const char **bindto)
```

Bind the specified variable to the specified field, which holds a string. The string must not be modified.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.42. dbi_result_bind_binary

```
int dbi_result_bind_binary(dbi_result Result, const char *fieldname, const unsigned char **bindto)
```

Bind the specified variable to the specified field, which holds binary BLOB data. The data must not be modified.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.43. dbi_result_bind_string_copy

```
int dbi_result_bind_string_copy(dbi_result Result, const char *fieldname, char **bindto)
```

Bind the specified variable to the specified field, which holds a string. The newly allocated string may be modified by the host program, but the program is responsible for freeing the string.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.44. dbi_result_bind_binary_copy

```
int dbi_result_bind_binary_copy(dbi_result Result, const char *fieldname, unsigned char **bindto)
```

Bind the specified variable to the specified field, which holds binary BLOB data. The newly allocated data may be modified by the host program, but the program is responsible for freeing the data.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.45. dbi_result_bind_datetime

```
int dbi_result_bind_datetime(dbi_result Result, const char *fieldname, time_t *bindto)
```

Bind the specified variable to the specified field, which holds a DATE and/or TIME value.

Arguments

`Result`: The target query result.

`fieldname`: The name of the field to bind to.

`bindto`: A pointer to the variable that will be updated with the specified field's value.

Returns

0 upon success, -1 if there was an error

3.5.46. dbi_result_get_char_idx

```
signed char dbi_result_get_char_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains a character.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.47. dbi_result_get_uchar_idx

```
unsigned char dbi_result_get_uchar_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains an unsigned character.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.48. dbi_result_get_short_idx

```
short dbi_result_get_short_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains a short integer.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.49. dbi_result_get_ushort_idx

```
unsigned short dbi_result_get_ushort_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains an unsigned short integer.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.50. dbi_result_get_long_idx

```
long dbi_result_get_long_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains a long integer.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.51. dbi_result_get_ulong_idx

```
unsigned long dbi_result_get_ulong_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains an unsigned long integer.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.52. dbi_result_get_longlong_idx

```
long long dbi_result_get_longlong_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains a long long integer.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.53. dbi_result_get_ulonglong_idx

```
unsigned long long dbi_result_get_ulonglong_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains an unsigned long long integer.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.54. dbi_result_get_float_idx

```
float dbi_result_get_float_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains a floating-point number.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.55. dbi_result_get_double_idx

```
double dbi_result_get_double_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains a double-precision fractional number.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.56. dbi_result_get_string_idx

```
const char *dbi_result_get_string_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains a string. The string may not be modified, and may not necessairly persist between row fetches.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.57. dbi_result_get_binary_idx

```
const unsigned char *dbi_result_get_binary_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains binary BLOB data. The data may not be modified, and may not necessarily persist between row fetches.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.58. dbi_result_get_string_copy_idx

```
char *dbi_result_get_string_copy_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains a string. The newly allocated string may be modified by the host program, but the program is responsible for freeing the string.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.59. dbi_result_get_binary_copy_idx

```
unsigned char *dbi_result_get_binary_copy_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the speficied field, which contains binary BLOB data. The newly allocated memory may be modified by the host program, but the program is responsible for freeing the data.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

3.5.60. dbi_result_get_datetime_idx

```
time_t dbi_result_get_datetime_idx(dbi_result Result, unsigned int idx)
```

Fetch the data stored in the specified field, which contains a DATE and/or TIME value.

Arguments

`Result`: The target query result.

`idx`: The index of the target field (starting at 1).

Returns

The data stored in the specified field.

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