Bioinformatics Resources
- SQL -

Lecture & Exercises
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SQL in use

- Syntax of MySQL server 5.6
- useful utilities: mysql, mysqladmin
- frequent tasks / operations
- command line
- Python integration
Prerequisites

- Know your server version: Even if SQL is a standard, different vendors implement different versions of add vendor/version specific features
- Have client programs installed (mysql, mysqladmin)
- Have a language driver/connector installed
Prerequisites

- command line clients come typically with the installation
- GUI clients are also available
- Connectors come in different flavors for many languages and may have to be installed
- Connectors may offer different APIs
(User) Administration

- Administration information is stored in the database ‘mysql’
- Users have to connect to the database server
- Users are managed via accounts:
  - username
  - hostname / IP address
  - optional password
(User) Administration

- Example: ‘dowj’@’myhost’
- special hostnames: localhost, 127.0.0.1, ::1
- ‘empty’ user name: anonymous
- hostnames may contain wildcards: % or _
- omission of user or host name allowed
- password can be and is set individually for each name/host combination
Example

<table>
<thead>
<tr>
<th>user</th>
<th>host</th>
<th>password</th>
</tr>
</thead>
<tbody>
<tr>
<td>root</td>
<td>localhost</td>
<td>*CABC7</td>
</tr>
<tr>
<td>root</td>
<td>phoenix.fritz.box</td>
<td>*CABC7</td>
</tr>
<tr>
<td>root</td>
<td>127.0.0.1</td>
<td>*CABC7</td>
</tr>
<tr>
<td>root</td>
<td>::1</td>
<td>*CABC7</td>
</tr>
<tr>
<td></td>
<td>localhost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>phoenix.fritz.box</td>
<td></td>
</tr>
<tr>
<td>richter</td>
<td>localhost</td>
<td>*75B62</td>
</tr>
</tbody>
</table>

- **Set / change password:**
  - `SET PASSWORD` for `‘dowj’@’localhost’` = `PASSWORD(‘cleartext_password’)`
More Administration

- default: only root account, might be unsecured
- databases: mysql, information_schema, performance schema, test
- further creation of user account and databases needed
More Administration

- use the mysqladmin tool to create a new, empty database:
  `mysqladmin -u root -p create resource_db`

- create a user (in a mysql session):
  `CREATE USER dowj [identified by ‘clear_pw’]`

- now you have to grant privileges on a certain database to the user:
  `GRANT ALL ON resource_db.* TO ‘dowj’@’localhost’`
Full Grant Syntax 1

GRANT

 priv_type [(column_list)]

 [, priv_type [(column_list)]] ...

 ON [object_type] priv_level

 TO user_specification [, user_specification] ...

 [REQUIRE {NONE | tsl_option [[AND] tsl_option] ...}]

 [WITH {GRANT OPTION | resource_option} ...]

GRANT PROXY ON user_specification

 TO user_specification [, user_specification] ...

 [WITH GRANT OPTION]

object_type: {

 TABLE

 | FUNCTION

 | PROCEDURE

}
Full Grant Syntax 2

priv_level: {
    *
    | *. *
    | db_name.*
    | db_name.tbl_name
    | tbl_name
    | db_name.routine_name
}

user_specification:
    user [ auth_option ]

auth_option: {
    IDENTIFIED BY 'auth_string'
    | IDENTIFIED BY PASSWORD 'hash_string'
    | IDENTIFIED WITH auth_plugin
    | IDENTIFIED WITH auth_plugin AS 'hash_string'
}
Full Grant Syntax 3

tsl_option: {
    SSL
    | X509
    | CIPHER 'cipher'
    | ISSUER 'issuer'
    | SUBJECT 'subject'
}

resource_option: {
    | MAX_QUERIES_PER_HOUR count
    | MAX_UPDATES_PER_HOUR count
    | MAX_CONNECTIONS_PER_HOUR count
    | MAX_USER_CONNECTIONS count
}
## Privileges

<table>
<thead>
<tr>
<th>Privilege</th>
<th>Meaning and Grantable Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL (PRIVILEGES)</td>
<td>Grant all privileges at specified access level except GRANT OPTION</td>
</tr>
<tr>
<td>ALTER</td>
<td>Enable use of ALTER_TABLE. Levels: Global, database, table.</td>
</tr>
<tr>
<td>ALTER ROUTINE</td>
<td>Enable stored routines to be altered or dropped. Levels: Global, database, procedure.</td>
</tr>
<tr>
<td>CREATE</td>
<td>Enable database and table creation. Levels: Global, database, table.</td>
</tr>
<tr>
<td>CREATE ROUTINE</td>
<td>Enable stored routine creation. Levels: Global, database.</td>
</tr>
<tr>
<td>CREATE TABLESPACE</td>
<td>Enable tablespaces and log file groups to be created, altered, or dropped. Level: Global.</td>
</tr>
<tr>
<td>CREATE TEMPORARY TABLES</td>
<td>Enable use of CREATE_TEMPORARY_TABLE. Levels: Global, database.</td>
</tr>
<tr>
<td>CREATE USER</td>
<td>Enable use of CREATE USER, DROP USER, RENAME USER, and REVOKE ALL PRIVILEGES. Level: Global.</td>
</tr>
<tr>
<td>CREATE VIEW</td>
<td>Enable views to be created or altered. Levels: Global, database, table.</td>
</tr>
<tr>
<td>DELETE</td>
<td>Enable use of DELETE. Level: Global, database, table.</td>
</tr>
<tr>
<td>DROP</td>
<td>Enable databases, tables, and views to be dropped. Levels: Global, database, table.</td>
</tr>
<tr>
<td>EVENT</td>
<td>Enable use of events for the Event Scheduler. Levels: Global, database.</td>
</tr>
<tr>
<td>EXECUTE</td>
<td>Enable the user to execute stored routines. Levels: Global, database, table.</td>
</tr>
<tr>
<td>FILE</td>
<td>Enable the user to cause the server to read or write files. Level: Global.</td>
</tr>
<tr>
<td>GRANT OPTION</td>
<td>Enable privileges to be granted to or removed from other accounts. Levels: Global, database,</td>
</tr>
<tr>
<td></td>
<td>table, procedure, proxy.</td>
</tr>
<tr>
<td>INDEX</td>
<td>Enable indexes to be created or dropped. Levels: Global, database, table.</td>
</tr>
<tr>
<td>INSERT</td>
<td>Enable use of INSERT. Levels: Global, database, table, column.</td>
</tr>
<tr>
<td>LOCK TABLES</td>
<td>Enable use of LOCK TABLES on tables for which you have the SELECT privilege. Levels: Global, database, table.</td>
</tr>
</tbody>
</table>

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<tr>
<td>PROCESS</td>
<td>Enable the user to see all processes with SHOW PROCESSES. Level: Global.</td>
</tr>
<tr>
<td>PROXY</td>
<td>Enable user proxying. Level: From user to user.</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>Enable foreign key creation. Levels: Global, database, table, column.</td>
</tr>
<tr>
<td>RELOAD</td>
<td>Enable use of FLUSH operations. Level: Global.</td>
</tr>
<tr>
<td>REPLICACTION CLIENT</td>
<td>Enable the user to ask where master or slave servers are. Level: Global.</td>
</tr>
<tr>
<td>REPLICACTION SLAVE</td>
<td>Enable replication slaves to read binary log events from the master. Level: Global.</td>
</tr>
<tr>
<td>SELECT</td>
<td>Enable use of SELECT. Levels: Global, database, table, column.</td>
</tr>
<tr>
<td>SHOW DATABASES</td>
<td>Enable SHOW DATABASES to show all databases. Level: Global.</td>
</tr>
<tr>
<td>SHOW CREATE VIEW</td>
<td>Enable use of SHOW CREATE VIEW. Levels: Global, database, table.</td>
</tr>
<tr>
<td>SHUTDOWN</td>
<td>Enable use of mysqladmin shutdown. Level: Global.</td>
</tr>
<tr>
<td>SUPER</td>
<td>Enable use of other administrative operations such as CHANGE MASTER TO, KILL, PURGE BINARY LOGS, SET GLOBAL, and mysqladmin debug command. Level: Global.</td>
</tr>
<tr>
<td>TRIGGER</td>
<td>Enable trigger operations. Levels: Global, database, table.</td>
</tr>
<tr>
<td>UPDATE</td>
<td>Enable use of UPDATE. Levels: Global, database, table, column.</td>
</tr>
<tr>
<td>USAGE</td>
<td>Synonym for &quot;no privileges&quot;</td>
</tr>
</tbody>
</table>

Data Export/Import


- mysqldump to create logical backups i.e.
  - a set of SQL statements to reproduce the current state of the database

- other output formats than SQL: CSV, XML

- require the respective privileges

- Examples:
  - mysqldump [options] db_name [tbl_name ...]
  - mysqldump [options] --databases db_name ...
  - mysqldump [options] --all-databases
Data Export/Import

- easy backup of logical dumps:

- in the mysql client:
  source file_name

- otherwise: create empty tables and use LOAD DATA INFILE
  - can be quite tricky because of input format specification