

MySQL

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1 Introduction

1.1 What is SQL?

For a more general introduction see the SQL Wikibook¹.

Structured Query Language is a third generation language to query Databases. Being a 3G language it is closer to human language than machine language and therefore easier to understand and work with.

- Dr. E. F. Ted Codd who worked for IBM described a relational model for database in 1970.
- In 1992, ANSI (American National Standards Institute), the apex body, standardized most of the basic syntax.
- Its called SQL 92 and most databases (like Oracle, MySQL, Sybase, etc.) implement a subset of the standard (and proprietary extensions that makes them often incompatible).

1.2 Why MySQL?

- Free as in Freedom - Released with GPL version 2 license (though a different license can be bought from Oracle, see below)
- Cost - Free!
- Support - Online tutorials, forums, mailing list (lists.mysql.com), paid support contracts.
- Speed - One of the fastest databases available. (<http://www.mysql.com/why-mysql/benchmarks/>)
- Functionality - supports most of ANSI SQL commands.
- Ease of use - less need of training / retraining.
- Portability - easily import / export from Excel and other databases
- Scalable - Useful for both small as well as large databases containing billions of records and terabytes of data in hundreds of thousands of tables.
- Permission Control - selectively grant or revoke permissions to users.

1.2.1 The MySQL license

MySQL is available under a *dual-licensing* scheme:

- Under the GNU General Public License, version 2, ("or later" allowed in versions released before 2007): this is a Free (as in freedom), copyleft software license that allows you to use MySQL for commercial and non-commercial purposes in your application, as long as your application

¹ <http://en.wikibooks.org/wiki/SQL>

is released under the GNU GPL. There is also a "FLOSS Exception" which essentially allows non-GPL'd but Free applications (such as the PHP programming language, under the PHP license) to connect to a MySQL server. The exception lists a set of free and open-source software license that can be used in addition to the GNU GPL for your MySQL-dependent Free application.

- A so-called "commercial" ², paid license, that is, a license where MySQL grants you the right to integrate MySQL with a non-FLOSS application that you are redistributing outside your own organization. ³

1.3 MySQL and its forks

MySQL is Free Software, so some forks and unofficial builds delivering contributions from the community exist.

1.3.1 MariaDB

In 2008 Sun Microsystems bought MySQL, Sun being itself later acquired by Oracle, in 2010. After the acquisition, the development process has changed. The team has started to release new MySQL versions less frequently, so the new code is less tested. There were also less contributions from the community.

In 2009 Monty Widenius, the founder of MySQL, left the company and created a new one, called The Monty Program⁴. He started a new fork called MariaDB. The scopes of MariaDB are:

- import all the new code that will be added to the main MySQL branch, but enhancing it to make it more stable;
- clean the MySQL code;
- add contributions from the community (new plugins, new features);
- develop the Aria storage engine, formerly named Maria;
- improving the performance;
- adding new features to the server.

The license is the GNU GPLv2 (inherited from MySQL).

The primary platform for MariaDB is GNU/Linux, but also works on one proprietary system. The following Storage Engine have been added:

- Aria (also used for internal tables)
- PBXT
- XtraDB
- FederatedX
- SphinxSE
- OQGRAPH

2 Calling it "commercial" is misleading, because the GNU GPL can be used in commercial (but non-proprietary) projects.

3 Proprietary projects still can connect to a MySQL server without purchasing this license by using old versions of the MySQL client connection libraries (under the GNU Lesser General Public License). However, these libraries cannot connect to the newest versions of the MySQL server.

4 <http://www.askmonty.org/>

- Others may be added in the future.

1.3.2 Drizzle

In 2008 Brian Aker, chief architect of MySQL, left the project to start a new fork called Drizzle⁵. While Oracle initially funded the project, Drizzle is now funded by Rackspace. Its characteristics are:

- only a small part of the MySQL code has survived in this fork, the rest being removed: only essential features are implemented in the Drizzle server;
- the survived code has been cleaned;
- Drizzle is modular: many features are or can be implemented as plugins;
- the software is optimized for multiCPU and multicore 64 bit machines;
- only GNU/Linux and UNIX systems are supported.

There are no public releases of this fork, still. Its main license will be the GNU GPLv2 (inherited from MySQL), but where possible the BSD license is applied.

1.3.3 OurDelta

OurDelta⁶ is another fork, maintained by Open Query. The first branch, which has number 5.0, is based on MySQL 5.0. The 5.1 branch is based on MariaDB. OurDelta includes some patches developed by the community or by third parties. OurDelta provides packages for some GNU/Linux distributions: Debian, Ubuntu, Red Hat/CentOS. It is not available for other systems, but the source code is freely available.

1.3.4 Percona Server

Percona Server is a MySQL fork maintained by Percona. It provides the ExtraDB Storage Engine, which is a fork of InnoDB, and some patches which mainly improve the performance.

1.4 Notes

7

5 <http://www.drizzle.org/>

6 <http://ourdelta.org/>

7 <http://en.wikibooks.org/wiki/Category%3A>

2 Table types

Every table is a logical object in a database; but it also needs to physically store its data (records) on the disk and/or in memory. Tables use a Storage Engine to do this. SE are plugins which can be installed or uninstalled into the server (if they're not builtin).

Many operations are requested by the server but physically done by the SE. So, from the SE we choose for a table affects performance, stability, LOCKs type, use of the query cache, disk space required and special features.

In some future versions of MySQL, partitioned tables will be able to use different SE for different partitions.

Let's see which Storage Engine is good for which uses.

Note:

Table Type is an old term deprecated in recent versions of MySQL. It is still accepted by some SQL commands for backward compatibility, but ENGINE[s] or STORAGE ENGINE[s] should be preferred.

2.1 Storage Engines

2.1.1 MyISAM and InnoDB

MyISAM does table level locking, while InnoDB does row level locking. In addition to foreign keys, InnoDB offers transaction support, which is absolutely critical when dealing with larger applications. Speed may suffer, particularly for inserts with full transaction guarantees, because all this Foreign Key / Transaction stuff adds overhead.

The default table type for MySQL on Linux is MyISAM, on Windows, normally InnoDB. MyISAM uses table level locking, which means during an UPDATE, nobody can access any other record of the same table. InnoDB however, uses Row level locking. Row level locking ensures that during an UPDATE, nobody can access that particular row, until the locking transaction issues a COMMIT. Many people use MyISAM if they need speed and InnoDB for data integrity.

MyISAM

- **Pros**
 - Fulltext search is currently only available with MyISAM tables
 - Geometric datatypes
 - Sometimes faster reads

- All numeric key values are stored with the high byte first to allow better index compression
- Internal handling of one AUTO_INCREMENT column per table is supported. MyISAM automatically updates this column for INSERT and UPDATE operations. This makes AUTO_INCREMENT columns faster (at least 10%)
- **Cons**
 - Table (not row) level locking only
 - No foreign keys constraints (but planned for MySQL 6.x)
 - Slower table checking and restarts after power loss, an issue for those who need high availability

InnoDB

- **Pros**
 - Provides MySQL with a transaction-safe (ACID compliant) storage engine that has commit, rollback, and crash recovery capabilities
 - XA transactions
 - Foreign keys
 - Row level locking
 - Maintains its own buffer pool for caching data and indexes in main memory
 - Faster for some workloads, particularly those where physical ordering by primary key helps or where the automatically built hash indexes speed up record lookups
 - Tables can be of any size even on operating systems where file size is limited to 2GB.
 - Fast and reliable recovery from power loss.
- **Cons**
 - Data takes more space to store
 - ACID guarantee requires full sync to disk at transaction commit, can be turned off where speed is more important than full ACID guarantees.
 - Data Versioning and transactions add overhead to table management.
 - They can lead to high memory requirements to manage large numbers of locks used in row locking.
 - Indexes are slow to build when they're added after a table has been created. Indexes should therefore be created when data is bulk-loaded.

Overall, InnoDB should be used for with applications that rely highly on data integrity or need transactions, while MyISAM can be used where that is not required or where fulltext indexing is needed. Where speed is more important, both should be tried because which is faster depends on the application.

Drizzle, a MySQL's fork supported by Sun Microsystems, uses InnoDB as its default engine and doesn't support MyISAM.

2.1.2 Merge Table

Synonyms: Merge, MRG_MYISAM

- A MERGE table is a collection of identical MyISAM tables that can be used as one.
- Identical means that all tables have identical column and index information, no deviation of any sort is permitted.

```
CREATE TABLE mumbai (first_name VARCHAR(30), amount INT(10))
TYPE=MyISAM
CREATE TABLE delhi (first_name VARCHAR(30), amount INT(10))
TYPE=MyISAM
CREATE TABLE total (first_name VARCHAR(30), amount INT(10))
TYPE=MERGE UNION=(mumbai,delhi)
```

Merges can be used to work around MySQL's or system's filesize limits. In fact those limits affect single MyISAM datafiles, but don't affect the whole Merge table, which doesn't have a datafile.

In the past, in some cases Merge and MyISAM could be used to replace views, which were not supported by MySQL. Merge could be used as a base table and MyISAM tables could be used as views containing part of the base table data. A SELECT on the Merge table returned all the effective data. View support was added in MySQL 5.0, so this use of Merge tables is obsolete.

2.1.3 MEMORY / HEAP

HEAP is the name of this table type before MySQL 4.1. MEMORY is the new, preferred name.

This engine is introduced in version 3.23.

2.1.4 BDB

Synonyms: BDB, BerkleyDB

BDB has been removed from version 5.1 and later due to lack of use.

BerkeleyDB is a family of free software embeddable DBMS's developer by SleepyCat, a company which has been acquired by Oracle. SleepyCat provided a Storage Engine for MySQL called BDB.

BDB supports transactions and page-level locking, but it also has many limitations within MySQL.

2.1.5 BLACKHOLE

Discards all data stored in it but does still write to the binary log, so it is useful in replication scale-out or secure binlog-do filtering situations where slaves aren't trustworthy and for benchmarking the higher layers of the server.

2.1.6 Miscellaneous

For completeness, other storage engines include:

- CSV: simple Comma-Separated Values engine, that uses the CSV format to store data. Used to share database with other CSV-aware applications maybe? Due to the simple nature of its format, indexing is not available.
- EXAMPLE (a stub for developers)
- ISAM (for pre-3.23 backward compatibility, removed in 5.1)

2.2 Metadata about Storage Engines

You can get metadata about official MySQL Storage Engines and other Storage Engines which are present on your server, via SQL.

SHOW STORAGE ENGINES

Starting from MySQL 5.0, you can get information about the Storage Engine which you can use using the SHOW STORAGE ENGINES statement.

```
SHOW STORAGE ENGINES
```

The STORAGE word is optional. This command returns a dataset with the following columns:

- **Engine** - Name of the Storage Engine.
- **Support** - Whether the Storage Engine is supported or not. Possible values:
 - 'DEFAULT' - it's supported and it's the default engine;
 - 'YES' - supported;
 - 'DISABLED' - it has been compiled, but MySQL has been started with that engine disabled (possibly with options like --skip-engine-name);
 - 'NO' - not supported.
- **Comment** - Brief description of the engine.
- **Transactions** - Whether the engine supports SQL transactions. Added in MySQL 5.1.
- **XA** - Whether the engine supports XA transactions. Added in MySQL 5.1.
- **Savepoints** - Whether the engine supports savepoints and rollbacks. Added in MySQL 5.1.

INFORMATION_SCHEMA 'ENGINES' table

'ENGINES' is a virtual table within the INFORMATION_SCHEMA database. It can be used to get information about Storage Engines. Its columns are the same which are returned by the SHOW ENGINES statement (see above).

ENGINES has been added in MySQL 5.1.5.

HELP statement

If you want more info about an official MySQL Storage Engine, you can use the HELP command:

```
HELP 'myisam'
```

If you are using the command line client, you can omit the quotes:

```
help myisam \g
```

2.3 Changing the Storage Engine

2.3.1 SQL

When you want to create a table using a given Storage Engine, you can use the ENGINE clause in the CREATE TABLE command:

```
CREATE TABLE ... ENGINE=InnoDB
```

If the ENGINE clause is not specified, the value of the storage_engine variable will be used. By default it's MyISAM, but you can change it:

```
SET storage_engine=InnoDB
```

Or you can modify the value of default-storage-engine in the my.cnf before starting the MySQL server.

You can also change the Storage Engine of an existing table:

```
ALTER TABLE `stats` ENGINE=MyISAM
```

2.3.2 mysql_convert_table_format

mysql_convert_table_format is a tool provided with MySQL, written in Perl. It converts all the tables contained in the specified database to another Storage Engine.

The syntax is:

```
mysql_convert_table_format [options] database
```

database is the name of the database in which the program will operate. It's mandatory.

Options are:

- help** Print a help and exit.
- version** Print version number and exit.
- host=host** The host on which MySQL is running. Default: localhost.
- port=port** TCP port.
- user=user** Specify the username.
- password=password** Specify the password. As it is insecure (it's visible with the command top, for example), you can use an option file, instead.
- type=storage_engine** The storage engine that the tables will use after conversion.

--force Don't stop the execution if an error occurs.

--verbose Print detailed information about the conversions.

Example:

```
mysql_convert_table_format --host=localhost --user=root
--password=xyz970 --force --type=InnoDB test
```

This command specifies access data (localhost, username, password) and converts all tables within database 'test' into InnoDB. If some tables can't be converted, the script skips them and converts the others (--force).

¹ *Italic text*

=Browsing the databases

The following SQL commands provide information about the databases located on the current server. The INFORMATION_SCHEMA table containing this information is SCHEMATA.

The mysqlshow command line tool can be used instead.

You can't show databases if the server has been started with the --skip-all-databases option.

If you don't have the 'SHOW DATABASES' privilege, you'll only see databases on which you have some permissions.

2.4 List databases

Show all databases:

```
SHOW DATABASES;
```

The SCHEMA keywords can be used in place of DATABASES. MySQL doesn't support standard SQL SCHEMAs, so SCHEMA is a synonym of database. It has been added for compatibility with other DBMSs.

2.4.1 Add a filter on the databases names

```
SHOW DATABASES LIKE 'pattern';
```

The LIKE operator here works as in normal SELECTs or DML statements. So you can list all databases whose name starts with 'my':

```
SHOW DATABASES LIKE 'my%';
```

¹ <http://en.wikibooks.org/wiki/Category%3A>

2.4.2 Add complex filters

You can add more complex filters using the WHERE clause:

```
SHOW DATABASES WHERE conditions;
```

WHERE clause allows you to use regular expressions, '<' and '>' operators, string functions or other useful expressions to filter the records returned by SHOW DATABASES.

2.5 List tables and views

The following SQL commands provide information about the tables and views contained in a database. The INFORMATION_SCHEMA tables containing this information are 'TABLES' and 'VIEWS'.

Since the following statements provide very little information about views, if you need to get metadata about them you'll probably prefer to query the VIEWS table.

The mysqlshow command line tool can be used instead.

2.5.1 Show all tables

```
USE `database`;  
SHOW TABLES;
```

```
SHOW TABLES FROM `database`;
```

The 2 forms shown above are equivalent.

2.5.2 Apply a filter

You can apply a filter to the tables names, to show only tables whose name match a pattern. You can use the LIKE operators, as you do in SELECTs or in the DML statements:

```
SHOW TABLES LIKE `pattern`;
```

Also, you can apply a more complex filter to any column returned by the SHOW TABLES command using the WHERE clause:

```
SHOW TABLES WHERE condition;
```

(see below)

2.5.3 Extra info

By default, SHOW TABLES returns only one column containing the name of the table. You can get extra information by using the FULL keyword:

```
SHOW FULL TABLES;
```

This will add a column called 'Table_type'. This can have 3 values: 'BASE TABLE' for tables, 'VIEW' for views and 'SYSTEM VIEW' for special tables created by the server (normally used only INFORMATION_SCHEMA tables).

So you can only list tables:

```
SHOW FULL TABLES WHERE `Table_type`='BASE TABLE';
```

Or, you can only list views:

```
SHOW FULL TABLES WHERE `Table_type`='VIEW';
```

2.5.4 Show only open tables

You can get a list of the non-temporary tables (not views) which are open in the cache:

```
SHOW OPEN TABLES;
```

This command has the same parameters as SHOW TABLES, except for FULL (useless in this case). You can't get this information from the INFORMATION_SCHEMA.

2.6 List fields

The following SQL commands provide information about the columns in a table or in a view. The INFORMATION_SCHEMA table containing this information is COLUMNS.

The mysqlshow command line tool can be used instead.

2.6.1 DESCRIBE

```
DESCRIBE `table`;  
DESCRIBE `database`.`table`;  
DESCRIBE `table` 'filter';
```

DESC can be used as a shortcut for DESCRIBE.

'filter' can be a column name. If a column name is specified, only that column will be shown. If 'filter' contains the '%' or the '_' characters, it will be evaluated as a LIKE condition. For example, you can list all fields which start with 'my':

```
DESC `table` 'my%';
```

2.6.2 SHOW COLUMNS

```
EXPLAIN `table`; --synonym
SHOW [FULL] FIELDS FROM `table`; -- synonym
SHOW COLUMNS FROM `table`; --synonym
SHOW COLUMNS FROM `table` FROM `database`;
SHOW COLUMNS FROM `table` LIKE 'pattern';
SHOW COLUMNS FROM `table` WHERE condition;
```

FIELDS and COLUMNS are synonyms. EXPLAIN is a synonym of SHOW COLUMNS / FIELDS too, but it doesn't support all of its clauses.

A databases name can be specified both in the form

```
SHOW COLUMNS FROM `table` FROM `database`;
```

both:

```
SHOW COLUMNS FROM `database`.`table`;
```

2.6.3 Extra info

Using the FULL keyword, extra info can be retrieved: the columns' collation, privileges you have on the column and the comment.

2.7 List indexes

The following SQL commands provide information about the indexes in a table. Information about keys is contained in the 'COLUMNS' table in the INFORMATION_SCHEMA.

The mysqlshow -k command line tool can be used instead.

```
SHOW INDEX FROM `TABLE`;
SHOW INDEX FROM `TABLE` FROM `databases`;
```

The KEYS reserved word can be used as a synonym of INDEX. No other clauses are provided.

2.8 INFORMATION_SCHEMA

`information_schema` is a virtual database provided by MySQL 5 and later, that contains metadata about the server and the databases.

You can't modify structure and data of `information_schema`. You can only query the tables.

Many `information_schema` tables provide the same data you can retrieve with a `SHOW` statement. While using `SHOW` commands is faster (the server responds much faster and you type less characters), the `information_schema` provides a more flexible way to obtain and organize the metadata.

3 Specifying table names

In this book, we will quote the MySQL identifiers (tables names, fields, databases, etc.) using backquotes (` `).

Backquote is ASCII 96. It can be type on Linux systems by pressing: ALT+'.

Most often, this is optional. However, this allows better error messages from MySQL. For example, this error is not very helpful:

```
mysql> SELECT user_id, group_id FROM user,group LIMIT 1;
ERROR 1064 (42000): You have an error in your SQL syntax;
check the manual that corresponds to your MySQL server version
for the right syntax to use near 'group LIMIT 1' at line 1
```

But this one is better:

```
mysql> SELECT user_id, group_id FROM `user`,`group` LIMIT 1;
ERROR 1146 (42S02): Table 'savannah.group' doesn't exist
```

Ok, it was just a missing s:

```
mysql> SELECT user_id, group_id FROM `user`,`groups` LIMIT 1;
+-----+-----+
| user_id | group_id |
+-----+-----+
|      100 |          2 |
+-----+-----+
1 row in set (0.02 sec)
```

This syntax allows the user to use reserved words and some illegal characters in objects' names. It is even possible to use backquotes by typing it twice:

```
RENAME TABLE `user` TO ``
```

However, this is not a portable syntax. The SQL standard recommends the use of a double quote ("). If you want to write portable SQL quote, do not quote the identifiers. But is there something like portable SQL, even remotely?

4 Definitions

- DDL (Data Definition Language) refers to the CREATE, ALTER and DROP statements

DDL allows to add / modify / delete the logical structures which contain the data or which allow users to access / maintain the data (databases, tables, keys, views...). DDL is about "metadata".

- DML (Data Manipulation Language) refers to the INSERT, UPDATE and DELETE statements

DML allows to add / modify / delete data itself.

- DQL (Data Query Language) refers to the SELECT, SHOW and HELP statements (queries)

SELECT is the main DQL instruction. It retrieves data you need. SHOW retrieves infos about the metadata. HELP... is for people who need help.

- DCL (Data Control Language) refers to the GRANT and REVOKE statements

DCL is used to grant / revoke permissions on databases and their contents. DCL is simple, but MySQL's permissions are rather complex. DCL is about security.

5 User Variables

5.1 Session Variables

- The ability to set variables in a statement with the := assignment operator:
- For e.g. (@total) to calculate the total in an example, you have to have the total column first because it must be calculated before the individual percentage calculations
- Session variables are set for the duration of the thread.
- In the vast majority of cases you'd use a programming language to do this sort of thing.
- Mysql variables can be useful when working on the Mysql command line.
- If no records are returned, the user variable will not be set for that statement.
- A user variable set in the field list cannot be used as a condition.
- The value of a variable is set with the SET statement or in a SELECT statement with :=

```
select @test := 2;
select @test + 1

set @startdate='some_start_date', @enddate='some_end_date'

SELECT @toremember:=count(*) FROM mempros;

select @numzero := count(*) from table1 where field=0;
select @numdistinct := count(distinct field) from table1 where field
<> 0 ;
select @numzero @numdistinct;
```

- You can copy values retrieved by a SELECT into one or more variables:

```
SELECT INTO
```

5.2 Global Variables

A global variable is visible to all users, it allows to modify the configuration files settings during the session or definitely. So when changing them, it's necessary to precise this permanent or ephemera criteria, with respectively *set global* and *set session*. Example:

```
mysql> set @@global.max_connections = 1000;
mysql> show global variables like 'wait_timeout';
+-----+-----+
| Variable_name | Value |
+-----+-----+
| wait_timeout  | 60    |
+-----+-----+
1 row in set (0.00 sec)
mysql> set @@session.wait_timeout=120;
```


6 Alias

An expression and a column may be given aliases using AS. The alias is used as the expression's column name and can be used with order by or having clauses. For e.g.

```
SELECT
    CONCAT(last_name,' ', first_name) AS full_name,
    nickname AS nick
FROM
    mytable
ORDER BY
    full_name
```

These aliases can be used in ORDER BY, GROUP BY and HAVING clauses. They should not be used in WHERE clause.

A table name can have a shorter name for reference using AS. You can omit the AS word and still use aliasing. For e.g.

```
SELECT
    COUNT(B.Booking_ID), U.User_Location
FROM
    Users U
LEFT OUTER JOIN
    Bookings AS B
ON
    U.User_ID = B.Rep_ID AND
    B.Project_ID = '10'
GROUP BY
    (U.User_Location)
```

Aliasing plays a crucial role while you are using self joins. For e.g. people table has been referred to as p and c aliases!

```
SELECT
    p.name AS parent,
    c.name AS child,
    MIN((TO_DAYS(NOW())-TO_DAYS(c.dob))/365) AS minage
FROM
    people AS p
LEFT JOIN
    people AS c
ON
    p.name=c.parent WHERE c.name IS NOT NULL
GROUP BY
    parent HAVING minage > 50 ORDER BY p.dob;
```


7 Queries

7.1 SELECT

select syntax is as follows:

```
SELECT *  
FROM table  
WHERE condition  
GROUP BY grouping field  
HAVING group condition  
ORDER BY order  
LIMIT limit, offset
```

7.1.1 List of fields

You must specify what data you're going to retrieve in the SELECT clause:

```
SELECT DATABASE() -- returns the current db's name  
SELECT CURRENT_USER() -- returns your username  
SELECT 1+1 -- returns 2
```

Any SQL expression is allowed here.

You can also retrieve all fields from a table:

```
SELECT * FROM `stats`
```

If you SELECT only the necessary fields, the query will be faster.

7.1.2 The table's name

If you are retrieving results from a table or a view, usually you specify the table's name in the FROM clause:

```
SELECT id FROM `stats` -- retrieve a field called id from a table  
called stats
```

Or:

```
SELECT MAX(id) FROM `stats`  
SELECT id*2 FROM `stats`
```

You can also use the `'db_name'.'table_name'` syntax:

```
SELECT id FROM `sitedb`.`stats`
```

But you can also specify the table's name in the `SELECT` clause:

```
SELECT `stats`.`id` -- retrieve a field called id from a table  
SELECT `sitedb`.`stats`.`id`
```

7.1.3 WHERE

You can set a filter to decide what records must be retrieved.

For example, you can retrieve only the record which has an id of 42:

```
SELECT * FROM `stats` WHERE `id`=42
```

Or you can read more than one record:

```
SELECT * FROM `antiques` WHERE buyerid IS NOT NULL
```

7.1.4 GROUP BY

You can group all records by one or more fields. The records which have the same value for that field will be grouped in one computed record. You can only select the grouped record and the result of some aggregate functions, which will be computed on all records of each group.

For example, the following will group all records in the table `'users'` by the field `'city'`. For each group of users living in the same city, the maximum age, the minimum age and the average age will be returned:

```
SELECT city, MAX(age), MIN(age), AVG(age) GROUP BY `city`
```

In the following example, the users are grouped by city and sex, so that we'll know the max, min and avg age of male/female users in each city:

```
SELECT city, sex, MAX(age), MIN(age), AVG(age) GROUP BY `city`,  
`sex`
```

7.1.5 HAVING

The HAVING clause declares a filter for the records which are computed by the GROUP BY clause. It's different from the WHERE clause, that operates before the GROUP BY. Here's what happens:

1. The records which match to the WHERE clause are retrieved
2. Those records are used to compute new records as defined in the GROUP BY clause
3. The new records that match to the HAVING conditions are returned

This means which WHERE decides what record are used to compose the new computed records.

HAVING decides what computed records are returned, so it can operate on the results of aggregate functions. HAVING is not optimized and can't use indexes.

Incorrect use of HAVING:

```
SELECT city, sex, MAX(age), MIN(age), AVG(age) GROUP BY `city`  
HAVING sex='m'
```

This probably gives a wrong results. MAX(age) and other aggregate calculations are made using all values, even if the record's sex value is 'f'. This is hardly the expected result.

Incorrect use of HAVING:

```
SELECT city, sex, MAX(age), MIN(age), AVG(age) GROUP BY `city`,  
`sex` HAVING sex='m'
```

This is correct and returns the expected results, but the execution of this query is not optimized. The WHERE clause can and should be used, because, so that MySQL doesn't computes records which are excluded later.

Correct use of HAVING:

```
SELECT city, sex, MAX(age), MIN(age), AVG(age) GROUP BY `city`  
HAVING MAX(age) > 80
```

It must group all records, because can't decide the max age of each city before the GROUP BY clause is execute. Later, it returns only the record with a MAX(age)>80.

7.1.6 ORDER BY

You can set an arbitrary order for the records you retrieve. The order may be alphabetical or numeric.

```
SELECT * FROM `stats` ORDER BY `id`
```

By default, the order is ASCENDING. You can also specify that the order must be DESCENDING:

Queries

```
SELECT * FROM `stats` ORDER BY `id` ASC -- default
SELECT * FROM `stats` ORDER BY `id` DESC -- inverted
```

NULLs values are considered as minor than any other value.

You can also specify the field position, in place of the field name:

```
SELECT `name`, `buyerid` FROM `antiques` ORDER BY 1 -- name
SELECT `name`, `buyerid` FROM `antiques` ORDER BY 2 -- buyerid
SELECT `name`, `buyerid` FROM `antiques` ORDER BY 1 DESC
```

SQL expressions are allowed:

```
SELECT `name` FROM `antiques` ORDER BY REVERSE(`name`)
```

You can retrieve records in a random order:

```
SELECT `name` FROM `antiques` ORDER BY RAND()
```

If a **GROUP BY** clause is specified, the results are ordered by the fields named in **GROUP BY**, unless an **ORDER BY** clause is present. You can even specify in the **GROUP BY** clause if the order must be ascending or descending:

```
SELECT city, sex, MAX(age) GROUP BY `city` ASC, `sex` DESC
```

If you have a **GROUP BY** but you don't want the records to be ordered, you can use **ORDER BY NULL**:

```
SELECT city, sex, MAX(age) GROUP BY `city`, `sex` ORDER BY NULL
```

7.1.7 LIMIT

You can specify the maximum of rows that you want to read:

```
SELECT * FROM `antiques` ORDER BY id LIMIT 10
```

This statement returns a maximum of 10 rows. If there are less than 10 rows, it returns the number of rows found. The limit clause is usually used with **ORDER BY**.

You can get a given number of random records:


```
SELECT * FROM `antiques` ORDER BY rand() LIMIT 1 -- one random
record
SELECT * FROM `antiques` ORDER BY rand() LIMIT 3
```

You can specify how many rows should be skipped before starting to return the records found. The first record is 0, not one:

```
SELECT * FROM `antiques` ORDER BY id LIMIT 10
SELECT * FROM `antiques` ORDER BY id LIMIT 0, 10 -- synonym
```

You can use the LIMIT clause to get the pagination of results:

```
SELECT * FROM `antiques` ORDER BY id LIMIT 0, 10 -- first page
SELECT * FROM `antiques` ORDER BY id LIMIT 10, 10 -- second page
SELECT * FROM `antiques` ORDER BY id LIMIT 20, 10 -- third page
```

Also, the following syntax is acceptable:

```
SELECT * FROM `antiques` ORDER BY id LIMIT 10 OFFSET 10
```

You can use the LIMIT clause to check the syntax of a query without waiting for it to return the results:

```
SELECT ... LIMIT 0
```

Optimization tips:

- `SQL_CALC_FOUND_ROWS` may speed up a query ¹²
- LIMIT is particularly useful for SELECTs which use ORDER BY, DISTINCT and GROUP BY, because their calculations don't have to involve all the rows.
- If the query is resolved by the server copying internally the results into a temporary table, LIMIT helps MySQL to calculate how much memory is required by the table.

7.1.8 DISTINCT

The DISTINCT keyword can be used to remove all duplicate rows from the resultset:

```
SELECT DISTINCT * FROM `stats` -- no duplicate rows
SELECT DISTINCTROW * FROM `stats` -- synonym
SELECT ALL * FROM `stats` -- duplicate rows returned (default)
```

You can use it to get the list of all values contained in one field:

- 1 http://www.mysqlperformanceblog.com/2007/08/28/to-sql_calc_found_rows-or-not-to-sql_calc_found_rows/
- 2 <http://dev.mysql.com/doc/refman/5.0/en/information-functions.html>

```
SELECT DISTINCT `type` FROM `antiques` ORDER BY `type`
```

Or you can use it to get the existing combinations of some values:

```
SELECT DISTINCT `type`, `age` FROM `antiques` ORDER BY `type`
```

If one of the fields you are SELECTing is the PRIMARY KEY or has a UNIQUE index, DISTINCT is useless. Also, it's useless to use DISTINCT in conjunction with the GROUP BY clause.

7.1.9 IN and NOT IN

```
SELECT id
FROM stats
WHERE position IN ('Manager', 'Staff')
```

```
SELECT ownerid, 'is in both orders & antiques'
FROM orders, antiques WHERE ownerid = buyerid
UNION
SELECT buyerid, 'is in antiques only'
FROM antiques WHERE buyerid NOT IN (SELECT ownerid FROM orders)
```

7.1.10 EXISTS and ALL

(Compatible: Mysql 4+)

```
SELECT ownerfirstname, ownerlastname
FROM owner
WHERE EXISTS (SELECT * FROM antiques WHERE item = 'chair')
```

```
SELECT buyerid, item
FROM antiques
WHERE price = ALL (SELECT price FROM antiques)
```

7.1.11 Optimization hints

There are some hints you may want to give to the server to better optimize the SELECTs. If you give more than one hints, the order of the keywords is important:

```
SELECT [ALL | DISTINCT | DISTINCTROW ]
      [HIGH_PRIORITY] [STRAIGHT_JOIN]
      [SQL_SMALL_RESULT | SQL_BIG_RESULT] [SQL_BUFFER_RESULT]
      [SQL_CACHE | SQL_NO_CACHE] [SQL_CALC_FOUND_ROWS]
      ...
```

HIGH_PRIORITY

Usually, DML commands (INSERT, DELETE, UPDATE) have higher priority than SELECTs. If you specify HIGH_PRIORITY though, the SELECT will have higher priority than DML statements.

STRAIGHT_JOIN Force MySQL to evaluate the tables of a JOIN in the same order they are named, from the leftmost.

SQL_SMALL_RESULT It's useful only while using DISTINCT or GROUP BY. Tells the optimizer that the query will return few rows.

SQL_BIG_RESULT It's useful only while using DISTINCT or GROUP BY. Tells the optimizer that the query will return a many rows.

SQL_BUFFER_RESULT Force MySQL to copy the result into a temporary table. This is useful to remove LOCKs as soon as possible.

SQL_CACHE Forces MySQL to copy the result into the query cache. Only works if the value of query_cache_type is DEMAND or 2.

SQL_NO_CACHE Tells MySQL not to cache the result. Useful if the query occurs very seldom or if the result often change.

SQL_CALC_FOUND_ROWS Useful if you are using the LIMIT clause. Tells the server to calculate how many rows would have been returned if there were no LIMIT. You can retrieve that number with another query:

```
SELECT SQL_CALC_FOUND_ROWS * FROM `stats` LIMIT 10 OFFSET 100;
SELECT FOUND_ROWS();
```

7.1.12 UNION and UNION ALL

(Compatible: Mysql 4+)

Following query will return all the records from both tables.

```
SELECT * FROM english
UNION ALL
SELECT * FROM hindi
```

UNION is the same as UNION DISTINCT.

If you type only UNION, then it is considered that you are asking for distinct records. If you want all records, you have to use UNION ALL.

```
SELECT word FROM word_table WHERE id = 1
UNION
SELECT word FROM word_table WHERE id = 2
```

```
(SELECT magazine FROM pages)
UNION DISTINCT
```

```
(SELECT magazine FROM pdflog)
ORDER BY magazine
```

```
(SELECT ID_ENTRY FROM table WHERE ID_AGE = 1)
UNION DISTINCT
(SELECT ID_ENTRY FROM table WHERE ID_AGE=2)
```

7.2 Joins

The Most important aspect of SQL is its relational features. You can query, compare and calculate two different tables having entirely different structure. Joins and subselects are the two methods to join tables. Both methods of joining tables should give the same results. The natural join is faster on most SQL platforms.

In the following example a student is trying to learn what the numbers are called in hindi.

```
CREATE TABLE english (Tag int, Inenglish varchar(255));
CREATE TABLE hindi (Tag int, Inhindi varchar(255));
```

```
INSERT INTO english (Tag, Inenglish) VALUES (1, 'One');
INSERT INTO english (Tag, Inenglish) VALUES (2, 'Two');
INSERT INTO english (Tag, Inenglish) VALUES (3, 'Three');
```

```
INSERT INTO hindi (Tag, Inhindi) VALUES (2, 'Do');
INSERT INTO hindi (Tag, Inhindi) VALUES (3, 'Teen');
INSERT INTO hindi (Tag, Inhindi) VALUES (4, 'Char');
```

	select * from english		select * from hindi
Tag	Inenglish	Tag	Inhindi
1	One	2	Do
2	Two	3	Teen
3	Three	4	Char

7.2.1 Cartesian join (CROSS JOIN)

A Cartesian join is when you join every row of one table to every row of another table.

```
SELECT * FROM english, hindi
```

It is also called Cross Join and may be written in this way:

```
SELECT * FROM english CROSS JOIN hindi
```

Tag	Inenglish	Tag	Inhindi
-----	-----------	-----	---------

1	One	2	Do
2	Two	2	Do
3	Three	2	Do
1	One	3	Teen
2	Two	3	Teen
3	Three	3	Teen
1	One	4	Char
2	Two	4	Char
3	Three	4	Char

7.2.2 Inner Join

```
SELECT hindi.Tag, english.Inenglish, hindi.Inhindi
FROM english, hindi
WHERE english.Tag = hindi.Tag
```

Tag	Inenglish	Inhindi
2	Two	Do
3	Three	Teen

You can also write the same query as

```
SELECT hindi.Tag, english.Inenglish, hindi.Inhindi
FROM english INNER JOIN hindi
ON english.Tag = hindi.Tag
```

Natural Joins using "using" (Compatible: MySQL 4+; but changed in MySQL 5) The following statement using "USING" method will display the same results.

```
SELECT hindi.tag, hindi.Inhindi, english.Inenglish
FROM hindi NATURAL JOIN english
USING (Tag)
```

7.2.3 Outer Joins

Tag	Inenglish	Tag	Inhindi
1	One		
2	Two	2	Do
3	Three	3	Teen
		4	Char

7.2.4 LEFT JOIN / LEFT OUTER JOIN

The syntax is as follows:

```
SELECT field1, field2 FROM table1 LEFT JOIN table2 ON field1=field2
```

```
SELECT e.Inenglish as English, e.Tag, '--no row--' as Hindi
FROM english AS e LEFT JOIN hindi AS h
ON e.Tag=h.Tag
WHERE h.Inhindi IS NULL
```

```
English tag Hindi
One 1 --no row-
```

7.2.5 Right Outer Join

```
SELECT '--no row--' AS English, h.tag, h.Inhindi AS Hindi
FROM english AS e RIGHT JOIN hindi AS h
ON e.Tag=h.Tag
WHERE e.Inenglish IS NULL
```

English tag Hindi --no row-- 4 Char

- Make sure that you have the same name and same data type in both tables.
- The keywords LEFT and RIGHT are not absolute, they only operate within the context of the given statement: we can reverse the order of the tables and reverse the keywords, and the result would be the same.
- If the type of join is not specified as inner or outer then it will be executed as an INNER JOIN.

7.2.6 Full Outer Join

As for v5.1, MySQL does not provide FULL OUTER JOIN. You may emulate it this way:

```
(SELECT a.*, b*
FROM tab1 a LEFT JOIN tab2 b
ON a.id = b.id)
UNION
(SELECT a.*, b*
FROM tab1 a RIGHT JOIN tab2 b
ON a.id = b.id)
```

7.2.7 Multiple joins

It is possible to join more than just two tables:

```
SELECT ... FROM a JOIN (b JOIN c on b.id=c.id) ON a.id=b.id
```

Here is an example from *Savane*:

```
mysql> SELECT group_type.type_id, group_type.name,
COUNT(people_job.job_id) AS count
FROM group_type
JOIN (groups JOIN people_job ON groups.group_id =
people_job.group_id)
ON group_type.type_id = groups.type_id
GROUP BY type_id ORDER BY type_id
```

type_id	name	count
1	Official GNU software	148
2	non-GNU software and documentation	268
3	www.gnu.org portion	4
6	www.gnu.org translation team	5

```
4 rows in set (0.02 sec)
```

7.3 Subqueries

(Compatible: Mysql 4.1 and later...***Bold text***)

- SQL subqueries let you use the results of one query as part of another query.
- Subqueries are often natural ways of writing a statement.
- Let you break a query into pieces and assemble it.
- Allow some queries that otherwise can't be constructed. Without using a subquery, you have to do it in two steps.
- Subqueries always appear as part of the WHERE (or HAVING) clause.
- Only one field can be in the subquery SELECT. It means Subquery can only produce a single column of data as its result.
- ORDER BY is not allowed; it would not make sense.
- Usually refer to name of a main table column in the subquery.
- This defines the current row of the main table for which the subquery is being run. This is called an outer reference.

For e.g. If RepOffice= OfficeNbr from Offices table, list the offices where the sales quota for the office exceeds the sum of individual salespersons' quotas

```
SELECT City FROM Offices WHERE Target > ???
```

??? is the sum of the quotas of the salespeople, i.e.

```
SELECT SUM(Quota)
FROM SalesReps
WHERE RepOffice = OfficeNbr
```

We combine these to get

```
SELECT City FROM Offices
WHERE Target > (SELECT SUM(Quota) FROM SalesReps
WHERE RepOffice = OfficeNbr)
```

Display all customers with orders or credit limits > \$50,000. Use the DISTINCT word to list the customer just once.

```
SELECT DISTINCT CustNbr
FROM Customers, Orders
WHERE CustNbr = Cust AND (CreditLimit>50000 OR Amt>50000);
```

7.4 References

7.5 Resources

- Official MySQL documentation³

³ <http://dev.mysql.com/doc>

8 Data manipulation

8.1 INSERT

The syntax is as follows:

Insert value1 into Column1, value2 into Column2, and value3 into Column3:

```
INSERT INTO TableName (Column1, Column2, Column3)
VALUES (value1, value2, value3)
```

Insert one record (values are inserted in the order that the columns appear in the database):

```
INSERT INTO TableName
VALUES (value1, value2, value3)
```

Insert two records:

```
INSERT INTO TableName
VALUES (value1, value2, value3), (value4, value5, value6)
```

```
INSERT INTO antiques VALUES (21, 01, 'Ottoman', 200.00);
INSERT INTO antiques (buyerid, sellerid, item) VALUES (01, 21,
'Ottoman');
```

You can also insert records 'selected' from other table.

```
INSERT INTO table1(field1, field2)
SELECT field1, field2
FROM table2
```

```
INSERT INTO World_Events SELECT * FROM National_Events
```

Performance tips:

- To insert many rows, consider using LOAD DATA INFILE instead.
- If bulk INSERTs are too slow and they operate on indexed non-empty tables, maybe you should increase the value of bulk_insert_buffer_size.
- Before performing bulk inserts, you may want to disable the keys.
- LOCKing a table also speeds up the INSERT.

8.2 UPDATE

The syntax is:

```
UPDATE table SET field = newvalue WHERE criteria ORDER BY field
LIMIT n
```

Examples are:

```
UPDATE owner SET ownerfirstname = 'John'
  WHERE ownerid = (SELECT buyerid FROM antiques WHERE item =
'Bookcase');

UPDATE antiques SET price = 500.00 WHERE item = 'Chair';

UPDATE order SET discount=discount * 1.05

UPDATE tbl1 JOIN tbl2 ON tbl1.ID = tbl2.ID
  SET tbl1.col1 = tbl1.col1 + 1
  WHERE tbl2.status='Active'

UPDATE tbl SET names = REPLACE(names, 'aaa', 'zzz')

UPDATE products_categories AS pc
  INNER JOIN products AS p ON pc.prod_id = p.id
  SET pc.prod_sequential_id = p.sequential_id

UPDATE table_name SET col_name =
  REPLACE(col_name, 'host.domain.com', 'host2.domain.com')
```

```
UPDATE posts SET deleted=True
  ORDER BY date LIMIT 1
```

With **ORDER BY** you can order the rows before updating them, and only update a given number of rows (**LIMIT**).

It is currently not possible to update a table while performing a subquery on the same table. For example, if I want to reset a password I forgot in SPIP:

```
mysql> UPDATE spip_auteurs SET pass =
  (SELECT pass FROM spip_auteurs WHERE login='paul') where
login='admin';
ERROR 1093 (HY000): You can't specify target table 'spip_auteurs'
for update in FROM clause
```

TODO: <http://www.xaprb.com/blog/2006/06/23/how-to-select-from-an-update-target> describes a work-around that I couldn't make to work with MySQL 4.1. Currently the work-around is not use 2 subqueries, possibly with transactions.

Performance tips

- UPDATES speed depends of how many indexes are updated.

- If you UPDATE a MyISAM table which uses dynamic format, if you make rows larger they could be splitted in more than one part. This causes reading overhead. So, if your applications often do this, you may want to regularly run an OPTIMIZE TABLE statement.
- Performing many UPDATES all together on a LOCKed table is faster than performing them individually.

8.3 REPLACE

REPLACE works exactly like INSERT, except that if an old record in the table has the same value as a new record for a PRIMARY KEY or a UNIQUE index, the old record is deleted before the new record is inserted.

With IGNORE, invalid values are adjusted to the closest values and inserted; warnings are produced but the statement does not abort.

Prior to MySQL 4.0.1, INSERT ... SELECT implicitly operates in IGNORE mode. As of MySQL 4.0.1, specify IGNORE explicitly to ignore records that would cause duplicate-key violations.

8.4 DELETE and TRUNCATE

```
DELETE [QUICK] FROM `table1`
TRUNCATE [TABLE] `table1`
```

- If you don't use a WHERE clause with DELETE, all records will be deleted.
- It can be very slow in a large table, especially if the table has many indexes.
- If the table has many indexes, you can make the cache larger to try making the DELETE faster (key_buffer_size variable).
- For indexed MyISAM tables, in some cases DELETES are faster if you specify the QUICK keyword (DELETE QUICK FROM ...). This is only useful for tables where DELETED index values will be reused.
- TRUNCATE will delete all rows quickly by DROPPing and reCREATE-ing the table (not all Storage Engines support this operation).
- TRUNCATE is not transaction-safe nor lock-safe.
- DELETE informs you how many rows have been removed, but TRUNCATE doesn't.
- After DELETing many rows (about 30%), an OPTIMIZE TABLE command should make next statements faster.
- For a InnoDB table with FOREIGN KEYs constraints, TRUNCATE behaves like DELETE.

```
DELETE FROM `antiques`
WHERE item = 'Ottoman'
ORDER BY `id`
LIMIT 1
```

You can order the rows before deleting them, and then delete only a given number of rows.

9 Table manipulation

9.1 CREATE TABLE

Create table syntax is: Create table tablename (FieldName1 DataType,

FieldName2 DataType)

The rows returned by the "select" query can be saved as a new table. The datatype will be the same as the old table. For e.g. CREATE TABLE LearnHindi

```
select english.tag, english.Inenglish as english, hindi.Inhindi as hindi
```

```
FROM english, hindi
```

```
WHERE english.tag = hindi.tag
```

9.2 ALTER TABLE

ALTER TABLE command can be used when you want to add / delete /modify the columns and / or the indexes; or, it can be used to change other table properties.

Add a column:

```
ALTER TABLE awards
ADD COLUMN AwardCode int(2)
```

Modify a column:

```
ALTER TABLE awards
CHANGE COLUMN AwardCode VARCHAR(2) NOT NULL
```

```
ALTER TABLE awards
MODIFY COLUMN AwardCode VARCHAR(2) NOT NULL
```

Drop a column:

```
ALTER TABLE awards
DROP COLUMN AwardCode
```

Re-order the record in a table:

```
ALTER TABLE awards ORDER BY id
```

(this operation is only supported by some Storage Engines; it could make some query faster)

9.3 Renaming a table

In order to rename a table, you must have ALTER and DROP privileges on the old table name (or on all the tables), and CREATE and INSERT privileges on the new table name (or on all the tables).

You can use ALTER TABLE to rename a table:

```
RENAME TABLE `old_name` TO `new_name`
```

You can rename more than one table with a single command:

```
RENAME TABLE `old1` TO `new1`, `old2` TO `new2`, ...
```

RENAME is a shortcut. You can also use the ALTER TABLE statement:

```
ALTER TABLE `old` RENAME `new`
```

Using ALTER TABLE you can only rename one table per statement, but it's the only way to rename temporary tables.

9.4 DROP TABLE

```
DROP TABLE `awards`
```

Will completely delete the table and all the records it contains.

You can also drop more than one table with a single statement:

```
DROP TABLE `table1`, `table2`, ...
```

There are some optional keywords:

```
DROP TEMPORARY TABLE `table`;
DROP TABLE `table` IF EXISTS;
```

TEMPORARY must be specified, to drop a temporary table. IF EXISTS tells the server that it must not raise an error if the table doesn't exist.

=Using/Dealing with NULL

Null is a special logical value in SQL. Most programming languages have 2 values of logic: True and False. SQL also has NULL which means "Unknown". A NULL value can be set.

NULL is a non-value, so it can be assigned to TEXT columns, INTEGER columns or any other datatype. A column can not contain NULLs only if it has been declared as NOT NULL (see ALTER TABLE).

```
INSERT into Singer
  (F_Name, L_Name, Birth_place, Language)
values
  ("", "Homer", NULL, "Greek"),
  ("", "Sting", NULL, "English"),
  ("Jonny", "Five", NULL, "Binary");
```

Do not quote the NULL. If you quote a Null then you name the person NULL. For some strange reason, NULLs do not show visually on windows XP in Varchar fields but they do in Fedora's version, so versions of mysql can give different outputs. Here we set the value of Sting and Homer's first name to a zero length string "", because we KNOW they have NO first name, but we KNOW we do not know the place they were born. To check for a NULLs use

```
SELECT * from Singer WHERE Birth_place IS NULL;
or
SELECT * from Singer WHERE Birth_place IS NOT NULL;
or
SELECT * from Singer WHERE isNull(Birth_place)
```

Remember, COUNT never counts NULLS.

```
select count(Birth_place) from Singer;
0
and sum(NULL) gives a NULL answer.
```

Normal operations (comparisons, expressions...) return NULL if at least one of the compared items is NULL:

```
SELECT (NULL=NULL) OR (NULL<>NULL) OR (NOT NULL) OR (1<NULL) OR
(1>NULL) OR (1 + NULL) OR (1 LIKE NULL)
```

because all the expressions between in parenthesis return NULL. It's definitely logical: if you don't know the value represented by NULL, you don't know is it's =1 or <>1. Be aware that even (NULL=NULL and (NOT NULL) return NULL.

9.5 Dealing with NULL

The function 'COALESCE' can simplify working with null values. for example, to avoid showing null values by treating null as zero, you can type:

```
SELECT COALESCE(colname,0) from table where COALESCE(colname,0) > 1;
```

In a date field, to treat NULL as the current date:

```
ORDER BY
(COALESCE(TO_DAYS(date), TO_DAYS(CURDATE())) - TO_DAYS(CURDATE()))

EXP(SUM(LOG(COALESCE('*the field you want to multiply*',1))))
```

The coalesce() function is there to guard against trying to calculate the logarithm of a null value and may be optional depending on your circumstances.

```
SELECT t4.gene_name, COALESCE(g2d.score,0),
COALESCE(dgp.score,0), COALESCE(pocus.score,0)
FROM t4
LEFT JOIN g2d ON t4.gene_name=g2d.gene_name
LEFT JOIN dgp ON t4.gene_name=dgp.gene_name
LEFT JOIN pocus ON t4.gene_name=pocus.gene_name;
```

Use of IFNULL() in your SELECT statement is to make the NULL any value you wish.

```
IFNULL(expr1,expr2)
```

If expr1 is not NULL, IFNULL() returns expr1, else it returns expr2.

IFNULL() returns a numeric or string value, depending on the context in which it is used:

```
mysql> SELECT IFNULL(1,0);
-> 1
mysql> SELECT IFNULL(NULL,10);
-> 10
mysql> SELECT IFNULL(1/0,10);
-> 10
mysql> SELECT IFNULL(1/0,'yes');
-> 'yes'
```

Null handling can be very counter intuitive and could cause problems if you have an incorrect function in a delete statement that returns null. For example the following query will delete all entries.

```
DELETE FROM my_table WHERE field > NULL (or function returning NULL)
```

If you want to have NULL values presented last when doing an ORDER BY, try this:

```
SELECT * FROM my_table ORDER BY ISNULL(field), field [ ASC | DESC ]
```


10 Reserved Words

Difficult Column Names, Like 'DATE' -- use backtick. If using "date" as a column name, enclose it in backticks ' as follows:

```
CREATE TABLE IF NOT EXISTS stocks (  
  pkey int NOT NULL auto_increment,  
  `date` date,  
  ticker varchar(5),  
  open decimal (9,2),  
  high decimal (9,2),  
  low decimal (9,2),  
  close decimal (9,2),  
  volume int,  
  timeEnter timestamp(14),  
  PRIMARY KEY (pkey)  
);
```

fr:MySQL/Mots_réservés¹

¹ http://fr.wikibooks.org/wiki/MySQL%2FMots_r%E9serv%E9s

11 Data Types

11.0.1 VARCHAR

VARCHAR is shorthand for CHARACTER VARYING. 'n' represents the maximum column length (upto 65,535 characters). A VARCHAR(10) column can hold a string with a maximum length of 10 characters. The actual storage required is the length of the string (L), plus 1 or 2 bytes (1 if the length is < 255) to record the length of the string.

For the string 'abcd', L is 4 and the storage requirement is 5 bytes.

CHAR(n) is similar to varchar(n) with the only difference that char will occupy fixed length of space in the database whereas varchar will need the space to store the actual text.

11.1 TEXT and BLOB

A BLOB or TEXT column with a maximum length of 65,535 characters. The required space is the real length of the stored data plus 2 bytes (1 byte if length is < 255). The BLOB / TEXT data is not stored in the table's datafile. This makes all operations (INSERT / UPDATE / DELETE / SELECT) involving the BLOB / TEXT data slower, but makes all other operations faster.

11.2 integer

Specifying an n value has no effect whatsoever. Regardless of a supplied value for n, maximum (unsigned) value stored is 429 crores¹. If you want to add negative numbers, add the "signed" keyword next to it.

11.3 decimal

decimal(n,m) decimal(4,2) means numbers upto 99.99 (and NOT 9999.99 as you may expect) can be saved. Four digits with the last 2 reserved for decimal.

¹ <http://en.wikipedia.org/wiki/Crore>

11.4 Dates

Out of the three types DATETIME, DATE, and TIMESTAMP, the DATE type is used when you need only a date value, without a time part. MySQL retrieves and displays DATE values in 'YYYY-MM-DD' format. The DATETIME type is used when you need values that contain both date and time information. The difference between DATETIME and TIMESTAMP is that the TIMESTAMP range is limited to 1970-2037 (see below).

TIME can be used to only store the time of day (HH:MM:SS), without the date. It can also be used to represent a time interval (for example: -02:00:00 for "two hours in the past"). Range: '-838:59:59' => '838:59:59'.

YEAR can be used to store the year number only.

If you manipulate dates, you have to specify the actual date, not only the time - that is, MySQL will not automatically use today as the current date. On the contrary, MySQL will even interpret the HH:MM:SS time as a YY:MM:DD value, which will probably be invalid.

The following examples show the precise date range for Unix-based timestamps, which starts at the Unix Epoch and stops just before the first new year before the $2^{31} - 1$ usual limit (2038).

```
mysql> SET time_zone = '+00:00'; -- GMT
Query OK, 0 rows affected (0.00 sec)
```

```
mysql> SELECT FROM_UNIXTIME(-1);
+-----+
| FROM_UNIXTIME(-1) |
+-----+
| NULL              |
+-----+
1 row in set (0.00 sec)

mysql> SELECT FROM_UNIXTIME(0); -- "Epoch"
+-----+
| FROM_UNIXTIME(0)  |
+-----+
| 1970-01-01 00:00:00 |
+-----+
1 row in set (0.00 sec)

mysql> SELECT FROM_UNIXTIME(2145916799);
+-----+
| FROM_UNIXTIME(2145916799) |
+-----+
| 2037-12-31 23:59:59      |
+-----+
1 row in set (0.00 sec)

mysql> SELECT FROM_UNIXTIME(2145916800);
+-----+
| FROM_UNIXTIME(2145916800) |
+-----+
| NULL                      |
+-----+
1 row in set (0.00 sec)
```

11.5 set and enum

A SET datatype can hold any number of strings from a predefined list of strings specified during table creation. The SET datatype is similar to the ENUM datatype in that they both work with predefined sets of strings, but where the ENUM datatype restricts you to a single member of the set of predefined strings, the SET datatype allows you to store any of the values together, from none to all of them.

12 Operators

MySQL uses some standard SQL operators and some non-standard operators. They can be used to write expressions which involve constant values, variables, values contained in fields and / or other expressions.

12.1 Precedence

12.1.1 Operator precedence

Table of operator precedence:

```
INTERVAL
BINARY, COLLATE
!
- (unary minus), ~ (unary bit inversion)
^
*, /, DIV, %, MOD
-, +
<<, >>
&
|
=, <=>, >=, >, <=, <, <>, !=, IS, LIKE, REGEXP, IN
BETWEEN, CASE, WHEN, THEN, ELSE
NOT
&&, AND
XOR
||, OR
:=
```

Modifiers:

- **PIPES_AS_CONCAT** - If this SQL mode is enabled, || has precedence on ^, but - and ~ have precedence on ||.
- **HIGH_NOT_PRECEDENCE** - If this SQL mode is enabled, NOT has the same precedence level as !.

12.1.2 Use of parenthesis

You can use parenthesis to force MySQL to evaluate a subexpression before another independently from operator precedence:

```
SELECT (1 + 1) * 5 -- returns 10
```

You can also use parenthesis to make an expression more readable by humans, even if they don't affect the precedence:

```
SELECT 1 + (2 * 5) -- the same as 1 + 2 * 5
```

12.2 Assignment operators

You can use the = operator to assign a value to a column:

```
UPDATE `myTable` SET `uselessField`=0
```

When you want to assign a value to a variable, you must use the := operator, because the use of = would be ambiguous (is it as assignment or a comparison?)

```
SELECT @myvar := 1
```

You can also use SELECT INTO to assign values to one or more variables.

12.3 Comparison operators

12.3.1 Equality

If you want to check if 2 values are equal, you must use the = operator:

```
SELECT True = True -- returns 1
SELECT True = False -- returns 0
```

If you want to check if 2 values are different, you can use the <> or != operators, which have the same meaning:

```
SELECT True <> False -- returns 1
SELECT True != True -- returns 0
```

<> return 1 where = returns 0 and vice versa.

12.3.2 IS and NULL-safe comparison

When you compare a NULL value with a non-NULL value, you'll get NULL. If you want to check if a value is null, you can use IS:


```
SELECT (NULL IS NULL) -- returns 1
SELECT (1 IS NULL) -- returns 0
SELECT (True IS True) -- returns an error!
```

You can check if a value is non-NULL:

```
SELECT (True IS NOT NULL) -- returns 1
```

There is also an equality operator which considers NULL as a normal value, so it returns 1 (not NULL) if both values are NULL and returns 0 (not NULL) if one of the values is NULL:

```
SELECT col1 <=> col2 FROM myTable
```

There is not a NULL-safe non-equality operator, but you can type the following:

```
SELECT NOT (col1 <=> col2) FROM myTable
```

12.3.3 IS and Boolean comparisons

IS and IS NOT can also be used for Boolean comparisons. You can use them with the reserved words TRUE, FALSE and UNKNOWN (which is merely a synonym for NULL).

```
SELECT 1 IS TRUE -- returns 1
SELECT 1 IS NOT TRUE -- returns 0
SELECT 1 IS FALSE -- returns 0
SELECT (NULL IS NOT FALSE) -- returns 1: unkown is not false
SELECT (NULL IS UNKNOWN) -- returns 1
SELECT (NULL IS NOT UNKNOWN) -- returns 0
```

12.3.4 Greater, Less...

You can check if a value is greater than another value:

```
SELECT 100 > 0 -- returns 1
SELECT 4 > 5 -- return 0
```

You can also check if a value is minor than another value:

```
SELECT 1 < 2 -- returns 1
SELECT 2 < 2 -- returns 0
```

This kind of comparisons also works on TEXT values:

```
SELECT 'a' < 'b' -- returns 1
```

Generally speaking, alphabetical order is used for TEXT comparisons. However, the exact rules are defined by the COLLATION used. A COLLATION defines the sorting rules for a given CHARACTER SET. For example, a COLLATION may be case-sensitive, while another COLLATION may be case-insensitive.

You can check if a value is equal or greater than another value. For example, the following queries have the same meaning:

```
SELECT 'a' >= 'b' FROM 'myTable'  
SELECT NOT ('a' < 'b') FROM 'myTable'
```

Similarly, you can check if a value is less or equal to another value:

```
SELECT 'a' <= 'b' FROM 'myTable'
```

12.3.5 BETWEEN

If you want to check if a value is included in a given range, you can use the BETWEEN ... AND ... operator. AND doesn't have its usual meaning. Example:

```
SELECT 20 BETWEEN 10 AND 100 -- returns 1
```

The value after BETWEEN and the value after AND are included in the range.

You can also use NOT BETWEEN to check if a value is not included in a range:

```
SELECT 8 NOT BETWEEN 5 AND 10 -- returns 0
```

12.3.6 IN

You can use the IN operator to check if a value is included in a list of values:

```
SELECT 5 IN (5, 6, 7) -- returns 1  
SELECT 1 IN (5, 6, 7) -- returns 0
```

You should not include in the list both numbers and strings, or the results may be unpredictable. If you have numbers, you should quote them:

```
SELECT 4 IN ('a', 'z', '5')
```

There is not a theoretical limit to the number of values included in the IN operator.

You can also use NOT IN:

```
SELECT 1 NOT IN (1, 2, 3) -- returns 0
```

12.4 Logical operators

12.4.1 MySQL Boolean logic

MySQL doesn't have a real BOOLEAN datatype.

FALSE is a synonym for 0. Empty strings are considered as FALSE in a Boolean context.

TRUE is a synonym for 1. All non-NULL and non-FALSE data are considered as TRUE in a boolean context.

UNKNOWN is a synonym for NULL. The special date 0/0/0 is NULL.

12.4.2 NOT

NOT is the only operator which has only one operand. It returns 0 if the operand is TRUE, returns 1 if the operand is FALSE and returns NULL if the operand is NULL.

```
SELECT NOT 1 -- returns 0
SELECT NOT FALSE -- returns 1
SELECT NOT NULL -- returns NULL
SELECT NOT UNKNOWN -- returns NULL
```

! is a synonym for NOT.

```
SELECT !1
```

12.4.3 AND

AND returns 1 if both the operands are TRUE, else returns 0; if one of the operands is NULL, returns NULL.

```
SELECT 1 AND 1 -- returns 1
SELECT 1 AND -- return 0
SELECT AND NULL -- returns NULL
```

&& is a synonym for AND.

```
SELECT 1 && 1
```

12.4.4 OR

OR returns TRUE if at least one of the operands is TRUE, else returns FALSE; if one of the operands is NULL, returns NULL.

```
SELECT TRUE OR FALSE -- returns 1
SELECT 1 OR 1 -- returns 1
SELECT FALSE OR FALSE -- returns 0
SELECT NULL OR TRUE -- returns NULL
```

|| is a synonym for OR.

```
SELECT 1 || 0
```

12.4.5 XOR

XOR (eXclusive OR) returns 1 if only one of the operands is TRUE and the other operand is FALSE; returns 0 if both the operands are TRUE or both the operands are FALSE; returns NULL if one of the operands is NULL.

```
SELECT 1 XOR 0 -- returns 1
SELECT FALSE XOR TRUE -- returns 1
SELECT 1 XOR TRUE -- returns 0
SELECT 0 XOR FALSE -- returns 0
SELECT NULL XOR 1 -- returns NULL
```

12.4.6 Synonyms

AND can be written as &&

OR can be written as ||

NOT can be written as !

Only NOT (usually) has a different precedence from its synonym. See operator precedence for detail.

12.5 Arithmetic operators

MySQL supports operands which perform all basic arithmetic operations.

You can type positive values with a '+', if you want:

```
SELECT +1 -- return 1
```

You can type negative values with a '-'. - is an inversion operand:

```
SELECT -1 -- returns -1
SELECT ++1 -- returns -1
SELECT --1 -- returns 1
```

You can make sums with '+':

```
SELECT 1 + 1 -- returns 2
```

You can make subtractions with '-':

```
SELECT True - 1 -- returns 0
```

You can multiply a number with '*':

```
SELECT 1 * 1 -- returns 1
```

You can make divisions with '/'. Returns a FLOAT number:

```
SELECT 10 / 2 -- returns 5.0000
SELECT 1 / 1 -- returns 1.0000
SELECT 1 / 0 -- returns NULL (not an error)
```

You can make integer divisions with DIV. Resulting number is an INTEGER. No reminder. This has been added in MySQL 4.1.

```
SELECT 10 DIV 3 -- returns 3
```

You can get the reminder of a division with '%' or MOD:

```
SELECT 10 MOD 3 -- returns 1
```

12.5.1 Using + to cast data

You can convert an INTEGER to a FLOAT doing so:

```
SELECT 1 + 0.0 -- returns 1.0
SELECT 1 + 0.000 -- returns 1.000
SELECT TRUE + 0.000 -- returns 1.000
```

You can't convert a string to a `FLOAT` value by adding 0.0, but you can cast it to an `INTEGER`:

```
SELECT '1' + 0 -- returns 1
SELECT '1' + FALSE -- returns 1
SELECT '' + '' -- returns 0
```

12.6 Text operators

There are no concatenation operators in MySQL.

Arithmetic operators convert the values into numbers and then perform arithmetic operations, so you can't use `+` to concatenate strings.

You can use the `CONCAT()` function instead.

12.6.1 LIKE

The `LIKE` operator may be used to check if a string matches to a pattern. A simple example:

```
SELECT * FROM articles WHERE title LIKE 'hello world'
```

The pattern matching is usually case insensitive. There are two exceptions:

- when a `LIKE` comparison is performed against a column which has been declared with the `BINARY` flag (see `CREATE TABLE`);
- when the expression contains the `BINARY` clause:

```
SELECT * 'test' LIKE BINARY 'TEST' -- returns 0
```

You can use two special characters for `LIKE` comparisons:

- `_` means "any character" (but must be 1 char, not 0 or 2)
- `%` means "any sequence of chars" (even 0 chars or 1000 chars)

Note that `"\"` also escapes quotes (`""`) and this behaviour can't be changed by the `ESCAPE` clause. Also, the escape character does not escape itself.

Common uses of `LIKE`:

- Find titles starting with the word "hello":

```
SELECT * FROM articles WHERE title LIKE 'hello%'
```

- Find titles ending with the word "world":

```
SELECT * FROM articles WHERE title LIKE '%world'
```

- Find titles containing the word "gnu":

```
SELECT * FROM articles WHERE title LIKE '%gnu%'
```

These special chars may be contained in the pattern itself: for example, you could need to search for the "_" character. In that case, you need to "escape" the char:

```
SELECT * FROM articles WHERE title LIKE '\_%' -- titles starting
with _
SELECT * FROM articles WHERE title LIKE '\\%' -- titles starting
with %
```

Sometimes, you may want to use an escape character different from "\". For example, you could use "/":

```
SELECT * FROM articles WHERE title LIKE '/_%' ESCAPE '/'
```

When you use = operator, trailing spaces are ignored. When you use LIKE, they are taken into account.

```
SELECT 'word' = 'word ' -- returns 1
SELECT 'word' LIKE 'word ' -- returns 0
```

LIKE also works with numbers.

```
SELECT 123 LIKE '%2%' -- returns 1
```

If you want to check if a pattern doesn't match, you can use NOT LIKE:

```
SELECT 'a' NOT LIKE 'b' -- returns 1
```

12.6.2 SOUNDS LIKE

You can use SOUNDS LIKE to check if 2 text values are pronounced in the same way. SOUNDS LIKE uses the SOUNDEX algorithm, which is based on English rules and is very approximate (but simple and thus fast).

```
SELECT `word1` SOUNDS LIKE `word2` FROM `wordList` -- short form
SELECT SOUNDEX(`word1`) = SOUNDEX(`word2`) FROM `wordList` -- long
form
```

SOUNDS LIKE is a MySQL-specific extension to SQL. It has been added in MySQL 4.1.

12.6.3 Regular expressions

You can use REGEXP to check if a string matches to a pattern using regular expressions.

```
SELECT 'string' REGEXP 'pattern'
```

You can use RLIKE as a synonym for REGEXP.

12.7 Bitwise operators

Bit-NOT:

```
SELECT ~0 -- returns 18446744073709551615
SELECT ~1 -- returns 18446744073709551614
```

Bit-AND:

```
SELECT 1 & 1 -- returns 1
SELECT 1 & 3 -- returns 1
SELECT 2 & 3 -- returns 2
```

Bit-OR:

```
SELECT 1 | 0 -- returns 1
SELECT 3 | 0 -- returns 3
SELECT 4 | 2 -- returns 6
```

Bit-XOR:

```
SELECT 1 ^ 0 -- returns 1
SELECT 1 ^ 1 -- returns 0
SELECT 3 ^ 1 -- returns 2
```

Left shift:

```
SELECT 1 << 2 -- returns 4
```

Right shift:

```
SELECT 1 >> 2 -- 0
```


13 Import/export

Aside from mysqldump (cf. MySQL/Administration¹), you can also export / import raw data.

13.1 Export data

Data can be exported using the "INTO OUTFILE" keyword

```
SELECT * FROM destinataire INTO OUTFILE '/tmp/test' WHERE id IN (41,
141, 260, 317, 735, 888, 1207, 2211);
```

Beware that the MySQL daemon itself will write the file, not the user you run the MySQL client with. The file will be stored on the server, not on your host. Moreover, the server will need write access to the path you specify (usually, the server can `_not_write` in your home directory, e.g.). Hence why we (unsecurely) used `/tmp` in the examples.

You can also use the command line to export data

```
mysql < query.txt > output.txt
```

where `query.txt` contains an sql-query and the output will be stored in `output.txt`

13.2 Import data

In another database/computer/etc. the data can be imported:

```
LOAD DATA INFILE '/tmp/test' INTO TABLE destinataire;
```

additional options are

```
FIELDS TERMINATED BY '\t'
LINES TERMINATED BY '\n'
IGNORE 1 LINES
```

to specify how the document is set up and whether there is a header. The columns in the data file can be mapped to the columns of the database table if they do not correspond and it is thus also possible

¹ Chapter 16 on page 73

to omit certain columns using a dummy variable:

```
LOAD DATA LOCAL INFILE
'/tmp/test'
INTO TABLE destinataire
FIELDS TERMINATED BY '\t'
LINES TERMINATED BY '\n'
IGNORE 1 LINES
(
@dummy,
name,
phone_number,
@dummy,
@dummy,
@dummy,
@dummy,
@dummy,
@dummy,
@dummy
)
```

In this example, we only need the second and third column of the data file and store these values in the name and phone_number column of our database table.

14 Functions

14.1 Syntax

Function names are case insensitive. You can write them as you prefer:

```
SELECT database() -- ok
SELECT DataBase() -- ok
SELECT DATABASE() -- ok
```

If the `IGNORE_SPACE SQL_MODE` is not set, you can not put a space between the function name and the first parenthesis. It would return a 1064 error. `IGNORE_SPACE` is usually 0. The reason is that the parser is faster if that flag is disabled. So:

```
SELECT DATABASE () -- usually not accepted
SELECT DATABASE() -- always works fine
```

However, this restriction only applies to the native MySQL functions. UDFs and stored functions may be written with a space after the name.

You can't use a value calculated in the `SELECT` clause as a constraint in the `WHERE` clause (its a chicken & egg problem); the `WHERE` clause is what determines the values in the `SELECT` clause. What you want is the `HAVING` clause which is applied *after* all matching rows have been found.

14.2 General functions

Type-independent functions.

BENCHMARK(times, expression)

Executes expression n times and returns how time it spent. Useful to find bottlenecks in SQL expressions.

```
BENCHMARK(10000, CAST(666 AS TEXT))
```

CAST(value AS type)

Returns value converted in the specified type.

CHARSET(string)

Returns the CHARACTER SET used by string.

COALESCE(value, ...)

Returns the first argument which is not NULL. If all arguments are NULL, returns NULL. There must be at least one argument.

COERCIBILITY(string)

COLLATION(string)

Returns the COLLATION used by the string.

CONNECTION_ID()

Returns the id of the current thread.

CONVERT(value, type)

Returns value converted to the specified type.

```
SELECT CONVERT ('666', UNSIGNED INTEGER)
```

CONVERT(string USING charset)

Converts the passed string to the specified CHARACTER SET.

```
SELECT CONVERT ('This is a text' USING utf8)
```

CURRENT_USER()

Returns the username and the hostname used in the current connection.

```
SELECT CURRENT_USER()  
SELECT CURRENT_USER -- it's correct
```

DATABASE()

Returns the current database's name, set with the USE command.

```
SELECT DATABASE ()
```

FOUND_ROWS()

After a SELECT with a LIMIT clause and the SQL_CALC_FOUND_ROWS keyword, you can run another SELECT with the FOUND_ROWS() function. It returns the number of rows found by the previous query if it had no LIMIT clause.

```
SELECT SQL_CALC_FOUND_ROWS * FROM stats ORDER BY id LIMIT 10 OFFSET  
50  
SELECT FOUND_ROWS () AS n
```

GREATEST(value1, value2, ...)

Returns the greatest argument passed.

IF(val1, val2, val3)

If val1 is TRUE, returns val2. If val1 is FALSE or NULL, returns val3.

IFNULL(val1, val2)

If val1 is NULL, returns val2; else, returns val1.

ISNULL(value)

If the value passed is NULL returns 1, else returns 0.

INTERVAL(val1, val2, val3, ...)

NULLIF(val1, val2)

If val1 = val2, returns NULL; else, returns val1.

LEAST(value1, value2, ...)

Returns the minimum argument passed.

14.3 Date and time

```
SELECT * FROM mytable
WHERE datetimedcol >= (CURDATE() - INTERVAL 1 YEAR) AND
datetimedcol < (CURDATE() - INTERVAL 1 YEAR) INTERVAL 1 DAY;
```

```
SELECT IF(DAYOFMONTH(CURDATE()) <= 15,
DATE_FORMAT(CURDATE(), '%Y-%m-15'),
DATE_FORMAT(CURDATE() + INTERVAL 1 MONTH, '%Y-%m-15')) AS next15
FROM table;
```

```
SELECT YEAR('2002-05-10'), MONTH('2002-05-10'),
DAYOFMONTH('2002-05-10')
```

```
SELECT PurchaseDate FROM table WHERE YEAR(PurchaseDate) <=
YEAR(CURDATE())
```

```
SELECT columns FROM table
WHERE start_time >= '2004-06-01 10:00:00' AND end_time <=
'2004-06-03 18:00:00'
```

```
SELECT * FROM t1
WHERE DATE_FORMAT(datetime_column, '%T') BETWEEN 'HH:MM:SS' AND
'HH:MM:SS'
```

```
SELECT Start_time, End_time FROM Table
WHERE Start_time >= NOW() - INTERVAL 4 HOUR

SELECT NOW() + INTERVAL 60 SECOND
```

```
SELECT UNIX_TIMESTAMP('2007-05-01'); -- 1177970400
SELECT FROM_UNIXTIME(1177970400); -- 2007-05-01 00:00:00
```

14.4 Aggregate functions

14.4.1 COUNT(field)

If * is given, instead of the name of a field, COUNT() returns the number of rows found by the query. It's commonly used to get the number of rows in a table.

```
SELECT COUNT(*) FROM `antiques`
```

If the DISTINCT keyword is used, identical rows are counted only once.

```
SELECT COUNT(DISTINCT *) FROM `antiques`
```

If a field name is given, returns the number of non-NULL values.

```
SELECT COUNT(`cost`) FROM `antiques`
```

If a field name is given and the DISTINCT keyword is given, returns the number of non-NULL values, and identical values are counted only once.

```
SELECT COUNT(DISTINCT `cost`) FROM `antiques`
```

You can count non-NULL values for an expression:

```
SELECT COUNT(`longitude` + `latitude`) FROM `cities`
```

This returns the number of rows where longitude and latitude are both non-NULL.

14.4.2 MAX(field)

MAX() can be used to get the maximum value for an expression in the rows matching to a query. If no row matches the query, returns NULL.

```
SELECT MAX(`cost`) FROM `antiques`
SELECT MAX(LENGTH(CONCAT(`first_name`, ' ', `last_name`))) FROM
`subscribers`
```

14.4.3 MIN(field)

MIN() can be used to get the minimum value for an expression in the rows matching to a query. If no row matches the query, returns NULL.

```
SELECT MIN('cost') FROM 'antiques'
```

14.4.4 AVG(field)

AVG() can be used to get the average value for an expression in the rows matching to a query. If no row matches the query, returns NULL.

```
SELECT AVG('cost') FROM 'antiques'
```

14.4.5 SUM(field)

SUM() can be used to get the sum of the values for an expression in the rows matching to a query. If no row matches the query, returns NULL.

If SUM(SELECTED expr) is used, identical values are added only once. SUM(DISTINCT) has been added in MySQL 5.1.

```
SELECT SUM('cost') FROM 'antiques'
```

14.4.6 GROUP_CONCAT(field)

GROUP_CONCAT() can be used to concatenate values from all records for a group into a single string separated by comma or any additional token you like.

```
CREATE TEMPORARY TABLE p (
  id INTEGER, ptype VARCHAR(10), pname VARCHAR(50)
);
```

```
INSERT INTO p VALUES
  (1, 'mp3', 'iPod'),
  (2, 'mp3', 'Zune'),
  (3, 'mp3', 'ZEN'),
  (4, 'notebook', 'Acer Eee PC'),
  (4, 'notebook', 'Everex CloudBook');
```

```
SELECT * FROM p;
```

```
SELECT ptype, group_concat(pname)
FROM p
GROUP BY ptype;
```

```
SELECT ptype,group_concat(' ',pname)
FROM p
GROUP BY ptype
;
```

14.4.7 Aggregate bit functions

General syntax:

```
FUNCTION_NAME(expression)
```

These functions calculate *expression* for each row of the result set and perform the calculation between all the *expressions*. These are bitwise functions. The precision used is 64 bit.

AND

```
SELECT BIT_AND(ip) FROM log
```

OR

```
SELECT BIT_OR(ip) FROM log
```

(returns 0 if there are no rows)

XOR

```
SELECT BIT_XOR(ip) FROM log
```

(returns 0 if there are no rows)

15 Exercises

15.1 Practicing SELECT

15.1.1 Table 'list'

ID	Name	Surname	FlatHave	FlatWant
1	Shantanu	Oak	Goregaon	
2	Shantanu	Oak	Andheri	
3	Shantanu	Oak		Dadar
4	Ram	Joshi		Goregaon
5	Shyam	Sharma		Andheri
6	Ram	Naik	Sion	
7	Samir	Shah	Parle	
8	Ram	Joshi	Dadar	
9	Shyam	Sharma	Dadar	

15.1.2 Exercise I - Questions

- Who has a flat in "Goregaon" and who wants to buy one?
- Who has a flat in "Parle" and who wants to buy one?
- Where does "Shantanu Oak" own the flats and where does he want to buy one?
- How many entries have been recorded so far?
- How many flats are there for sale?
- What are the names of our clients?
- How many clients do we have?
- List the customers whose name start with "S"?
- Rearrange the list Alphabetically sorted.

15.1.3 Exercise I - Answers

- `select * from list where FlatHave = "Goregaon" or FlatWant = "Goregaon"`
- `select * from list where FlatHave = "Parle" or FlatWant = "Parle"`
- `select * from list where Name = "Shantanu" and Surname = "Oak"`
- `select count(*) from list`
- `select count(FlatHave) from list where FlatHave is not null`
- `select distinct Name, Surname from list`
- `select count(distinct Name, surname) from list`

- `select * from list where Name like "S%"`
- `select Surname, Name, FlatHave, FlatWant from list order by Name`

15.1.4 Table 'grades'

ID	Name	Math	Physics	Literature
1	John	68	37	54
2	Jim	96	89	92
3	Bill	65	12	57
4	Jeri	69	25	82

15.1.5 Exercise II - Questions

- A list of all students who scored over 90 on his or her math paper?
- A list of all students who scored more than 85 in all subjects?
- Declare Results: Print the results of all students with result column.
- Find out total marks of all the students.
- What are the average marks of the class for each subject?
- What are the minimum marks in Math?
- What are the maximum marks in Math?
- Who got the highest marks in Math?

15.1.6 Exercise II - Answers

Note: many problems have more than one correct solution.

- `SELECT * FROM grades WHERE math > 90`
- `SELECT name FROM grades WHERE math > 85 AND physics > 85 AND literature > 85`
- `SELECT *, IF((math <= 35 OR physics <= 35 OR literature <= 35), 'fail', 'pass') AS result FROM grades ORDER BY result DESC`
- `SELECT name, math+physics+literature FROM grades`
- `SELECT AVG(math), AVG(physics), AVG(literature) FROM grades`
- `SELECT MIN(math) FROM grades`
- `SELECT MAX(math) FROM grades`
- `SELECT * FROM grades ORDER BY math DESC LIMIT 1` -- this is good if we have only one guy with top score.

```
SELECT * FROM grades where math=max(math); -- the max() function
cannot be used after "where". Such usage results in "ERROR 1111
(HY000): Invalid use of group function"
```

15.2 Examples

15.2.1 Finding Duplicates

```
SELECT Vendor, ID, Count(1) as dupes
FROM table_name
GROUP BY Vendor, ID HAVING Count(1) >1
```

```
SELECT txt, COUNT(*)
FROM dupes
GROUP BY txt HAVING COUNT(*) > 1;
```

```
SELECT id, COUNT( id ) AS cnt,
FROM myTable
GROUP BY id HAVING cnt > 1
```

15.2.2 Remove duplicate entries

Assume the following table and data.

```
CREATE TABLE IF NOT EXISTS dupTest
```

```
(pkey int(11) NOT NULL auto_increment,
```

```
a int, b int, c int, timeEnter timestamp(14),
```

```
PRIMARY KEY (pkey));
```

```
insert into dupTest (a,b,c) values (1,2,3),(1,2,3),
```

```
(1,5,4),(1,6,4);
```

Note, the first two rows contains duplicates in columns a and b. It contains other duplicates; but, leaves the other duplicates alone.

```
ALTER IGNORE TABLE dupTest ADD UNIQUE INDEX(a,b);
```


16 Administration

16.1 Installation

16.1.1 Debian packages

The package name is usually *mysql-server*, either directly or as a transitional package for the latest version.

Stable

There are two Debian packages in the current *stable* release:

- *mysql-server*¹: depends on latest MySQL version
- *mysql-server-5.0*²: MySQL 5.0

You can install it using this command:

```
apt-get install mysql-server
```

or by installing the package you want using the Synaptic GUI.

Backports

Backports.org may also offers more recent versions.

To install it, you need to add the backports source in your `/etc/apt/sources.list`:

```
deb http://www.backports.org/debian lenny-backports main
```

and then use `aptitude`:

```
apt-get install -t lenny-backports mysql-server-5.1
```

¹ <http://packages.debian.org/lenny/mysql-server>

² <http://packages.debian.org/lenny/mysql-server-5.0>

Uninstall

To simply remove the program:

```
apt-get remove mysql-server
```

To remove the configuration files as well, resulting in a clean environment:

```
apt-get remove --purge mysql-server
```

Debconf will ask you if you want to remove the existing databases as well. Answer wisely!

16.1.2 Fedora Core 5

The package name is [ftp://ftp.tu-chemnitz.de/pub/linux/fedora-core/5/i386/os/Fedora/RPMS/mysql-server-5.0.18-2.1.i386.rpm mysql-server].

You can install it using this command:

```
yum install mysql-server
```

which will take care of installing the needed dependencies.

Using *pirut* (Applications->Add/Remove Software), you can also server *MySQL Database* in the *Servers* category:

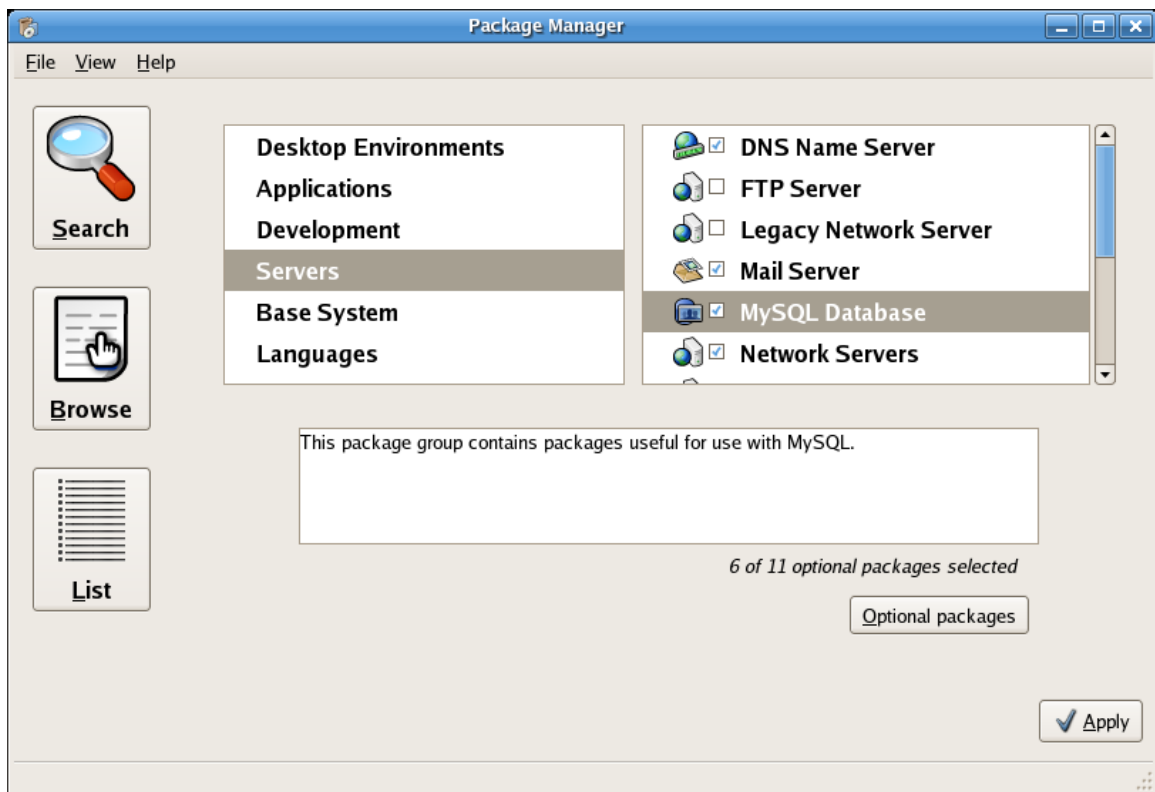


Figure 1

16.1.3 Gentoo

MySQL is available in the main Portage tree as "dev-db/mysql". You must use the fully qualified ebuild name as "mysql" is made ambiguous by "virtual/mysql"

Command:

```
emerge dev-db/mysql
```

16.1.4 FreeBSD

The stable FreeBSD port is version 5.0³, and beta version 5.1 is also available.

You can install it using this command:

```
cd /usr/ports/databases/mysql50-server/ && make install clean
```

³ <http://www.freshports.org/databases/mysql50-server/>

This command will install the MySQL 5.0 server as well as all necessary dependencies (which includes the MySQL client). t

16.2 Start the service

16.2.1 Debian

In Debian, you use the `mysql` init script.

```
/etc/init.d/mysql start
/etc/init.d/mysql stop
/etc/init.d/mysql restart
```

If you need to do so in scripts, prefer the `invoke-rc.d` command, which only restart the service if it is launched on system startup. That way, you do not launch a service if it wasn't meant to be run:

```
invoke-rc.d mysql start|stop|restart
```

If you want to control whether to launch MySQL on startup, you can use the `rcconf` package, or `update-rc.d`:

```
cp /usr/local/mysql/support-files/mysql.server
/etc/init.d/anysqlservernamehere
chmod +x /etc/init.d/anysqlservernamehere
update-rc.d anysqlservernamehere defaults
```

16.2.2 Fedora Core

Fedora Core suggests that you use the `service` wrapper, which cleans the environment before to run the service, so that all services run in the same standard environment (for example, the current directory is set to the system root `/`).

```
service mysqld start|stop|restart
service mysqld --full-restart # means stop, then start - not a
direct restart
```

You can also use the `/etc/init.d/mysqld` if needed.

FC5 displays useful hints the first time you launch the MySQL server (i.e. when launching `/usr/bin/mysql_install_db`):

```
$ service mysqld start
[...]
PLEASE REMEMBER TO SET A PASSWORD FOR THE MySQL root USER !
To do so, start the server, then issue the following commands:
```



```

/usr/bin/mysqladmin -u root password 'new-password'
/usr/bin/mysqladmin -u root -h localhost password 'new-password'
[...]
```

See the next section about changing passwords.

To control whether to launch MySQL on startup, you can use the `ntsysv` tool:

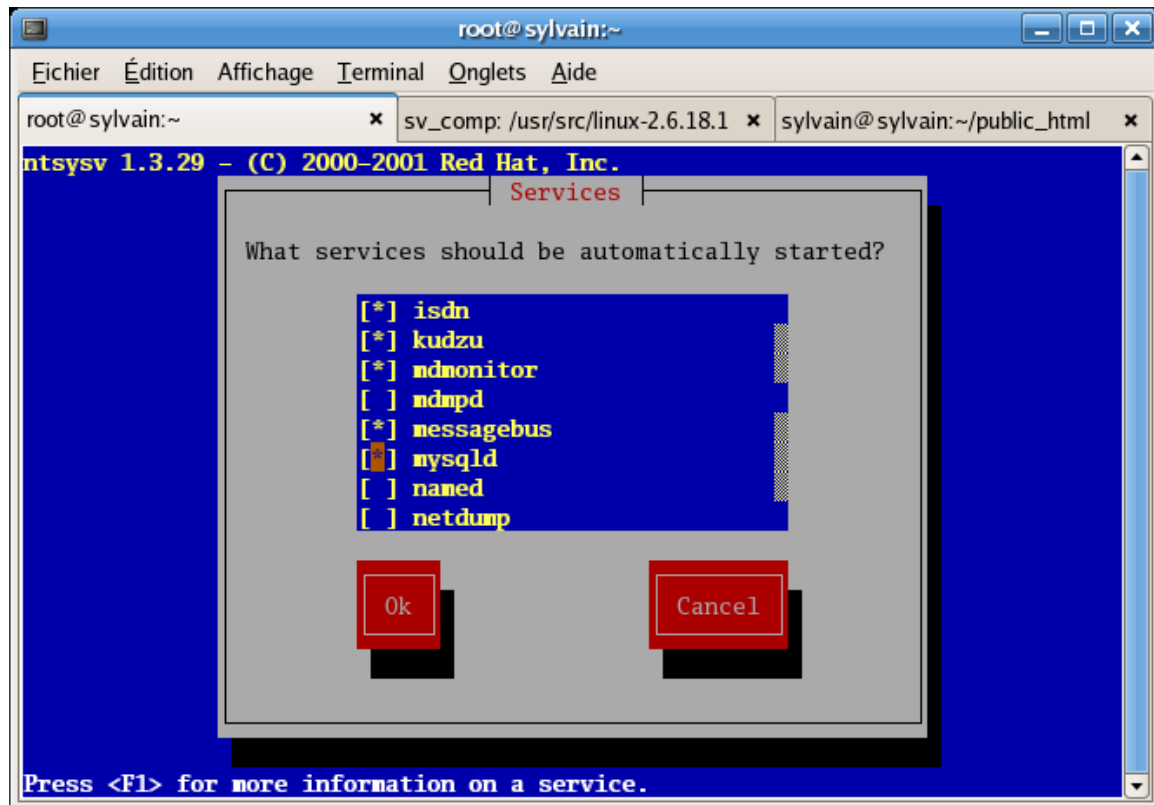


Figure 2

16.3 Client connection

There are two ways to connect to a MySQL server, using Unix sockets and TCP/IP.

The default TCP/IP port is 3306:

```

# grep mysql /etc/services
mysql          3306/tcp      # MySQL
mysql          3306/udp      # MySQL
mysql-cluster  1186/tcp      # MySQL Cluster
Manager
mysql-cluster  1186/udp      # MySQL Cluster
Manager
mysql-im       2273/tcp      # MySQL Instance
Manager
```

```
mysql-im          2273/udp          # MySQL Instance
Manager
```

As a client, MySQL interprets 'localhost' as 'use the Unix socket'. This means that MySQL won't connect to 127.0.0.1:3306, but will use /var/run/mysqld/mysqld.sock:

```
$ mysql -h localhost
mysql> \s
-----
mysql Ver 14.12 Distrib 5.0.22, for redhat-linux-gnu (i386) using
readline 5.0
[...]
Current user:          sylvain@localhost
[...]
Connection:           Localhost via UNIX socket
[...]
UNIX socket:          /var/lib/mysql/mysql.sock
```

If you really need to connect to MySQL via TCP/IP to the local host without using Unix sockets, then specify '127.0.0.1' instead of 'localhost':

```
$ mysql -h 127.0.0.1
mysql> \s
-----
mysql Ver 14.12 Distrib 5.0.22, for redhat-linux-gnu (i386) using
readline 5.0
[...]
Current user:          sylvain@localhost
[...]
Connection:           127.0.0.1 via TCP/IP
[...]
TCP port:             3306
```

In both cases, MySQL will understand your machine name as 'localhost' (this is used in the privileges system).

16.4 Configuration

Configure /etc/mysql/my.cnf - for heavily loaded databases, for fat databases...; different kinds of connexions (Unix sockets, TCP/IP w/ or w/o SSL, MySQL+SSL licensing issues)

16.4.1 Change the root password

```
$ mysql -u root
mysql> SET PASSWORD = PASSWORD('PassRoot');
```

For more information, see the #SET_PASSWORD⁴ section.

4 Chapter 16.5.7 on page 81

16.4.2 Network configuration

```
--bind-address=127.0.0.1 # localhost only
--bind-address=0.0.0.0 # listen on all interfaces
--bind-address=192.168.1.120 # listen on that IP only
```

skip-networking

When you specify `skip-networking` in the configuration, then MySQL will not listen on any port, not even on localhost (127.0.0.1). This means that only programs running on the same machine than the MySQL server will be able to connect to it. This is a common setup on dedicated servers.

The only way to contact MySQL will be to use the local *Unix socket*, such as `/var/run/mysqld/mysqld.sock` (Debian) or `/var/lib/mysql/mysql.sock` (FC5). You can specify where the socket is located using the `socket` parameter in the `[mysqld]` section of the configuration:

```
[mysqld]
...
socket=/var/lib/mysql/mysql.sock
```

16.5 Privileges

The MySQL privileges system.

16.5.1 Introduction

MySQL requires you to identify yourself when you connect to the database. You provide the following credentials:

- an identity, composed of:
 - a username
 - a machine name or IP address (detected automatically by the server)
- a password, to prove your identity

Usually, MySQL-aware applications also ask you for a database name, but that's not part of the credentials, because this does not relate to who you are.

MySQL then associate privileges to these credentials; for example, the right to query a given database, add data to another one, create additional databases or remove existing ones, etc.

16.5.2 Who am I?

Once connected, it is not necessarily obvious who MySQL thinks you are. `CURRENT_USER()` provides this information:

```
mysql> SELECT CURRENT_USER();
+-----+
| CURRENT_USER() |
+-----+
| root@localhost |
+-----+
1 row in set (0.00 sec)
```

16.5.3 SHOW GRANTS

Prototype:

```
SHOW GRANTS FOR user
SHOW GRANTS --current user
```

SHOW GRANTS allow you to check the current privileges for a given user. For example, here are the default privileges for user root:

```
mysql> SHOW GRANTS FOR 'root'@'localhost';
+-
-----+
| Grants for root@localhost
|
+-
-----+
| GRANT ALL PRIVILEGES ON *.* TO 'root'@'localhost' WITH GRANT
OPTION |
+-
-----+
1 row in set (0.00 sec)
```

You also use `SHOW GRANTS;` to check the privileges for the current user.

16.5.4 GRANT

The **GRANT** command allow you to give (GRANT) privileges to a given user.

16.5.5 DROP USER

```
DROP USER 'mediawiki';
DROP USER 'mediawiki'@'host';
```

Starting with v5.0.2, this removes the associated privileges as well.

With earlier versions you also need to **REVOKE** its **PRIVILEGES** manually.

16.5.6 REVOKE

```
REVOKE ALL PRIVILEGES ON database.* FROM 'user'@'host';
REVOKE ALL PRIVILEGES, GRANT OPTION FROM 'user'@'host';
```

16.5.7 SET PASSWORD

Prototype:

```
SET PASSWORD [FOR user] = PASSWORD('your_password')
```

If *user* is not specified, the current user is used (this is useful when you connect to mysql using the command line).

Example with an explicit user:

```
SET PASSWORD FOR 'mediawiki'@'localhost' = PASSWORD('ifda8GQg');
```

There is a command-line synonym:

```
mysqladmin password 'your_password'
```

(with the usual connection options `-h -u` and `-p`)

However, using passwords on the command line presents a security risk. For example, if root changes his MySQL password:

```
root# mysqladmin password 'K2ekiEk3'
```

Then another user can spy on him by looking at the process list:

```
user$ ps aux | grep mysqladmin
root      7768  0.0  0.1  7044  1516 pts/1    S+   16:57   0:00
mysqladmin password K2ekiEk3
```

Conclusion: don't use `mysqladmin password`.

If you are looking for a way to generate passwords, either secure or easy to remember, try the `pwgen` program (there is a Debian package available):

```
$ pwgen
ooGoo7ba ir4Raeje Ya2veigh zaXeero8 Dae8aiqu rai9ooYi phoTi6gu
Yeingo9r
tho9aeDa Ohjoh6ai Aem8chee aheich8A Aelaeph3 eu4Owudo koh6Iema
oH6ufuya
[...]
$ pwgen -s # secure
zCRhn8LH EJtzzLRE G4Ezb5BX e7hQ88In TB8hE6nn f8IqdMVQ t7BBDWTH
```

```
ZZMhZyhR
gbsXdIes hCQMbPE6 XD8Owd0b xitloisw XCWKX9B3 MEATkWHH vW2Y7HnA
3V5ubf6B
[...]
```

Very handy if you manage a lot of accounts :)

16.5.8 MySQL 4.1 password issues

As of version 4.1, MySQL introduced a password-related change.

You'll experience this via errors such as: *Client does not support authentication protocol requested by server; consider upgrading MySQL client.*⁵

If you wish to support older client programs, you need to define the MySQL account password this way:

```
SET PASSWORD [FOR user] = OLD_PASSWORD('your_pass');
```

There is apparently no way to use old passwords with the `GRANT ... IDENTIFIED BY 'password'` syntax.

Alternatively, you can use the `old_passwords` configuration option in your server's `my.cnf`. This means that new passwords will be encoded using the old-style, shorter, less secure format. For example, in Debian Sarge and FC5, the MySQL default configuration enforces old-style password for backward compatibility with older clients:

```
[mysqld]
...
old_passwords=1
```

16.6 Processes

MySQL provides a Unix-like way to show the current server threads and kill them.

16.6.1 SHOW PROCESSLIST

Here is a peaceful MySQL server:

⁵ For example, you can get this error on Debian Sarge's `apache+libapache_mod_php4+php4-mysql`, the latter depends on `libmysqlclient12` aka MySQL 4.0 (`ldd /usr/lib/php4/20020429/mysql.so` gives `libmysqlclient.so.12 => /usr/lib/libmysqlclient.so.12`). If you rely and `libmysqlclient14` or later, then your application supports both the old and the new password formats.

```
mysql> SHOW PROCESSLIST;
+----+-----+
+-----+-----+-----+-----+-----+-----+
| Id | User      | Host      | db      | Command | Time | State |
+-----+-----+-----+-----+-----+-----+
| 34 | monddprod | localhost | monddprod | Sleep   | 1328 |      |
+-----+-----+-----+-----+-----+-----+
| 43 | root      | localhost | NULL    | Query   | 0    | NULL |
+-----+-----+-----+-----+-----+-----+
SHOW PROCESSLIST |
+-----+-----+
2 rows in set (0.00 sec)
```

mysqladmin provides a command-line synonym:

```
$ mysqladmin processlist
+----+-----+
+-----+-----+-----+-----+-----+-----+
| Id | User      | Host      | db      | Command | Time | State |
+-----+-----+-----+-----+-----+-----+
| 34 | monddprod | localhost | monddprod | Sleep   | 1368 |      |
+-----+-----+-----+-----+-----+-----+
| 44 | root      | localhost |          | Query   | 0    |      |
+-----+-----+-----+-----+-----+-----+
show processlist |
+-----+-----+
+-----+-----+-----+-----+-----+-----+
```

16.6.2 KILL

If a heavy, nasty query is consuming too much resources on your server, you need to shut it down.

```
TODO: Add a sample SHOW PROCESSLIST output here
```

The brute force way is to restart the server:

```
/etc/init.d/mysql restart
```

A more subtle way is to use SHOW PROCESSLIST to identify the nasty query, and kill it independently of other server threads.

```
mysql> KILL 342;
Query OK, 0 rows affected (0.00 sec)
```

There is also a command-line synonym:

```
$ mysqladmin kill 342
```

16.7 Security

Basic security: firewall (iptables), SELinux? also some words about: do not store passwords as cleartext

16.8 Backup

Backup/recovery and import/export techniques.

16.8.1 mysqldump

```
mysqldump --opt -h 192.168.2.105 -u john -p'****' mybase | gzip >
mybase-`date +%Y%m%d`.sql.gz
```

This creates the `mybase-20061027.sql.gz` file.

`--opt` is the magical option that uses all the options that are generally useful. In recent versions of `mysqldump`, it is even enabled by default, so you need not type it. `--opt` means `--add-drop-table --add-locks --create-options --disable-keys --extended-insert --lock-tables --quick --set-charset` - so it will lock tables during the backup for consistency, add `DROP TABLE` statements so the dump can be applied without cleaning the target database, will use the most efficient ways to perform the `INSERT`s and specify the charset (latin1, Unicode/UTF-8...) used.

If you don't provide a database to `mysqldump`, you'll get a backup containing all databases - which is less easy to use for restoring a single database later on.

16.8.2 Daily rotated mysqldump with logrotate

We're using `logrotate` in a slightly non-standard way to keep a batch of dumps. Each day, `logrotate` will cycle the dumps so as to keep the last `N` dumps, removing old backups automatically, and generating the new one immediately through a `postrotate` hook.

The following configuration keeps 2 months of daily backups:

```
/dumps/mybase.sql.gz {
    rotate 60
    dateext
    daily
    nocompress
    nocopytruncate
    postrotate
        HOME=/root mysqldump --opt mybase | gzip >
```



```

/dumps/mybase.sql.gz
    endsript
}

```

Cf. `logrotate(8)` in the GNU/Linux man pages for more information.

Variant to backup all databases at once:

```

/dumps/*/*.sql.gz {
    daily
    rotate 20
    dateext
    nocompress
    sharedscripts
    create
    postrotate
        export HOME=/root
        for i in $(mysql --batch --skip-column-names -e
'SHOW DATABASES' | grep -v '^information_schema$'); do
            if [ ! -e /dumps/$i ]; then mkdir -m 700
/dumps/$i; fi
            mysqldump --opt $i | gzip -c >
/dumps/$i/$i.sql.gz
        done
    endsript
}

```

Setup:

- Create your `~/ .my.cnf` for password-less database access
- Place the logrotate configuration file above in the `/etc/logrotate.d/` directory
- Bootstrap the first dump:
 - `mkdir -m 700 /dumps`
 - `mkdir -m 700 /dumps/mybase`
 - `touch /dumps/mybase/mybase.sql.gz`
 - `logrotate -f /etc/logrotate.d/mysql-dumps`
- Check the dump using `zcat /dumps/mybase.sql.gz`.

Comments on the code: `HOME=/root` is needed for systems (such as FC5) that set `HOME=/` in their cron, which prevents `mysqldump` from finding the `.my.cnf` configuration. We also use `| gzip` instead of logrotate's `compress` option for disk I/O efficiency (single-step).

In production, you'll get something like this:

```

# ls -lt /dumps
total 16520
-rw-r----- 1 root clisscom 2819533 mar  2 06:25 clisscom.sql.gz
-rw-r----- 1 root clisscom 2815193 mar  1 06:25
clisscom.sql.gz-20100302
-rw-r----- 1 root clisscom 2813579 fév 28 06:26
clisscom.sql.gz-20100301
-rw-r----- 1 root clisscom 2812251 fév 27 06:25
clisscom.sql.gz-20100228
-rw-r----- 1 root clisscom 2810803 fév 26 06:25
clisscom.sql.gz-20100227
-rw-r----- 1 root clisscom 2808785 fév 25 06:25

```

```
clisscom.sql.gz-20100226
...
```

Beware that the date in the filename is the date of the rotation, not the date of the dump. Using `dateext` helps with remote backups, because filenames don't change daily, not you avoid re-downloading all of /dumps each time.

16.8.3 Remote mysqldump using CGI

`mysqldump` can be found sometimes in shared-hosting facilities. You can use a simple CGI script to get a direct dump:

```
#!/bin/sh

echo "Content-Type: application/x-tar"
echo "Content-Encoding: x-gzip"
echo ""

mysqldump --host=mysql.hosting.com --user=john --password=XXXXX
my_base | gzip 2>&1
```

You can then get it with your browser or `wget`:

```
$ wget -O- --quiet http://localhost/~sylvain/test2.cgi > base-`date
+%Y%m%d`.sql.gz
```

You can even re-inject it on-the-fly in your local test database:

```
$ wget -O- --quiet http://localhost/~sylvain/test2.cgi | gunzip |
mysql test_install -u myself -pXXXX
```

Protect the script with a `.htaccess`, write a `.netrc` for `wget` to use, and you'll have a simple, unattended way to grab a backup even without command-line access. This allows to gain time when grabbing a dump (compared to using `phpMyAdmin`) and to setup remote automated backups (no interaction is needed).

Something similar should be feasible in PHP provided you have access to `exec()`.

16.8.4 Exporting a single table

If you need to import/export a table, not a complete database, check `MySQL/Language#Import_-.2F_export`⁶.

⁶ http://en.wikibooks.org/wiki/MySQL%2FLanguage%23Import_-.2F_export

16.9 Binary logs

Binary logs are a mechanism to keep track of everything that happens on the MySQL server (forensics), allowing to replay the same sequence of commands on a different computer (master/slave replication), or at a later time (crash recovery).

On Debian they are stored in `/var/log/mysql/mysql-bin.0*`.

To view the SQL commands in a binary log, you use the `mysqlbinlog` command:

```
mysqlbinlog /var/log/mysql/mysql-bin.000001
```

For the crash recovery to be useful, binary logs are usually stored on a different computer (via a NFS mount, for example). Note that it is meant to recover the *full* mysql server, not just one database. You could attempt to filter the log by database, but this isn't straightforward.

So in order use binary logs as a recovery plan, you usually combine them with a full standard backup:

```
mysqldump -A | gzip > all.sql.gz
```

To flush/reset the logs at the same time (TODO: test):

```
mysqldump -A --master-data --flush-logs | gzip > all.sql.gz
```

To recover you'll just combine the two sources (preferably, disable binary logging in the server configuration during the recovery, and re-enable it right after.):

```
(zcat all.sql.gz && mysqlbinlog /var/log/mysql/mysql-bin.0*) | mysql
```

16.10 Logs

Where interesting logs are located, common errors to look at. For example:

```
tail -f /var/log/mysql.log
```

16.11 Admin Tools

Various third-party graphical interfaces and utilities.

16.11.1 Web interfaces

- phpMyAdmin (wikipedia: phpMyAdmin⁷)
- eSKUeL⁸: an alternative to phpMyAdmin
- MySQL on Servers Support⁹

16.11.2 Desktop GUI

- MySQL Administrator:¹⁰ from MySQL AB. If you want to create real backups, though, do not use this, since it runs backups using `at` on the client machine - which is likely not to be online every day.

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7 <http://en.wikipedia.org/wiki/PhpMyAdmin>

8 <http://eskuel.sourceforge.net/>

9 <http://www.runmapglobal.com/blog/mysql-databases-on-dedicated-servers/>

10 <http://mysql.com/products/tools/administrator/>

11 <http://en.wikibooks.org/wiki/Category%3A>

17 Replication

17.1 What is replication

Replication means that data written on a master MySQL will be send to separate server and executed there.

Applications:

- backups
- spread read access on multiple servers for scalability
- failover/HA

Replication types:

- Asynchronous replication (basic master/slave)
- Semi-asynchronous replication (asynchronous replication + enforce 1 slave replication before completing queries)

Replication configurations:

- standard: master->slave
- dual master: master<->master

In Master-Master replication both hosts are masters and slaves at the same time. ServerA replicates to serverB which replicates to serverA. There are no consistency checks and even with `auto_increment_increment/auto_increment_offset` configured both servers should not be used for concurrent writes.

17.2 Asynchronous replication

That's the most simple replication. A master writes a binary log file, and slaves can read this log file (possibly selectively) to replay the query statements. It's asynchronous, which mean the master and slaves may have different states at a specific point of time; also this setup can survive a network disconnection.

17.2.1 Configuration on the master

In `/etc/mysql/my.cnf`, in the `[mysqld]` section:

- Define a server identifier (detects loops?); customarily we'll use 1 for the server, but it can be different:

Replication

```
server-id = 1
```

- Replication is based on binary logs¹, so enable them:

```
log-bin  
# or log-bin = /var/log/mysql/mysql-bin.log
```

Create a new user for the slave to connect with:

```
CREATE USER 'myreplication';  
SET PASSWORD FOR 'myreplication' = PASSWORD('mypass');  
GRANT REPLICATION SLAVE ON *.* to 'myreplication';
```

Verify your server identifier:

```
SHOW VARIABLES LIKE 'server_id';
```

17.2.2 Configuration on each slave

In `/etc/mysql/my.cnf`, in the `[mysqld]` section:

- Define a server identifier, different than the master (and different than the other slaves):

```
server-id = 2
```

- Verify with:

```
SHOW VARIABLES LIKE 'server_id';
```

- You can also declare the slave hostname to the master (cf. `SHOW SLAVE HOSTS` below):

```
report-host=slave1
```

Declare the master:

```
CHANGE MASTER TO MASTER_HOST='master_addr',  
MASTER_USER='myreplication', MASTER_PASSWORD='mypass';
```

If setting up replication from backup, specify start point (add to previous command):

```
MASTER_LOG_FILE='<binary_log_from_master>',  
MASTER_LOG_POS=<master_binary_log_position>;
```

Start the replication:

¹ Chapter 16.9 on page 87

```
START SLAVE;
```

This will create a file named `master.info` in your data directory, typically `/var/lib/mysql/master.info`; this file will contain the slave configuration and status.

TODO:

```
Oct 15 21:11:19 builder mysqld[4266]: 101015 21:11:19 [Warning]
Neither --relay-log nor --relay-log-index were used; so
  replication may break when this MySQL server acts as a slave and
has his hostname changed!! Please use
  '--relay-log=mysqld-relay-bin' to avoid this problem.
```

17.2.3 Check the replication

On the slave

On a slave, type:

```
SHOW SLAVE STATUS;
```

Or more for a more readable (line-based) output:

```
SHOW SLAVE STATUS\G
```

Example:

```
***** 1. row *****
      Slave_IO_State:
        Master_Host: master_addr
        Master_User: myreplication
        Master_Port: 3306
      ...
```

Check in particular:

```
Slave_IO_Running: Yes
Slave_SQL_Running: Yes
```

You can suspect the asynchronous nature of the replication:

```
Seconds_Behind_Master: 0
```

See also:

```
mysql> SHOW GLOBAL VARIABLES LIKE "%SLAVE%";
```

On the master

You can see a connection from the slave in the process list.

```
mysql> SHOW PROCESSLIST\G
[...]
```

***** 6. row *****	
Id:	14485
User:	myreplication
Host:	10.1.0.106:33744
db:	NULL
Command:	Binlog Dump
Time:	31272
State:	Has sent all binlog to slave; waiting for binlog to be updated
Info:	NULL

If you enabled `report-host`, the slave is also visible in:

```
mysql> SHOW SLAVE HOSTS;
```

Server_id	Host	Port	Rpl_recovery_rank	Master_id
2	myslave	3306	0	1

1 row in set (0.00 sec)

17.2.4 Consistency

Note that this replication is a simple replay, similar to feeding a `mysqldump` output to the `mysql` client. Consequently, to maintain the consistency:

- Do not write on the slave (this is possible!!)
- Start the replication with identical initial data on both the master and the slave
- To test: we suspect it would be best to use the same version of MySQL on the master and slaves

17.2.5 Fixing

By default, replicate will stop if it meets an error. This can happen if your master and slaves were not consistent in the beginning, or due to a network error causing a malformed query.

In this case, you'll get a trace in the system log (typically `/var/log/syslog`):


```
Oct 15 21:11:19 builder mysqld[4266]: 101015 21:11:19 [ERROR] Slave:
Error 'Table 'mybase.form'
doesn't exist' on query. Default database: 'mybase'. Query:
'INSERT INTO `form` (`form_id`,`timestamp`,`user_id`) VALUES
('abed',1287172429,0)',
Error_code: 1146
```

The best way is to reset the replication entirely.

You can also fix the mistake manually, and then ask MySQL to skip 1 statement this way:

```
STOP SLAVE;
SET GLOBAL SQL_SLAVE_SKIP_COUNTER = 1;
START SLAVE;
```

You can set `SQL_SLAVE_SKIP_COUNTER` to any number, e.g. 100. Beware that in this case, it will skip both valid and invalid statements, not only errors.

Another way to fix broken replication is to use Maatkit tools.

- `mk-slave-restart` (to restart replication on slave if there are more errors and `SQL_SLAVE_SKIP_COUNTER` can't help)
- `mk-table-checksum` (to perform checksumming of tables on master and slave)
- `mk-table-sync` (to sync slave with master based on stats generated by `mk-table-checksum`)

17.2.6 Uninstalling

To erase the replication:

- Type:

```
mysql> RESET SLAVE;
```

- Note: at this point, MySQL paused the slave and replaced the configuration with default values. The `master.info` file was also removed.
- Restart MySQL to clear all configuration.

Warning: `STOP SLAVE` will stop replication. It can be started manually again or (by default) it will automatically resume if you restart the MySQL server. To avoid auto start of replication during process of startup, add to your configuration file:

```
slave-skip-start
```

If you want to stop the replication for good (and use the server for another purpose), you need to reset the configuration as explained above.

At this point your slave configuration should be completely empty:

Replication

```
mysql> SHOW SLAVE STATUS;  
Empty set (0.00 sec)
```

18 Databases manipulation

18.1 Creation

CREATE DATABASE database;

Require ? privilege.

`mysqladmin create` is a command-line wrapper for this function.

18.2 Deletion

- DROP DATABASE database;

Require ? privilege.

`mysqladmin drop` is a command-line wrapper for this function. The `-f` option can be used to suppress the interactive confirmation (useful for unattended scripts).

18.3 Rename

In some 5.1.x versions there was a RENAME DATABASE command, but it has been removed because renaming databases via SQL caused some problems.

However, in the command-line, you can create/export/import/delete:

```
mysqladmin create name2
mysqldump --opt name1 | mysql name2
mysqladmin drop -f name1
```

Another option, if you have root access, is to rename the database directory:

```
cd /var/lib/mysql/
/etc/init.d/mysql stop
mv name1/ name2/
/etc/init.d/mysql start
```

You also need to drop privileges on name1 and recreate them on name2:

```
UPDATE mysql.db SET `Db`='name2' WHERE `Db`='name1';  
FLUSH PRIVILEGES;
```

18.4 Copy

There is no direct copy command in MySQL. However, this can easily be done using some tools.

18.4.1 With phpMyAdmin

18.4.2 With mysqldump

As seen in the Backup section, mysqldump can be used to generate a complete flat-file copy of the database. You can then reinject this copy in another database.

This requires a direct access to the database; if you do not have it, you may need to use phpMyAdmin instead.

```
# First, clean-up the target database:  
mysqladmin drop -f base2  
mysqladmin create base2  
  
# Copy base1 to base2:  
mysqldump --opt base1 | mysql base2
```

18.5 Migration from other databases

TODO

Tools: MySQL Migration Toolkit¹

18.6 Tools for data modeling

- MySQL Query Browser apparently includes a *MySQL Table Editor* module.
- WWW SQL Designer² demo³
- Kexi⁴ (wikipedia: Kexi⁵)

1 <http://mysql.com/products/tools/migration-toolkit/>

2 <http://ondras.praha12.net/sql>

3 <http://ondras.praha12.net/sql/demo>

4 <http://www.kexi-project.org/>

5 <http://en.wikipedia.org/wiki/Kexi>

18.6.1 DB Designer 4 and MySQL Workbench

DBDesigner begins to be old. It is released under the GNU GPL, but it cannot be fully considered as free software since it requires the non-free Kylix compiler to build.

But MySQL AB acquired fabFORCE⁶, who distributed DB Designer, and MySQL Workbench⁷ is the next version. For now the project is still Alpha and not ready for use yet.

Meanwhile, if you use the latest release of DBDesigner, you'll find that it cannot connect to MySQL, with the "unable to load libmysqlclient.so" error. To workaroud this,

- Install the MySQL "Shared compatibility libraries" (from <http://dev.mysql.com/downloads/mysql/5.0.html#downloads> for version 5.0, generic RPMS aka MySQL-shared-compat.i386 will do).
- Replace DBDesigner's version of libmysqlclient.so with the newly installed one:

```
sudo ln -sf /usr/lib/libmysqlclient.so.10
/usr/lib/DBDesigner4/libmysqlclient.so
```

- Find and install `kylixlibs3-unwind-3.0-rh.4.i386.rpm`
- Find an old `xorg` (e.g. `xorg-x11-libs-6.8.2-37.FC4.49.2.1.i386.rpm` from FC4) and extract it:

```
rpm2cpio x.rpm | cpio -i
```

- Get `libXft.so.1.1` in that package and install it:

```
sudo cp libXft.so.1.1 /usr/lib
ldconfig
```

You now can connect to your MySQL5 server from DBDesigner4. Consider this a temporary work-around waiting for community (free) and commercial (not free) versions MySQL Workbench.

18.6.2 OpenOffice Base and ODBC

Typical configuration :

- MySQL database on a host machine (which name is `mysqlhost` below)
- OOO 2 on a client machine (Debian GNU/Linux for instance)
- Connection via ODBC⁸.

It's a client configuration : we need `mysql-client`:

```
aptitude install mysql-client
```

⁶ In the forums: <http://www.mysqltalk.org/db-designer-4-vt146168.html> but we'd need something more official

⁷ <http://en.wikipedia.org/wiki/MySQL%20Workbench>

⁸ <http://en.wikipedia.org/wiki/ODBC>

Under Fedora/CentOS:

```
yum install mysql
```

Before installing ODBC, we can test the remote connexion locally:

```
$ mysql -h mysqlhost -u user1 mysqldatabase -p
Enter password: PassUser1
```

You must have create the database `mysqldatabase` and the user `user1` on `mysqlhost`. It seems there is no problem (hope there is not ;-)):

```
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 33 to server version:
5.0.24a-Debian_5`bpo.1-log
Type 'help;' or '\h' for help. Type '\c' to clear the buffer.
mysql>
```

Then, it's possible to test, through different queries :

```
mysql> show databases;
+-----+
| Database          |
+-----+
| information_schema |
| mysqldatabase     |
+-----+
2 rows in set (0.00 sec)
....
mysql> quit;
Bye
```

Fine ! Let's go with OOo and ODBC, on the client machine:

```
aptitude install libmyodbc unixodbc
```

For Fedora/CentOS:

```
yum install mysql-connector-odbc unixODBC
```

`/etc/odbc.ini` (empty file) and `/etc/odbcinst.ini` are created. `odbcinst.ini` declares the available ODBC driver. Here's the MySQL statement (paths to the `.so` files may vary depending on the distribution); for Debian:

```
[MySQL]
Description      = MySQL driver
Driver           = /usr/lib/odbc/libmyodbc.so
```

```
Setup          = /usr/lib/odbc/libodbcmyS.so
CPTimeout      =
CPReuse        =
FileUsage      = 1
```

for CentOS:

```
[MySQL]
Description    = ODBC for MySQL
Driver         = /usr/lib/libmyodbc3.so
Setup          = /usr/lib/libodbcmyS.so
FileUsage      = 1
```

Now we can use `odbcinst` :

```
# odbcinst -j
unixODBC 2.2.4
DRIVERS.....: /etc/odbcinst.ini
SYSTEM DATA SOURCES: /etc/odbc.ini
USER DATA SOURCES..: /root/.odbc.ini
```

For further options : `man odbcinst`

First of all, we have to create at least one DSN (Data Source Name or Data Set Name), because every ODBC connection is initialized through an existing DSN. It's true in every cases, so it is required for an ODBC connection from OOo.

To create a DSN, one have different possibilities :

- Modify `/etc/odbc.ini` (concerns all users)
- Modify `~/.odbc.ini` (concerns a specific user)
- Use graphical applications such as **ODBCConfig** (Debian: `unixodbc-bin`, Fedora: `unixODBC-kde`). Finally, these graphical applications modify **`/etc/odbc.ini`** or **`~/.odbc.ini`**

For instance, a `/etc/odbc.ini` file (the name of the DSN is between brackets []):

```
[MySQL-test]
Description    =      MySQL ODBC Database
TraceFile      =      stderr
Driver         =      MySQL
SERVER         =      mysqlhost
USER           =      user1
PASSWORD       =
DATABASE       =      mysqldatabase
```

In that case, the DSN is called **MySQL-test**

Then we can test, using **isql** command:

```
$ isql -v MySQL-test user1 PassUser1
+-----+
| Connected! |
|          |
```

```
| sql-statement          |
| help [tablename]     |
| quit                  |
|                       |
+-----+
SQL> show databases;
+-----+
| Database              |
+-----+
| information_schema    |
| mysqlatabase         |
+-----+
2 rows affected
2 rows returned
SQL> quit;
```

And now, from OOo:

```
-> File
  -> New
    -> Database
-> Connecting to an existing database
  -> MySQL
    -> Next
-> Connect using ODBC
  -> Next
-> Choosing a Data Source
  -> MySQL-test
    -> Next
-> Username : user1 (tick password required)
-> Yes, register the database for me
-> Finish
```

At that step, one is connected to the **mysqlatabase** database, under the user **user1**. Just before accessing the database, for example to create tables, one will give user1 password. Then, through OOo, it is now quite easy to access and manipulate the database. We can just notice that Java is required in the following cases :

- Wizard to create a form (at the opposite, to create a form directly don't need any JRE).
- Wizard to create reports.
- Wizard to create queries (at the opposite, to create a query directly or through a view don't need any JRE).
- Wizard to create tables (at the opposite, to create a table directly or to create a view don't need any JRE).

GNU/Linux distros usually ships OpenOffice with IcedTea (openjdk-6-jre/java-1.6.0-openjdk) or GCJ (java-gcj-compat/java-1.4.2-gcj-compat) so that these Java-based features work.

9

19 Appendixes

19.1 Cheat Sheet

19.1.1 Query

```
SELECT * FROM table
SELECT * FROM table1, table2, ...
SELECT field1, field2, ... FROM table1, table2, ...
SELECT ... FROM ... WHERE condition
SELECT ... FROM ... WHERE condition GROUP BY field
SELECT ... FROM ... WHERE condition GROUP BY field HAVING condition2
SELECT ... FROM ... WHERE condition ORDER BY field1, field2
SELECT ... FROM ... WHERE condition ORDER BY field1, field2 DESC
SELECT ... FROM ... WHERE condition LIMIT 10
SELECT DISTINCT field1 FROM ...
SELECT DISTINCT field1, field2 FROM ...
```

```
SELECT ... FROM t1 JOIN t2 ON t1.id1 = t2.id2 WHERE condition
SELECT ... FROM t1 LEFT JOIN t2 ON t1.id1 = t2.id2 WHERE condition
SELECT ... FROM t1 JOIN (t2 JOIN t3 ON ...) ON ...
SELECT ... FROM t1 JOIN t2 USING(id) WHERE condition
```

19.1.2 Conditionals

```
field1 = value1
field1 <> value1
field1 LIKE 'value _ %'
field1 IS NULL
field1 IS NOT NULL
field1 IN (value1, value2)
field1 NOT IN (value1, value2)
condition1 AND condition2
condition1 OR condition2
```

19.1.3 Data Manipulation

```
INSERT INTO table1 (field1, field2, ...) VALUES (value1, value2, ...)
INSERT table1 SET field1=value_1, field2=value_2 ...
```

```
DELETE FROM table1 / TRUNCATE table1
DELETE FROM table1 WHERE condition
-- join:
DELETE FROM table1, table2 WHERE table1.id1 = table2.id2 AND condition
```

```
UPDATE table1 SET field1=new_value1 WHERE condition
-- join:
UPDATE table1, table2 SET field1=new_value1, field2=new_value2, ...
WHERE table1.id1 = table2.id2 AND condition
```

19.1.4 Browsing

```
SHOW DATABASES
SHOW TABLES
SHOW FIELDS FROM table / SHOW COLUMNS FROM table / DESCRIBE table /
DESC table / EXPLAIN table
SHOW CREATE TABLE table
SHOW CREATE TRIGGER trigger
SHOW TRIGGERS LIKE '%update%'
SHOW PROCESSLIST
KILL process_number
```

```
$ mysqlshow
$ mysqlshow database
```

19.1.5 Create / delete / select / alter database

```
CREATE DATABASE [IF NOT EXIST] mabase [CHARACTER SET charset]
[COLLATE collation]
CREATE DATABASE mabase CHARACTER SET utf8
DROP DATABASE mabase
USE mabase
```

```
ALTER DATABASE mabase CHARACTER SET utf8
```

19.1.6 Create/delete/modify table

```
CREATE TABLE table (field1 type1, field2 type2, ...)
CREATE TABLE table (field1 type1, field2 type2, ..., INDEX (field))
CREATE TABLE table (field1 type1, field2 type2, ..., PRIMARY KEY
(field1))
CREATE TABLE table (field1 type1, field2 type2, ..., PRIMARY KEY
(field1, field2))
CREATE TABLE table1 (fk_field1 type1, field2 type2, ...,
FOREIGN KEY (fk_field1) REFERENCES table2 (t2_fieldA)
[ON UPDATE|ON DELETE] [CASCADE|SET NULL])
CREATE TABLE table1 (fk_field1 type1, fk_field2 type2, ...,
FOREIGN KEY (fk_field1, fk_field2) REFERENCES table2 (t2_fieldA,
t2_fieldB))
CREATE TABLE table IF NOT EXISTS (...)
```

```
CREATE TABLE new_tbl_name LIKE tbl_name
[SELECT ... FROM tbl_name ...]
```

```
CREATE TEMPORARY TABLE table (...)
```

```
DROP TABLE table
DROP TABLE IF EXISTS table
DROP TABLE table1, table2, ...
DROP TEMPORARY TABLE table
```

```
ALTER TABLE table MODIFY field1 type1
ALTER TABLE table MODIFY field1 type1 NOT NULL ...
ALTER TABLE table CHANGE old_name_field1 new_name_field1 type1
ALTER TABLE table CHANGE old_name_field1 new_name_field1 type1 NOT
NULL ...
ALTER TABLE table ALTER field1 SET DEFAULT ...
ALTER TABLE table ALTER field1 DROP DEFAULT
ALTER TABLE table ADD new_name_field1 type1
ALTER TABLE table ADD new_name_field1 type1 FIRST
ALTER TABLE table ADD new_name_field1 type1 AFTER another_field
ALTER TABLE table DROP field1
ALTER TABLE table ADD INDEX (field);
ALTER TABLE table ADD PRIMARY KEY (field);
```

```
-- Change field order:
ALTER TABLE table MODIFY field1 type1 FIRST
ALTER TABLE table MODIFY field1 type1 AFTER another_field
ALTER TABLE table CHANGE old_name_field1 new_name_field1 type1 FIRST
ALTER TABLE table CHANGE old_name_field1 new_name_field1 type1 AFTER
another_field
```

```
ALTER TABLE old_name RENAME new_name;
```

19.1.7 Keys

```
CREATE TABLE table (... , PRIMARY KEY (field1, field2))
CREATE TABLE table (... , FOREIGN KEY (field1, field2) REFERENCES
table2 (t2_field1, t2_field2))
ALTER TABLE table ADD PRIMARY KEY (field);
```

19.1.8 Privileges

```
GRANT ALL PRIVILEGES ON base.* TO 'user'@'localhost' IDENTIFIED BY
'password';
GRANT SELECT, INSERT, DELETE ON base.* TO 'user'@'localhost'
IDENTIFIED BY 'password';
REVOKE ALL PRIVILEGES ON base.* FROM 'user'@'host'; -- one
permission only
REVOKE ALL PRIVILEGES, GRANT OPTION FROM 'user'@'host'; -- all
permissions
```

```
SET PASSWORD = PASSWORD('new_pass')
SET PASSWORD FOR 'user'@'host' = PASSWORD('new_pass')
SET PASSWORD = OLD_PASSWORD('new_pass')
```

```
DROP USER 'user'@'host'
```

19.1.9 Main data types

```
TINYINT (1o: -127+128) SMALLINT (2o: +-65 000)
MEDIUMINT (3o: +-16 000 000) INT (4o: +- 2 000 000 000)
BIGINT (8o: +-9.1018)
Precise interval: -(28*N-1) -> (28*N)-1
/>\ INT(2) = "2 digits displayed" -- NOT "number with 2 digits
max"
```

```
INT NOT NULL auto_increment PRIMARY KEY -- auto-counter for PK
```

```
FLOAT(M,D) DOUBLE(M,D) FLOAT(D=0->53)
/!\ 8,3 -> 12345,678 -- NOT 12345678,123!
```

```
TIME (HH:MM) YEAR (AAAA) DATE (AAAA-MM-JJ) DATETIME (AAAA-MM-JJ
HH:MM; années 1000->9999)
TIMESTAMP (like DATETIME, but 1970->2038, compatible with Unix)
```

```
VARCHAR (single-line; explicit size) TEXT (multi-lines; max
size=65535) BLOB (binary; max size=65535)
Variants for TEXT&BLOB: TINY (max=255) MEDIUM (max=~16000) LONG
(max=4Go)
Ex: VARCHAR(32), TINYTEXT, LONGBLOB, MEDIUMTEXT
```

```
ENUM ('value1', 'value2', ...) -- (default NULL, or '' if NOT NULL)
```

19.1.10 Forgot root password?

```
$ /etc/init.d/mysql stop
$ mysqld_safe --skip-grant-tables
$ mysql # on another terminal
mysql> UPDATE mysql.user SET password=PASSWORD('nouveau') WHERE
user='root';
## Kill mysqld_safe from the terminal, using Control + \
$ /etc/init.d/mysql start
```

19.1.11 Repair tables after unclean shutdown

```
mysqlcheck --all-databases
mysqlcheck --all-databases --fast
```

19.1.12 load data from local file

1

19.2 About this book

19.2.1 Contributors

- Beuc²: structured the book in chapters and setup the print version; wrote the initial Administration, Database Manipulation, CheatSheet section; contributed to Introduction (MySQL license), Optimization (query cache and benchmark examples, indices exercise), Table types (reference other possible table types), Language (datetime/timestamp valid intervals), Pivot table (alternate

1 <http://en.wikibooks.org/wiki/Category%3A>

2 <http://en.wikibooks.org/wiki/User%3ABeuc>

version w/o maths). I'd like to thank my employer, Cliss XXI³, for giving me time to work on these chapters. Then wrote the Replication section (on free time).

- Lathspell⁴: wrote the initial Optimization section
- LucienPetit⁵: wrote the initial *OpenOffice Base and ODBC* section. I'd like to thank my employer, Cliss XXI⁶, for giving me time to work on it (but I also worked on my free time).
- Shantanuo⁷: wrote the initial Language section.
- Sante Caserio⁸: started Stored Programs; started APIs; edited some existing stuff; added Language.Operators; added Table Types.Metadata about Storage Engines;

9

3 <http://www.cliss21.com>

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