

MySQL Database Lab

Developing the Tools
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Lab Objectives

- Connect to a MySQL server through
 - MySQL client
 - PHPMyAdmin
 - Java (MySQL Connector/J)
- Write SQL queries
 - Manage MySQL user rights
 - Data definition (`CREATE TABLE` etc.)
 - Data manipulation (`SELECT`, `INSERT` etc.)
- Exercise: Golub dataset

Lab Outline

- MySQL Command Line client
- Manage MySQL user rights
- PHPMyAdmin
- Data Modeling for the Golub dataset
- Exercise:
 - Creating the Golub database
 - Use Java/JDBC to connect to the Golub database

MySQL Command Line Client

- The standard MySQL client is `mysql`. It is completely command line based.
- The most used options are
 - `-h` indicate the host to which you want to connect
 - `-u` indicate your username (if different from login)
 - `-p` you must use a password to connect
- To connect as database administrator:

```
mysql -h localhost -u root  
--socket=/tmp/mysql.sock -p
```

MySQL Client

```
gehdom@CRHS_J55249: ~  
File Edit View Terminal Go Help  
mysql> show tables;  
+-----+  
| Tables_in_golub |  
+-----+  
| class            |  
| expression       |  
| gene             |  
| sample          |  
+-----+  
4 rows in set (0.00 sec)  
  
mysql> describe gene;  
+-----+-----+-----+-----+-----+-----+  
| Field          | Type                | Null | Key | Default | Extra          |  
+-----+-----+-----+-----+-----+-----+  
| gene_id        | int(10) unsigned    |      | PRI | NULL     | auto_increment |  
| description    | varchar(255)        | YES  |     | NULL     |                |  
| accession      | varchar(255)        | YES  | MUL | NULL     |                |  
+-----+-----+-----+-----+-----+-----+  
3 rows in set (0.00 sec)  
  
mysql> █
```

MySQL Client – First Commands

- Connect by using
`mysql -u root --socket=/tmp/mysql.sock`
- Show all databases
`show databases;`
- Use a specific database
`use mysql;`
- Show all tables in this database
`show tables;`

.my.cnf

- If you don't want to indicate your connection parameters every time on the command line, you can create a `.my.cnf` file
- Complete documentation is available at http://dev.mysql.com/doc/mysql/en/Option_files.html

- **Example**

```
[client]
password="secret"
host="localhost"
socket="/tmp/mysql.sock"
user="login"
```

Backup and Restore

- Create a backup of MySQL database:
`mysqldump dbName > fileName.sql`
- Restore
 - From the Unix command line
`mysql dbName < fileName.sql`
 - From inside MySQL
`source fileName.sql`

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- PHPMyAdmin
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Manage MySQL User Rights

- MySQL is a multi-user database server: different users can have different access rights to different databases
- Take advantage of it: create several users and give only minimal privileges !
- The command to create new users is GRANT
- <http://dev.mysql.com/doc/mysql/en/GRANT.html>

GRANT

- Create a new user for the golub database
GRANT ALL PRIVILEGES
ON golub.*
TO golub_admin@localhost
IDENTIFIED BY 'your_password'
- Create a new user for the golub database
having on 'select' rights
GRANT SELECT
ON golub.*
TO golub_user@localhost

Changing Passwords

- MySQLAdmin

```
mysqladmin -u myUser -p password  
'newPwd'
```

- By entering directly the `mysql` database

```
UPDATE user  
SET password=password('secret')  
WHERE user='myUser';
```

```
FLUSH PRIVILEGES;
```

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PHPMyAdmin

- PHPMyAdmin is a web application (written in PHP) to facilitate MySQL administration
- Available at <http://www.phpmyadmin.net>
- Features:
 - Create / modify databases / tables
 - Import / export data
 - Manage MySQL users
 - Create PDF database schemata

golub running on localhost - phpMyAdmin 2.5.5-pl1 - Mozilla

File Edit View Go Bookmarks Tools Window Help

https://10.128.80.9/admin-ecogenix/index.php?lang=en-iso-8859-1&s

Home Bookmarks Red Hat, Inc. Red Hat Network Support Shop Products Training

golub running on localhost - phpMy...

Database *golub* running on localhost

Structure SQL Export Search Query Drop

Table	Action	Records	Type	Size	Overhead
<input type="checkbox"/> class		2	MyISAM	4.1 KB	-
<input type="checkbox"/> expression		213,870	MyISAM	13.4 MB	-
<input type="checkbox"/> gene		7,129	MyISAM	606.9 KB	-
<input type="checkbox"/> sample		63	MyISAM	5.2 KB	-
4 table(s)	Sum	221,064	--	14.0 MB	0 Bytes

Check All / Uncheck All With selected: ▾

- ◆ [Print view](#)
- ◆ [Data Dictionary](#)
- ◆ Database comment:
- ◆ Create new table on database golub :
 Name :
 Fields :
- ◆ [Edit PDF Pages](#)

Query window

Database Schema

The screenshot shows the phpMyAdmin interface for the 'golub' database. The sidebar on the left contains the following elements:

- Logo: php MyAdmin
- Home
- Search: golub (4)
- Database: golub
 - class
 - expression
 - gene
 - sample

The main content area is titled "Database *golub* - Table *sample* running on localhost". It includes the following controls:

- Please choose a Page to edit: 8: test (dropdown), Edit, Delete, Go
- Create a new Page: (input field), (Automatic layout), Go

The "Select Tables" section contains:

- Toggle scratchboard
- Reset

The visual representation of the database schema shows two tables:

- expression**
 - expression_id
 - gene_id
 - sample_id
 - value
- gene**
 - gene_id
 - description
 - accession

PHPMyAdmin Configuration

- Configuration is explained in the `Documentation.txt` file
- Major configuration steps
 - Download from www.phpmyadmin.net
 - Extract files from downloaded archive
 - Install the distribution in a directory accessible to the web server
 - Edit the `config.inc.php` file
 - Create an auxiliary database and MySQL user

config.inc.php

- `$cfg['PmaAbsoluteUri'] = 'http://localhost/phpMyAdmin-2.5.6/';`
- `$cfg['blowfish_secret'] = 'secret';`
- `$cfg['Servers'][$i]['controluser'] = 'phpmyadmin';`
- `$cfg['Servers'][$i]['controlpass'] = 'secret';`
- `$cfg['Servers'][$i]['auth_type'] = 'cookie';`
- `$cfg['Servers'][$i]['pmadb'] = 'phpmyadmin';`
- `$cfg['Servers'][$i]['bookmarktable'] = 'pma_bookmark';`
- `$cfg['Servers'][$i]['relation'] = 'pma_relation';`
- `$cfg['Servers'][$i]['table_info'] = 'pma_table_info';`
- `$cfg['Servers'][$i]['table_coords'] = 'pma_table_coords';`
- `$cfg['Servers'][$i]['pdf_pages'] = 'pma_pdf_pages';`
- `$cfg['Servers'][$i]['column_info'] = 'pma_column_info';`
- `$cfg['Servers'][$i]['history'] = 'pma_history';`

Create auxiliary MySQL User

- `GRANT USAGE ON mysql.* TO 'phpmyadmin'@'localhost' IDENTIFIED BY 'secret';`
- `GRANT SELECT (Host, User, Select_priv, Insert_priv, Update_priv, Delete_priv, Create_priv, Drop_priv, Reload_priv, Shutdown_priv, Process_priv, File_priv, Grant_priv, References_priv, Index_priv, Alter_priv, Show_db_priv, Super_priv, Create_tmp_table_priv, Lock_tables_priv, Execute_priv, Repl_slave_priv, Repl_client_priv) ON mysql.user TO 'phpmyadmin'@'localhost';`
- `GRANT SELECT ON mysql.db TO 'phpmyadmin'@'localhost';`
- `GRANT SELECT ON mysql.host TO 'phpmyadmin'@'localhost';`
- `GRANT SELECT (Host, Db, User, Table_name, Table_priv, Column_priv) ON mysql.tables_priv TO 'phpmyadmin'@'localhost';`
- `GRANT SELECT, INSERT, UPDATE, DELETE ON phpmyadmin.* TO 'phpmyadmin'@'localhost';`

Create auxiliary Database

- Database used to store information needed by PHPMyAdmin (pdf, table relations, history etc.)
- Example script:

```
CREATE DATABASE phpmyadmin;
USE phpmyadmin;
CREATE TABLE `pma_bookmark` ( ... ) TYPE=MyISAM
CREATE TABLE `pma_relation` ( ... ) TYPE=MyISAM
CREATE TABLE `pma_table_info` ( ... ) TYPE=MyISAM
CREATE TABLE `pma_table_coords` ( ... ) TYPE=MyISAM
CREATE TABLE `pma_pdf_pages` ( ... ) TYPE=MyISAM
CREATE TABLE `pma_column_info` ( ... ) TYPE=MyISAM
CREATE TABLE `pma_history` ( ... ) TYPE=MyISAM
```

PHPMyAdmin - The Fun Part

- PHPMyAdmin is already installed ! You don't have to configure it yourself today ...
- <http://localhost:8080/phpmyadmin>
- If you want to have a look at the source code, it's available at
`/opt/diro/phpMyAdmin`

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- PHPMyAdmin
- **Data Modeling for the Golub dataset**
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Data Modeling

- We want to create a database for the golub dataset.
- What does the dataset look like ?
`table_ALL_AML_samples.txt`
`data_set_ALL_AML_train.txt`
- What tools are available to help us modeling (and avoid writing 'CREATE TABLE' statements) ?

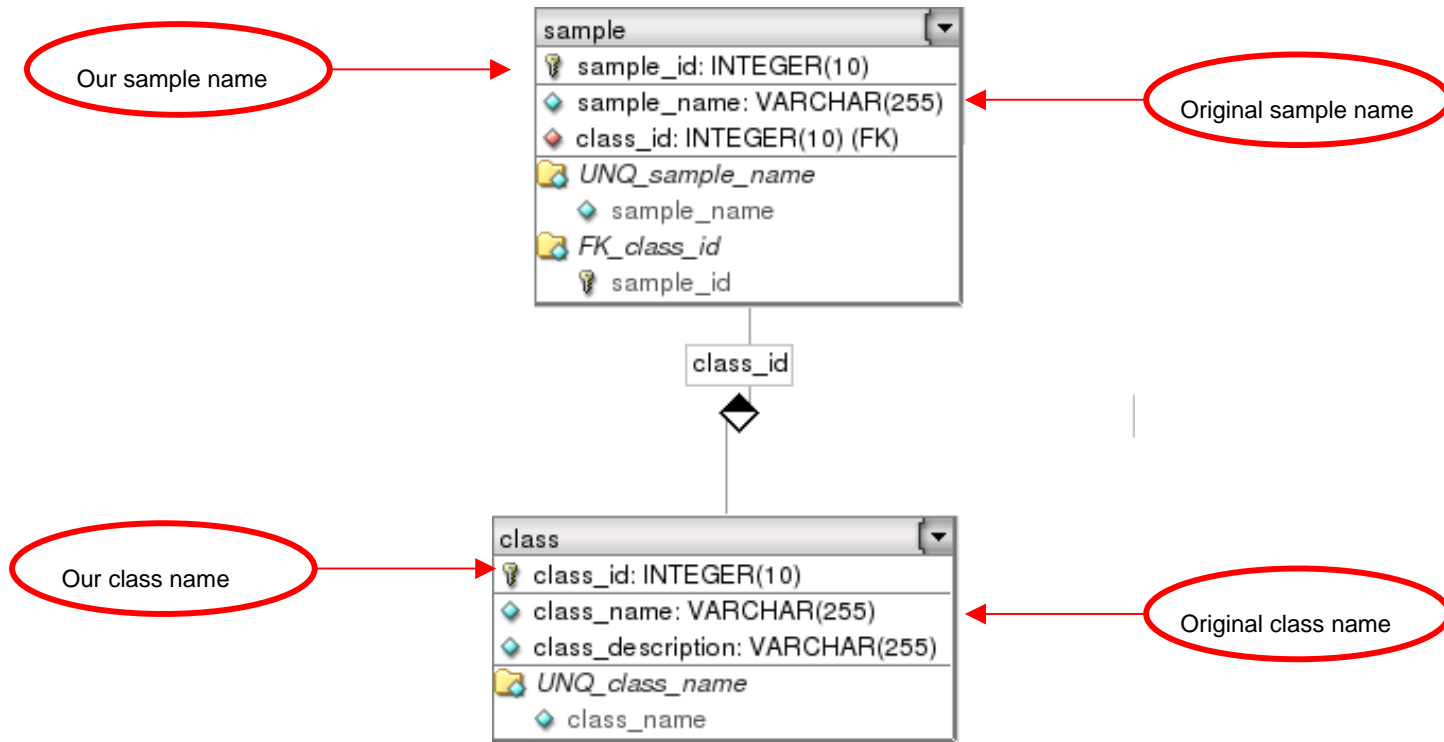
Samples

Samples	ALL/AML	BM/PB	T/B-cell (if ALL)	FAB (if AML)	Date/Gender	% Blasts Treatment	PS Response	Source
INITIAL SET								
1	ALL	BM	B-cell		09/04/96 - M		1.00	DFCI
2	ALL	BM	B-cell		- M		0.41	DFCI
3	ALL	BM	B-cell		- M		0.87	DFCI
4	ALL	BM	B-cell				0.91	DFCI
5	ALL	BM	B-cell				0.89	DFCI
6	ALL	BM	T-cell		- M		0.76	DFCI
7	ALL	BM	B-cell		03/25/83 - F		0.78	DFCI
8	ALL	BM	B-cell		- F		0.77	DFCI
9	ALL	BM	T-cell		- M		0.89	DFCI
10	ALL	BM	T-cell		07/23/87 - M		0.56	DFCI
11	ALL	BM	B-cell		06/25/85 - M		0.74	DFCI
12	ALL	BM	B-cell		09/17/85 - F		0.20	DFCI
13	ALL	BM	B-cell		07/27/88 - F		1.00	DFCI
14	ALL	BM	B-cell		11/27/87 - M		0.73	DFCI
15	ALL	BM	B-cell		03/25/89 - F		0.98	DFCI
16	ALL	BM	B-cell		02/12/90 - M		0.95	DFCI
17	ALL	BM	B-cell		09/26/90 - M		0.49	DFCI
18	ALL	BM	B-cell		- F		0.59	DFCI
19	ALL	BM	B-cell				0.80	DFCI
20	ALL	BM	B-cell				0.90	DFCI
21	ALL	BM	B-cell		01/24/84 - M		0.76	DFCI
22	ALL	BM	B-cell		05/27/88 - M		0.37	DFCI
23	ALL	BM	T-cell		07/09/91 - M		0.77	DFCI
24	ALL	BM	B-cell		05/19/81 - M		0.92	DFCI
25	ALL	BM	B-cell		02/18/82 - M		0.43	DFCI
26	ALL	BM	B-cell		- F		0.89	DFCI
27	ALL	BM	B-cell		- F		0.82	DFCI
28	AML	BM	B-cell	M2		79 Failure	0.44	CALGB

Samples

- Information we are interested in:
 - Sample Name
 - Cancer Type
- Since we can imaging working with several other cancer types and would like to keep some more information on each cancer type, we will create two different tables:
 - Sample (sample name, cancer class)
 - Class (cancer class)

Sample



Gene Expression

Sample

Gene Descrip	Gene Access	1 call	2 call	3 call	4 call
AFFX-BioB-5	AFFX-BioB-5	-214 A	-139 A	-76 A	-135 A
AFFX-BioB-M	AFFX-BioB-M	-153 A	-73 A	-49 A	-114 A
AFFX-BioB-3	AFFX-BioB-3	-58 A	-1 A	-307 A	265 A
AFFX-BioC-5	AFFX-BioC-5	88 A	283 A	309 A	12 A
AFFX-BioC-3	AFFX-BioC-3	-295 A	-264 A	-376 A	-419 A
AFFX-BioDn-	AFFX-BioDn-	-558 A	-400 A	-650 A	-585 A
AFFX-BioDn-	AFFX-BioDn-	199 A	-330 A	33 A	158 A
AFFX-CreX-5	AFFX-CreX-5	-176 A	-168 A	-367 A	-253 A
AFFX-CreX-3	AFFX-CreX-3	252 A	101 A	206 A	49 A
AFFX-BioB-5	AFFX-BioB-5	206 A	74 A	-215 A	31 A
AFFX-BioB-M	AFFX-BioB-M	-41 A	19 A	19 A	363 A
AFFX-BioB-3	AFFX-BioB-3	-831 A	-743 A	-1135 A	-934 A
AFFX-BioC-5	AFFX-BioC-5	-653 A	-239 A	-962 A	-577 A
AFFX-BioC-3	AFFX-BioC-3	-462 A	-83 A	-232 A	-214 A
AFFX-BioDn-	AFFX-BioDn-	75 A	182 A	208 A	142 A
AFFX-BioDn-	AFFX-BioDn-	381 A	164 A	432 A	271 A
AFFX-CreX-5	AFFX-CreX-5	-118 A	-141 A	84 A	-107 A
AFFX-CreX-3	AFFX-CreX-3	-565 A	-423 A	-501 A	-101 A
hum_alu_at (hum_alu_at	15091 P	11038 P	16692 P	15763 P
AFFX-DapX-5	AFFX-DapX-5	7 A	37 A	183 A	45 A
AFFX-DapX-M	AFFX-DapX-M	311 A	134 A	378 A	268 A
AFFX-DapX-3	AFFX-DapX-3	-231 A	-161 A	-221 A	-27 A
AFFX-LysX-5	AFFX-LysX-5	21 A	-21 A	67 A	43 A
AFFX-LysX-M	AFFX-LysX-M	-107 A	-180 A	-203 A	-52 A
AFFX-LysX-3	AFFX-LysX-3	165 A	18 A	238 A	247 A
AFFX-PheX-5	AFFX-PheX-5	-78 A	-120 A	-124 A	-116 A
AFFX-PheX-M	AFFX-PheX-M	-204 A	-65 A	-161 A	-208 A
AFFX-PheX-3	AFFX-PheX-3	29 A	97 A	36 A	22 A

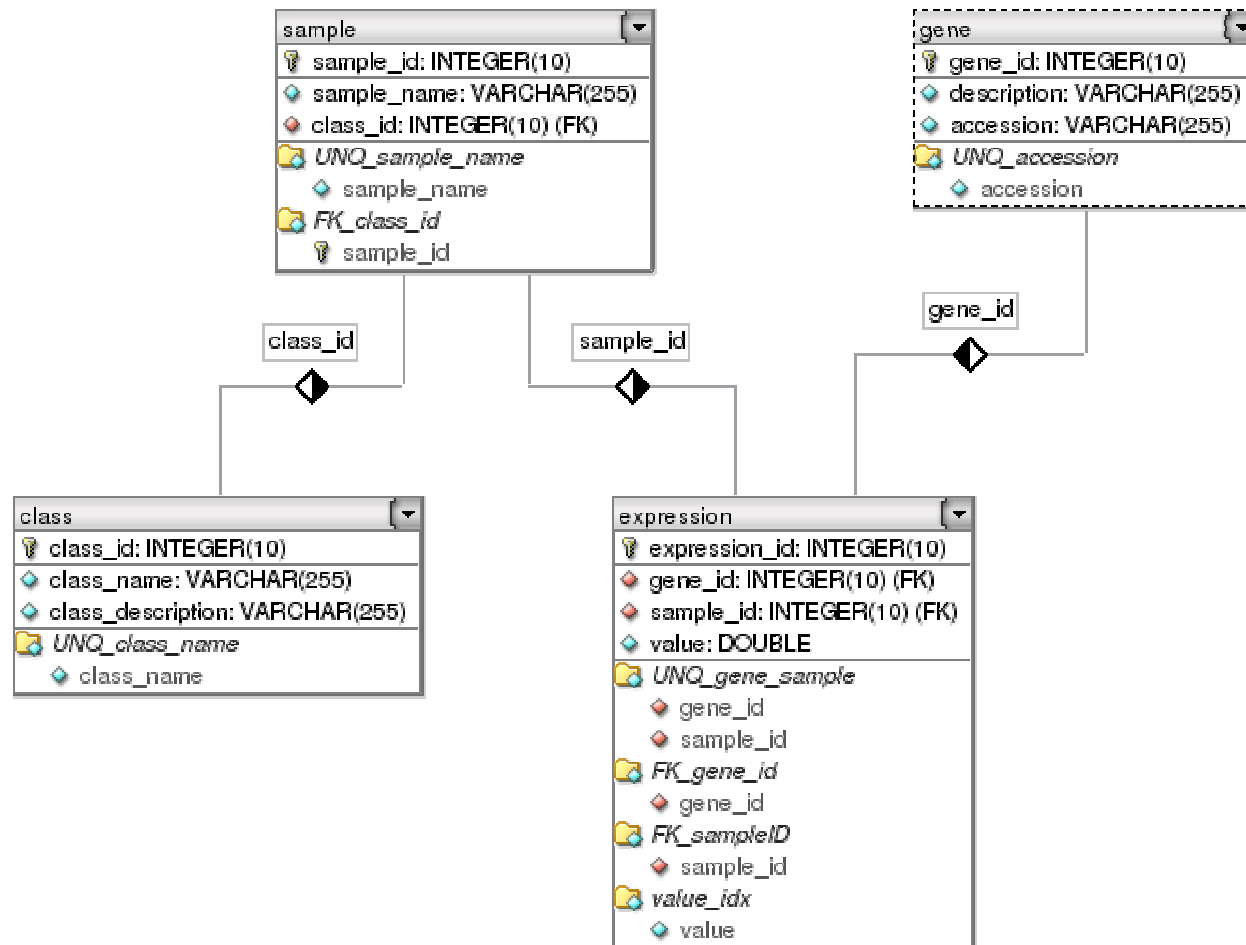
Gene

Expression
Sample 2

Gene Expression

- We'll need again two tables
 - Gene
 - Gene Name
 - Accession
 - Expression
 - Sample Name
 - Gene Name
 - Expression value

Complete Database Schema



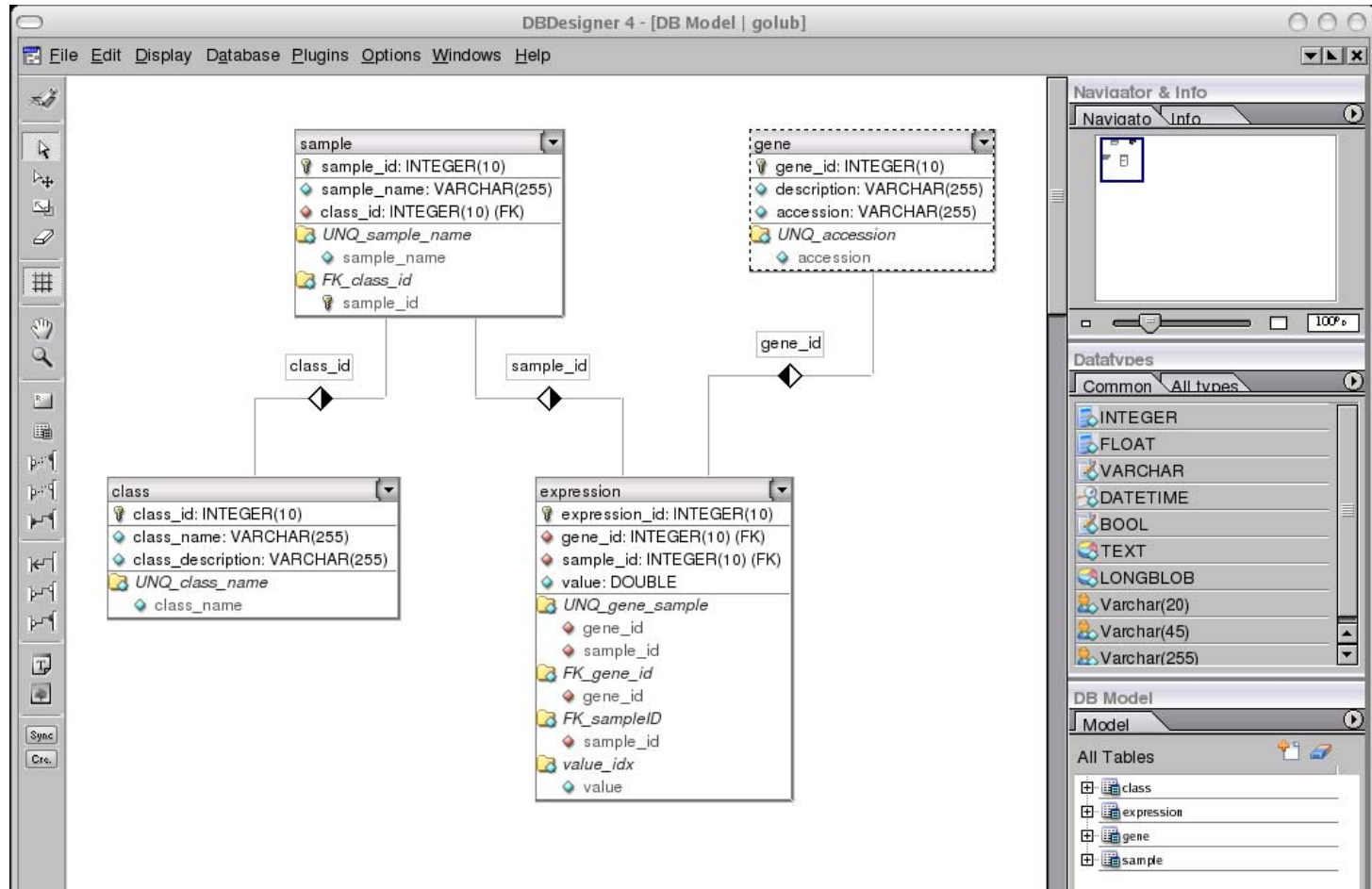
Creating the database

- We can now create the MySQL database by typing every CREATE TABLE statement in the command line

```
CREATE TABLE gene (  
  gene_id int(10) unsigned NOT NULL auto_increment,  
  description varchar(255) default NULL,  
  accession varchar(255) default NULL,  
  PRIMARY KEY (gene_id),  
  KEY accession_idx (accession))
```

- By using tools:
 - PHPMyAdmin (<http://www.phpmyadmin.net>)
 - DBDesigner 4 (<http://www.fabforce.net/dbdesigner4/>)

DBDesigner



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- **Exercise:**
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Lab Exercise 1

- Finally ...
- Create a user having only rights to the Golub database.
- Create the Golub database.
- You can choose if you want to create the database
 - from the command line
 - using PHPMyAdmin ... or
 - just using the provided backup

Lab Exercise 2

- Create a Java program which obtains, from the Golub database you just created, the gene(s) for which expression ≥ 20000 for the most samples.
- An example JDBC URL is
`"jdbc:mysql://localhost/dbName?user=userName&password=secret"`
- Add a possibility for the user to specify an upper and lower threshold on the expression value.