Analysis with MySQL

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With Brad Sawatzky, Tyler Hague

Hall A/C Analysis Workshop
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- MySQL introduction
  - What is …
  - Example
  - Create run info table from Logbook
  - python/ROOT MySQL connector

- MySQL at JLab
  - RCDB (run condition database)
  - Tritium database
  - RCDB for Hall A (work with Brad Sawatzky)

MySQL 101

SQL (Structured Query Language): relational database management system

MySQL: an open source version of SQL

MySQL server: store data, command line interface (already installed on the virtualbox thanks to Ole!)

Advantage:

- Fast, good to store large, structured data
- commands easy to read / learn
- Allow multiple people access / edit data
- Interface with webpage, python, C++ (ROOT)

`MySQL Server -> databases -> Tables -> Columns -> Rows (Entries)`

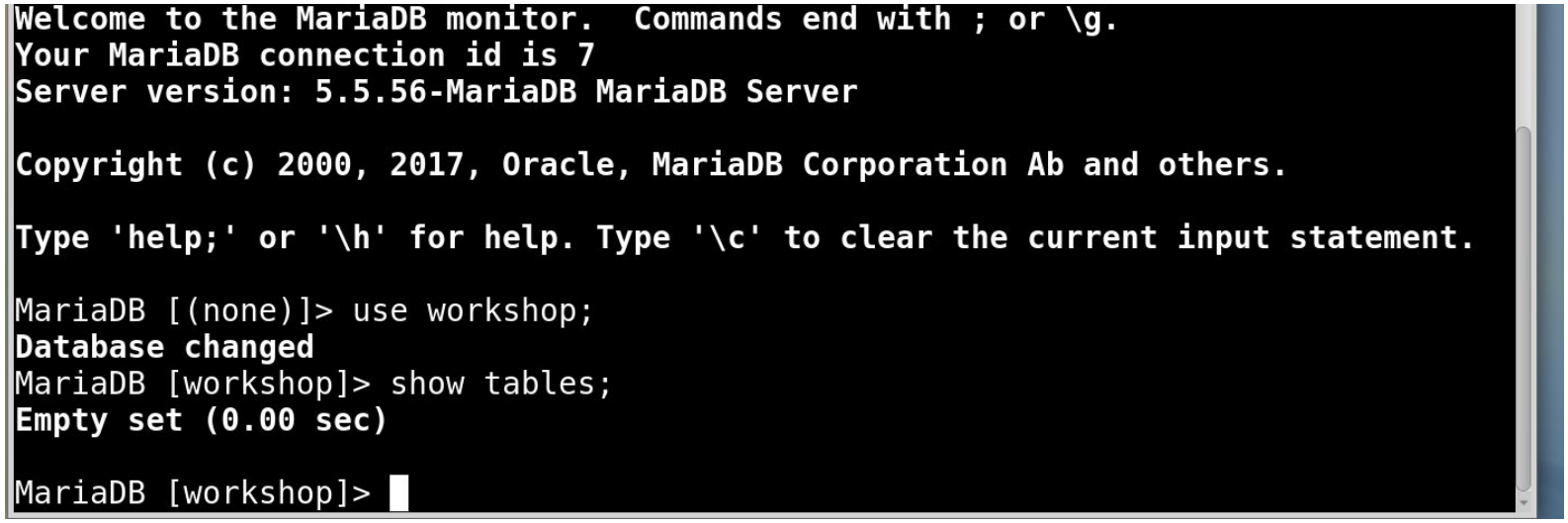
MySQL 101

References:
https://dev.mysql.com/doc/refman/5.7/en/tutorial.html
https://www.ntu.edu.sg/home/ehchua/programming/sql/MySQL_Beginner.html
https://mariadb.com/kb/en/library/sql-statements/

- Semi colon to end command ;
- Enter to break line;
- Command is not case sensitive;

Log in MySQL

>> mysql -u <username> -p<password> -h <hostname> <database name>



Create Table

>> create table target(name varchar(20) default null, type varchar(20) default null, density float(8,3) not null, primary key (name, type));

```
MariaDB [workshop]> show tables;
+--------------------+
| Tables_in_workshop |
+--------------------+
| target             |
+--------------------+
1 row in set (0.00 sec)

MariaDB [workshop]> describe target;
+---------+-------------+------+-----+---------+-------+
| Field   | Type        | Null | Key | Default | Extra |
+---------+-------------+------+-----+---------+-------+
| name    | varchar(20) | NO   | PRI |         |       |
| type    | varchar(20) | NO   | PRI |         |       |
| density | float(8,3)  | NO   |     | NULL    |       |
+---------+-------------+------+-----+---------+-------+
3 rows in set (0.00 sec)
```

Edit table Content

```
MariaDB [workshop]> insert into target values ('tritium','gas',0.77);
Query OK, 1 row affected (0.00 sec)

MariaDB [workshop]> insert into target values ('helium-3','gas',0.53),('carbon f
oil','solid',0.12);
Query OK, 2 rows affected (0.01 sec)
Records: 2  Duplicates: 0  Warnings: 0
```

```
MariaDB [workshop]> update target set density=0.077 where name='tritium';
Query OK, 1 row affected (0.00 sec)
Rows matched: 1  Changed: 1  Warnings: 0

MariaDB [workshop]> update target set density=density/10.0 where name='helium-3'
;
Query OK, 1 row affected (0.01 sec)
Rows matched: 1  Changed: 1  Warnings: 0

MariaDB [workshop]> select * from target;
+-------------+-------+---------+
| name        | type  | density |
+-------------+-------+---------+
| carbon foil | solid |   0.120 |
| helium-3    | gas   |   0.053 |
| tritium     | gas   |   0.077 |
+-------------+-------+---------+
```

Edit table Content

```
MariaDB [workshop]> alter table target add beamtime float(8,3) not null;
Query OK, 3 rows affected (0.02 sec)
Records: 3  Duplicates: 0  Warnings: 0

MariaDB [workshop]> describe target;
+----------+-------------+------+-----+---------+-------+
| Field    | Type        | Null | Key | Default | Extra |
+----------+-------------+------+-----+---------+-------+
| name     | varchar(20) | NO   | PRI |         |       |
| type     | varchar(20) | NO   | PRI |         |       |
| density  | float(8,3)  | NO   |     | NULL    |       |
| beamtime | float(8,3)  | NO   |     | NULL    |       |
+----------+-------------+------+-----+---------+-------+
4 rows in set (0.00 sec)

MariaDB [workshop]> update target set beamtime=100 where type='gas';Query OK, 2 rows affected (0.00 sec)
Rows matched: 2  Changed: 2  Warnings: 0

MariaDB [workshop]> update target set beamtime=10 where type='solid';
Query OK, 1 row affected (0.01 sec)
Rows matched: 1  Changed: 1  Warnings: 0

MariaDB [workshop]> select * from target;+-------------+-------+---------+----------+
| name        | type  | density | beamtime |
+-------------+-------+---------+----------+
| carbon foil | solid |   0.120 |   10.000 |
| helium-3    | gas   |   0.053 |  100.000 |
| tritium     | gas   |   0.077 |  100.000 |
+-------------+-------+---------+----------+
3 rows in set (0.00 sec)
```

Display Table Content

```
MariaDB [workshop]> select sum(beamtime) from target where type='gas';
+---------------+
| sum(beamtime) |
+---------------+
|       200.000 |
+---------------+
1 row in set (0.00 sec)
```

```
MariaDB [workshop]> select name, density from target order by density desc;
+-------------+---------+
| name        | density |
+-------------+---------+
| carbon foil |   0.120 |
| tritium     |   0.077 |
| helium-3    |   0.053 |
+-------------+---------+
3 rows in set (0.00 sec)
```

Python Connector Example:

Create_table.py:

Create a table called “runinfo”

Log2db.py (need the ‘requests’ module)

- Talk to logbook API to get start/end of run content
- Read desired information, write into database

Always CLOSE connection in the end of scripts !

Import/export SQL file

Export:

mysqldump -u… -p… workshop runinfo > workshops.sql

Import:

mysql> use workshop;
mysql> source workshop.sql;

Import/export CSV file

-- need to create table structure in advance, use the command below or run create_table.py

mysql> create table cer_L(run_number int not null, pmt_id int(2) unsigned not null, pedestal int(4) not null,gain int(4) not null,primary key (run_number,pmt_id));

-- load the file:

mysql>LOAD DATA INFILE "cerL.csv" INTO TABLE cer_L COLUMNS TERMINATED BY '\t' OPTIONALLY ENCLOSED BY '"' ESCAPED BY '"' LINES TERMINATED BY '\n' IGNORE 1 LINES;

ROOT Example:

https://root.cern.ch/doc/v608/group__tutorial__sql.html

```
#include "TSQLServer.h"
#include "TSQLResult.h"
#include "TSQLRow.h"

……

 TSQLServer* Server = TSQLServer::Connect("mysql://localhost/workshop","usernamer",”password");
TString  query(Form("select target from runinfot where run_number=%d",runnum));
TSQLResult* result=Server->Query(query.Data());
TSQLRow *row;
row=result->Next();
string tempname;
tempname=row->GetField(0);
Server->Close();
```

Using SQL at JLab

Hall D:

- RCDB (run condition database)
  - Web interface: https://halldweb.jlab.org/rcdb/
  - Github: https://github.com/JeffersonLab/rcdb/wiki/Deployment
- CCDB (Calibration database)

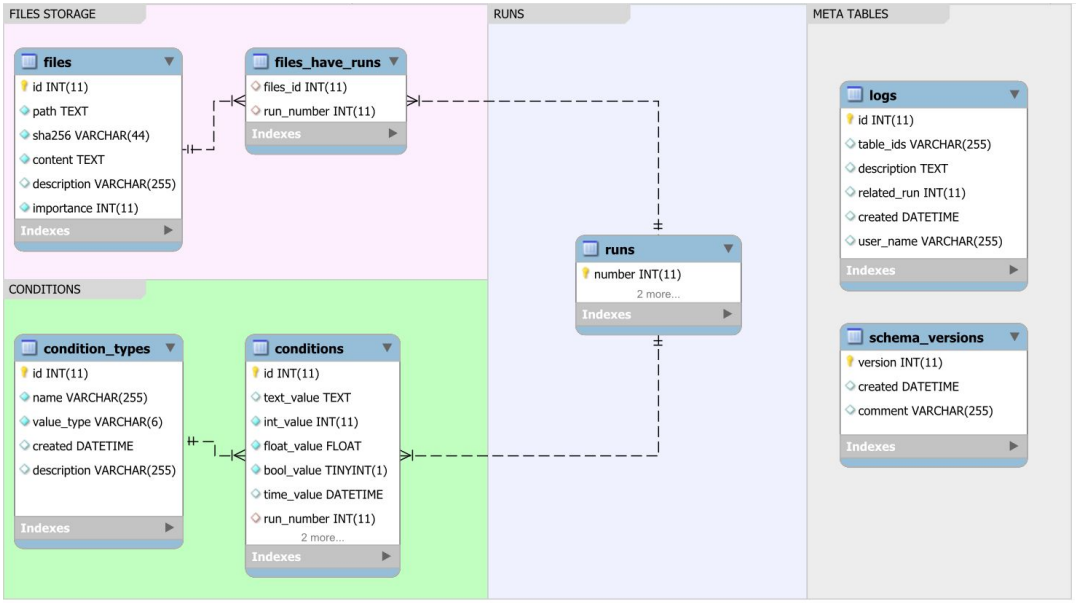
Hall A:

- G2p: https://hallaweb.jlab.org/experiment/g2p/mysql/
- Tritium: https://hallaweb.jlab.org/experiment/Tritium/E12-11-112/tritium_page/runlist.php

Coming Soon: RCDB for Hall A/C

- Work in-progress with Brad and the Hall D RCDB team

- Use the existing RCDB platform maintained by Dmitry Romanov from Hall D
- Well-designed structure, customized connector, web interface
- One database for all experiments, no re-inventing wheels



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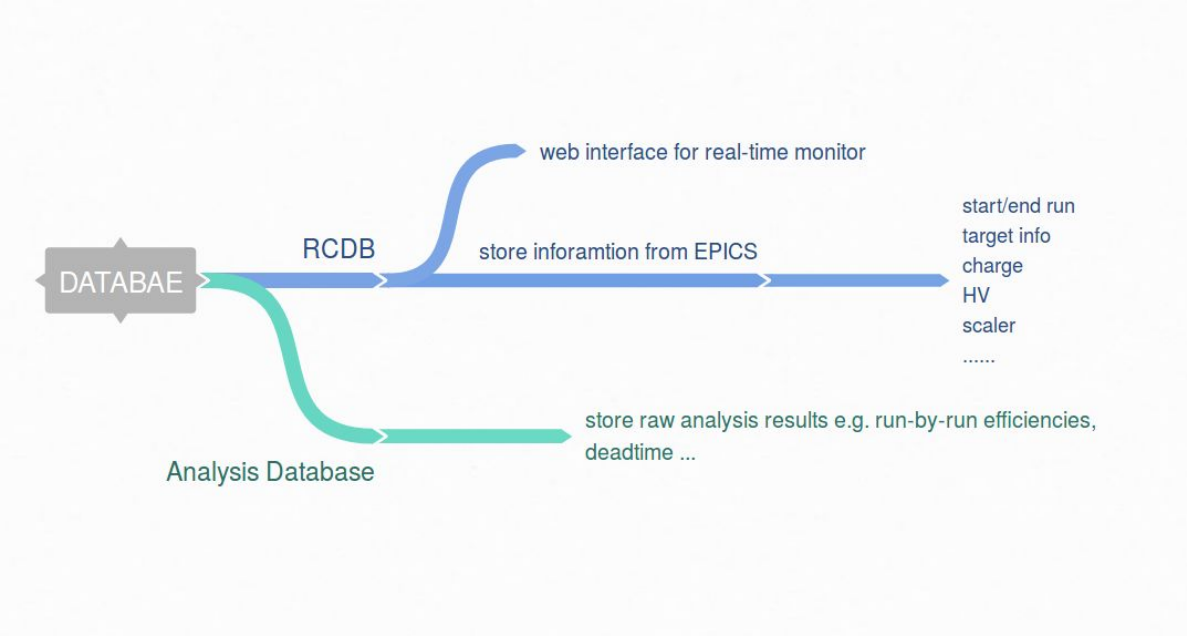

Thanks Hall D RCDB team for the support!