MariaDB Basics

Agenda

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    - Is mariadb listening to the outside world (and how to fix)?
3. Administration
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    - Server System Variables
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    - Getting rid of specific user after user permissions changes
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10. Backup and Restore (Point-In-Time aka PIT)
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11. Migration
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12. Documentation
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    - MySQL Performance Blog
    - Alternative password authentication (salting)

- User statistics

13. Misc
    - When should I use MySQL, when MariaDB

Add-Ons (Further read) / backlog

1. Architecture of MariaDB
    - Query Cache Usage and Performance
2. Administration
    - Handling general_log
3. Training Data
    - Setup training data "contributions"
4. Optimal use of indexes
    - Index-Types
        - Describe and indexes
        - Find out indexes
    - Index and Functions (Cool new feature in MySQL 5.7)
    - Index and Likes
    - profiling-get-time-for-execution-of.query
    - Find out cardinality without index
5. Monitoring
    - What to monitor?
6. Replication
    - Slave einrichten -gtid
    - Slave einrichten - master_pos
    - MaxScale installieren
    - Reference: MaxScale-Proxy mit Monitoring
    - Walkthrough:Automatic Failover Master Slave
7. Tools
    - pt-query-digist - analyze slow logs
    - pt-online-schema-change howto
8. Diagnosis and measurement of performance
    - Best practices to narrow down performance problems
9. Performance and optimization of SQL statements
    - Do not use '*' whenever possible
    - Be aware of subselects - Example 1
    - Optimizer-hints (and why you should not use them)
10. Replication
    - Replikation Read/Write
11. Performance
    - Best Practices
    - Example sys-schema and Reference
    - Change schema online (pt-online-schema-change)
    - Optimizer-Hints
12. Upgrading / Patching
    - Upgrade vom 10.3 (Distri Ubuntu 20.04) -> 10.4 (MariaDB-Foundation)
13. Security and User Rights
    - Create User/Grant/Revoke - Management of users
    - Getting rid of specific user after user permissions changes
    - Disable unix_socket authentication for user
    - Debug and Setup External Connection

- Get Rights of user
- Auth with unix_socket
- User- and Permission-concepts (best-practice)
- Setup external access

14. Backup and Restore (Point-In-Time aka PIT)

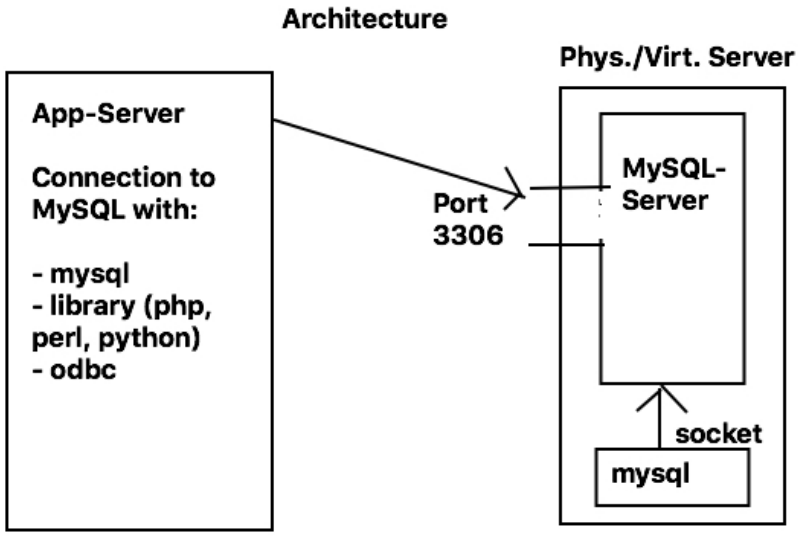
- General
- Backup and Create new database based on backup
- PIT - Point-in-time-Recovery Exercise
- Backup / Recover to Network Destination
- Flashback
- Use xtrabackup for MariaDB 5.5

15. Documentation / Literature

- Effective MySQL
- MariaDB Galera Cluster
- MySQL Galera Cluster

Architecture of MariaDB

Architecture Server



Storage Engines

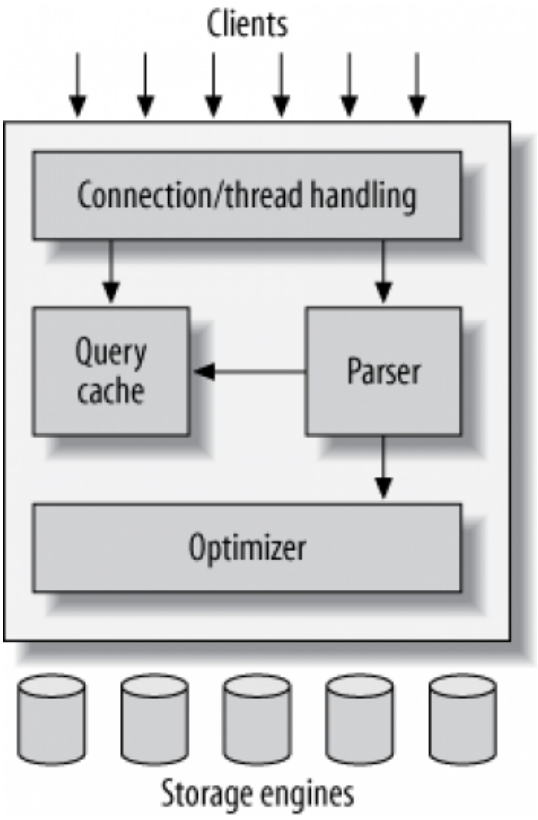
Why ?

```
Let's you choose:
How your data is stored
```

What ?

- Performance, features and other characteristics you want

Looks like



What do they do ?

- In charge for: Responsible for storing and retrieving all data stored in MySQL
- Each storage engine has its:
  - Drawbacks and benefits
- Server communicates with them through the storage engine API
  - this interface hides differences
  - makes them largely transparent at query layer
  - api contains a couple of dozen low-level functions e.g. “begin a transaction”, “fetch the row that has this primary key”

Storage Engine do not ....

- Storage Engines do not parse SQL
- Storage Engines do not communicate with each other

They simply .....

- They simply respond to requests from the server

Which are the most important one ?

- MyISAM/Aria
- InnoDB
- Memory
- CSV
- Blackhole (/dev/null)
- Archive
- Federated/FederatedX

Installation / Configuration

Installation (Ubuntu)

Install version from distribution (older version)

```
apt update
apt install mariadb-server
```

Install Newest version from mariadb

```
https://downloads.mariadb.org/mariadb/repositories/
## repo
sudo apt-get install software-properties-common
sudo apt-key adv --fetch-keys 'https://mariadb.org/mariadb_release_signing_key.asc'
sudo add-apt-repository 'deb [arch=amd64,arm64,ppc64el] https://mirror.dogado.de/mariadb/repo/10.5/ubuntu focal
main'

apt update
apt install mariadb-server
```

Secure installation

```
mariadb-secure-installation
## OR: if not present before 10.4
mysql_secure_installation
```

Installation (Debian)

Install version from distribution (older version)

```
apt update
apt install mariadb-server
```

Install Newest version from mariadb

```
https://downloads.mariadb.org/mariadb/repositories/
```

```
## repo
sudo apt-get install apt-transport-https curl
sudo curl -o /etc/apt/trusted.gpg.d/mariadb_release_signing_key.asc
'https://mariadb.org/mariadb_release_signing_key.asc'
sudo sh -c "echo 'deb https://ftp.agdsn.de/pub/mirrors/mariadb/repo/10.6/debian bullseye main'
>>/etc/apt/sources.list"
```

```
apt update
apt install mariadb-server
```

Secure installation

```
mariadb-secure-installation
## OR: if not present before 10.4
mysql_secure_installation
```

start/stop/status and logs

```
## How to find out if it is running
systemctl status mariadb

## To stop it
systemctl stop mariadb

## To start it
systemctl start mariadb

## to restart it
systemctl restart mariadb

## How it the configuration of the service
systemctl cat mariadb

## Logs
```

```
## last 10 lines
systemctl status mariadb
journalctl -u mariadb
```

Is mariadb listening to the outside world (and how to fix)?

not the case

```
lsof -i
## or
netstat -ant
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 127.0.0.1:3306          0.0.0.0:*               LISTEN

## <- in this case not - localhost
```

Yes !

```
## ubuntu 20.04
## change to listen on all interfaces
## vi /etc/mariadb-conf.d/50-server.cnf
## this is only for the mysqld standalone daemon
[mysqld]
bind-address = 0.0.0.0

## restart
systemctl restart mariadb

lsof -i
## connect to the server by external interface (e.g.  eth0 )
mysql -h 10.0.3.3
```

Administration

Debug configuration error

Producing

```
## make an nonsense entry
/etc/mysql/mariadb.conf.d/50-server.cnf
[mysqld]
nonsense
```

Walkthrough

```
## Service is not restarting - error giving
systemctl restart mariadb.service

## Step 1 : status -> what do the logs tell (last 10 lines)
systemctl status mariadb.service

## no findings -> step 2:
journalctl -xe

## no findings -> step 3:
journalctl -u mariadb.service
## or journalctl -u mariadb

## no findings -> step 4:
## search specific log for service
## and eventually need to increase the log level
## e.g. with mariadb (find through internet research)
```

```
less /var/log/mysql/error.log

## Didn't find something -> step 5
## General Log
## Debian/Ubuntu
/var/log/syslog
## REdhat/Centos
/var/log/messages
```

Find errors in logs quickly

```
cd /var/log/mysql
## -i = case insensitive // no matter if capital or lower letters
cat error.log | grep -i error
```

Find the wrong configuration option

```
grep -nir nonsense /etc/mysql
```

Server System Variables

```
MariaDB [(none)]> show global variables like '%long%';
+-------------------------------------------------------+-----------+
| Variable_name                                         | Value     |
+-------------------------------------------------------+-----------+
| deadlock_search_depth_long                            | 15        |
| deadlock_timeout_long                                 | 50000000  |
| long_query_time                                       | 10.000000 |
| max_long_data_size                                    | 16777216  |
| performance_schema_events_stages_history_long_size    | -1        |
| performance_schema_events_statements_history_long_size | -1        |
| performance_schema_events_waits_history_long_size     | -1        |
+-------------------------------------------------------+-----------+
7 rows in set (0.001 sec)

MariaDB [(none)]> select @@long_query_Time
    -> ;
+--------------------+
| @@long_query_Time |
+--------------------+
|          10.000000 |
+--------------------+
1 row in set (0.000 sec)

MariaDB [(none)]> select @@long_query_time
    -> ;
+--------------------+
| @@long_query_time |
+--------------------+
|          10.000000 |
+--------------------+
1 row in set (0.000 sec)

MariaDB [(none)]> select @@GLOBAL.long_query_time
    -> ;
+---------------------------+
| @@GLOBAL.long_query_time |
+---------------------------+
|                 10.000000 |
+---------------------------+
1 row in set (0.000 sec)

MariaDB [(none)]> select @@global.long_query_time
    -> ;
+---------------------------+
| @@global.long_query_time |
```

```
+--------------------------+
|                10.000000 |
+--------------------------+
1 row in set (0.000 sec)
```

```
## Within server
SET GLOBAL general_log = 1;
```

Show structure of database

```
mysql>use mysql;
mysql>describe columns_priv;
mysql>show create table columns_priv;
```

Binary Logging

General

- It is disabled by default

Why and when to use it ?

- Not Needed Galera Cluster (3 - Node - Cluster), but bin_log_format = ROW
- Replication
- PIT (Point-In-Time) - Recovery (e.g. recover to start from 4 a.m. with full backup + binary log)

How to enable it ?

```
## Ubuntu
## vi /etc/mysql/mariadb.conf.d/50-server.cnf
[mysqld]
log-bin
```

```
## Restart server
systemctl restart mariadb
```

Find out if it is activated

```
mysql -e "show variables like 'log_bin%'"
```

How to view the binary-log

```
## Adding a new database to see it in the binary logs
mysql -e "create database bintest;"
```

```
cd /var/lib/mysql
mysqlbinlog -vv mysqld-bin.000001
## in the special configuration from /etc/mysql/... gets in the way
mysqlbinlog -vv mysqld-bin.000001
```

Kill Session/User

```
MariaDB [(none)]> show processlist;
+----+-------------+-----------+------+---------+------+--------------------------+--------------------+----------
+
| Id | User        | Host      | db   | Command | Time | State                    | Info               | Progress
|
+----+-------------+-----------+------+---------+------+--------------------------+--------------------+----------
| 37 | root        | localhost | NULL | Query   |    0 | Init                     | show processlist   |    0.000
|
| 38 | root        | localhost | NULL | Query   |   10 | User sleep               | select sleep(1000) |    0.000
|

 # kill thread 38. Connection will be interrupted. User session will be cancelled
```

```
 kill 38
```

```
## Alternative: Get information from processlist out of information_schema
select * from information_schema.processlist where user='training';
select * from information_schema.processlist
```

SQL Commands / Database / Table-Management

Numeric Data Types

- https://mariadb.com/kb/en/numeric-data-type-overview/

Examples

```
## Connect to the server with mysql-client
mysql
```

Create database/table and inserting

```
create database training;
show databases;
use training;
create table courses (id smallint, name varchar(80), primary key(id));
insert into courses (id,name) values (2,'MariaDB Administration');
```

Administrative Commands

```
use mysql;
show tables;

## Want to know more about a specific table
show create table user;
```

Changing Structure ALTER

Example - Step 1: Create structure first

```
-- done within the mysql interface
create database training;
use training;

CREATE TABLE courses (
  id smallint(6) NOT NULL,
  name varchar(80) DEFAULT NULL,
  PRIMARY KEY (id)
);

show tables;
show create table courses;
```

Example - Step 2: Modify structure

```
ALTER TABLE courses ADD room VARCHAR(40), ADD price DECIMAL(5,2);
ALTER TABLE courses MODIFY price DECIMAL(6,2);
```

INSERT/UPDATE/DELETE/TRUNCATE with example

Prerequisites

setup database and table

INSERT

```
-- only the case in mysql (in php using the appropriate php command to use specific database
use training;
```

```
INSERT INTO courses (id,name) values (1,'Galera Training');
INSERT INTO courses (id,name,room,price) values (2,'MariaDB Administration','Bukarest',1000.50);
-- better in terms of performance then select * FROM
-- showing all
SELECT id,name FROM courses;
SELECT id,name FROM courses WHERE id = 2;
```

UPDATE

```
UPDATE courses SET room='Berlin',price=800.7555 WHERE id = 1;
```

DELETE

```
DELETE FROM courses WHERE id = 2;
```

TRUNCATE (will delete all data)

```
TRUNCATE courses;
```

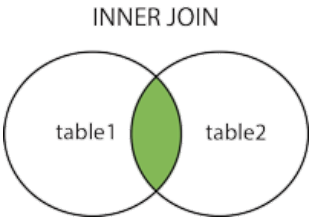
JOINS

Overview over joins

What is a JOIN for ?

- combines rows from two or more tables
- based on a related column between them.

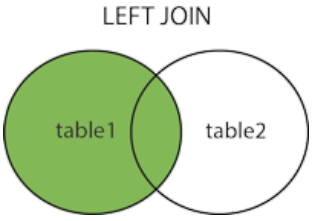
MySQL/MariaDB (Inner) Join



MySQL/MariaDB (Inner) Join (explained)

- Inner Join and Join are the same
- Returns records that have matching values in both tables
- Inner Join, Cross Join and Join
  - are the same in MySQL

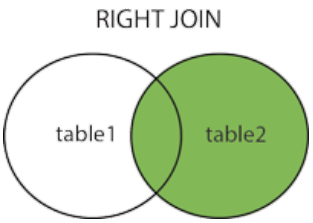
MySQL/MariaDB Left Join



MySQL/MariaDB Left (outer) Join (explained)

- Return all records from the left table
- *AND* the matched records from the right table
- The result is NULL on the right side
  - if there are no matched columns on the right
- Left Join and Left Outer Join are the same

MySQL Right Join



MySQL Right Join (explained)

- Return all records from the right table
  - *AND* the matched records from the left table
- Right Join and Right Outer Join are the same

MySQL Straight Join

- MySQL (inner) Join and Straight Join are the same
- **Difference:**
  - The left column is always read first
- **Downside:**
  - Bad optimization through mysql (query optimizer)
- **Recommendation:**
  - Avoid straight join if possible
  - use join instead

Type of Joins

- [inner] join
  - **inner join** and **join** are the same
- left [outer] join
- right [outer] join
- full [outer] join
- straight join < equals > join
- cross join = join (in mysql)
- natural join <= equals => join (but syntax is different)

In Detail: [INNER] JOIN

- Return rows when there
  - is a match in both tables
- Example

```
SELECT actor.first_name, actor.last_name, film.title
FROM film_actor
INNER JOIN actor ON film_actor.actor_id = actor.actor_id
INNER JOIN film ON film_actor.film_id = film.film_id;
```

In Detail: Joining without JOIN - Keyword

- Explanation: Will have the same query execution plan as [INNER] JOIN

```
SELECT actor.first_name, actor.last_name, film.title
FROM film_actor,actor,film
where film_actor.actor_id = actor.actor_id
and film_actor.film_id = film.film_id;
```

In Detail: Left Join

- Return all rows from the left side
  - even if there is not result on the right side
- Example

```
SELECT
    c.customer_id,
```

```
    c.first_name,
    c.last_name,
    a.actor_id,
    a.first_name,
    a.last_name
FROM customer c
LEFT JOIN actor a
ON c.last_name = a.last_name
ORDER BY c.last_name;
```

In Detail: Right Join

- Return all rows from the right side
  - even if there are no results on the left side
- Example

```
SELECT
    c.customer_id,
    c.first_name,
    c.last_name,
    a.actor_id,
    a.first_name,
    a.last_name
FROM customer c
RIGHT JOIN actor a
ON c.last_name = a.last_name
ORDER BY a.last_name;
```

In Detail: Having

- Simple: WHERE for GroupBy (because where does not work here)
- Example

```
SELECT last_name, COUNT(*)
FROM sakila.actor
GROUP BY last_name
HAVING count(last_name) > 2
```

Internal (type of joins) - NLJ

- NLJ - (Nested Loop Join)

```
for each row in t1 matching range {
  for each row in t2 matching reference key {
    for each row in t3 {
      if row satisfies join conditions, send to client
    }
  }
}
```

Internal (type of joins) - BNL

- BNL - (Block Nested Loop)
  - in explain: -> using join buffer
  - columns of interest to a join are stored in join buffer
    - --> not whole rows.
  - join_buffer_size system variable
    - -> determines the size of each join buffer used to process a query.
- https://dev.mysql.com/doc/refman/5.7/en/nested-loop-joins.html

BNL - Who can I see, if it is used ?

- Can be seen in explain

```
| 1 | PRIMARY | SE | ALL | PRIMARY | NULL | NULL | NULL | 5 | Using where; Using join buffer (Block Nested Loop)
```

```
explain SELECT a.* FROM actor a  INNER JOIN actor b where a.actor_id > 20 and b.actor_id < 20
```

```
When using a Block Nested-Loop Join, MySQL will, instead of automatically joining t2,
insert as many rows from t1 that it can into a join buffer
and then scan the appropriate range of t2 once,
matching each record in t2 to the join buffer.
From here, each matched row is then sent to the next join,
which, as previously discussed, may be another table,
t3, or, if t2 is the last table in the query,
the rows may be sent to the network.
```

BNL's - Refs:

- https://www.burnison.ca/notes/fun-mysql-fact-of-the-day-block-nested-loop-joins

Example Joins

Structure of join

```
## In General
## Do not execute, no real life example
SELECT field_from_tablea,field_from_tableb
FROM table_a a join table_b b
ON a.id = b.actor_id;
```

```
## Step 1: get some data from table 1
select c.last_name,c.address_id from customer c;

## Step 2: Refer to the second table
SELECT c.last_name,c.address_id,a.address_id FROM customer c LEFT JOIN address a ON c.address_id=a.address_id;

## Step 3: join over 3 tables,
SELECT * from city;
SELECT c.first_name,c.last_name,a.address,a.postal_code,ct.city FROM customer c JOIN address a ON
c.address_id=a.address_id JOIN city ct ON a.city_id =ct.city_id;
```

Indexes

Sakila, Indexes and Examples

```
use sakila;
select * from actor;

show create table from actor;
show indexes from actor;
```

Index is being used (System can only read indexes from left to right)

```
select * from actor where last_name like 'A%';
explain select * from actor where last_name like 'A%';

+------+-------------+-------+-------+---------------------+---------------------+---------+------+------+--------
---------------+
| id   | select_type | table | type  | possible_keys       | key                 | key_len | ref  | rows | Extra
|
+------+-------------+-------+-------+---------------------+---------------------+---------+------+------+--------
---------------+
|    1 | SIMPLE      | actor | range | idx_actor_last_name | idx_actor_last_name | 182     | NULL | 7    | Using
index condition |
+------+-------------+-------+-------+---------------------+---------------------+---------+------+------+--------
---------------+
1 row in set (0.000 sec)
```

Index cannot be used, because index would need to be read from right to left (and cannot)

```
select * from actor where last_name like '%N';
explain select * from actor where last_name like '%N';

-- NO INDEX BEIG USED -> type -> ALL -> which means table scan (looking into every single line in the table)
+------+-------------+-------+------+---------------+------+---------+------+------+-------------+
| id   | select_type | table | type | possible_keys | key  | key_len | ref  | rows | Extra       |
+------+-------------+-------+------+---------------+------+---------+------+------+-------------+
|    1 | SIMPLE      | actor | ALL  | NULL          | NULL | NULL    | NULL | 200  | Using where |
+------+-------------+-------+------+---------------+------+---------+------+------+-------------+
1 row in set (0.000 sec)
```

Creating index for better performance

```
use sakila;
create table actor2 as select * from actor;
explain select * from actor2 where first_name like 'D%';

create index idx_actor2_first_name on actor2 (first_name);
show indexes from actor2;
-- index is used
explain select * from actor2 where first_name like 'D%';
```

```
-- output
+--------+------------+-----------------------+--------------+-------------+-----------+-------------+----------+-
-------+------+------------+---------+---------------+---------+
| Table  | Non_unique | Key_name              | Seq_in_index | Column_name | Collation | Cardinality | Sub_part |
Packed | Null | Index_type | Comment | Index_comment | Ignored |
+--------+------------+-----------------------+--------------+-------------+-----------+-------------+----------+-
-------+------+------------+---------+---------------+---------+
| actor2 |          1 | idx_actor2_first_name |            1 | first_name  | A         |         201 |     NULL |
NULL   |      | BTREE      |         |               | NO      |
+--------+------------+-----------------------+--------------+-------------+-----------+-------------+----------+-
-------+------+------------+---------+---------------+---------+
1 row in set (0.001 sec)

MariaDB [sakila]> explain select * from actor2 where first_name like 'D%';
+------+-------------+--------+-------+-----------------------+-----------------------+---------+------+------+---
--------------------+
| id   | select_type | table  | type  | possible_keys         | key                   | key_len | ref  | rows |
Extra                 |
+------+-------------+--------+-------+-----------------------+-----------------------+---------+------+------+---
--------------------+
|    1 | SIMPLE      | actor2 | range | idx_actor2_first_name | idx_actor2_first_name | 182     | NULL | 7    |
Using index condition |
+------+-------------+--------+-------+-----------------------+-----------------------+---------+------+------+---
--------------------+
1 row in set (0.000 sec)
```

Never ever use functions on where -> field_name side !!

```
## Problem of order
## We need to get last_name data first, before we can make a substring
## So we need get every single dataset
explain select first_name,last_name from actor where substring(last_name,1,4) = 'TORN'
```

But this works

```
## because it is statik and on the value side
explain select first_name,last_name from actor where last_name  like concat('A','%');
```

Drop old index and create index over 2 fields

- Second query does not take index into account because index only works from left to right

```
drop index idx_actor2_fist_name on actor2;
create index idx_actor2_first_name_last_name on actor2 (first_name,last_name);

MariaDB [sakila]> explain select * from actor2 where first_name like 'A%';
+------+-------------+--------+-------+--------------------------------+--------------------------------+-------
--+------+------+-----------------------+
| id   | select_type | table  | type  | possible_keys                  | key                            |
key_len | ref  | rows | Extra                 |
+------+-------------+--------+-------+--------------------------------+--------------------------------+-------
--+------+------+-----------------------+
|    1 | SIMPLE      | actor2 | range | idx_actor2_first_name_last_name | idx_actor2_first_name_last_name | 182
| NULL | 13   | Using index condition |
+------+-------------+--------+-------+--------------------------------+--------------------------------+-------
--+------+------+-----------------------+
1 row in set (0.001 sec)

MariaDB [sakila]> explain select * from actor2 where last_name like 'A%';
+------+-------------+--------+------+---------------+------+---------+------+------+-------------+
| id   | select_type | table  | type | possible_keys | key  | key_len | ref  | rows | Extra       |
+------+-------------+--------+------+---------------+------+---------+------+------+-------------+
|    1 | SIMPLE      | actor2 | ALL  | NULL          | NULL | NULL    | NULL | 201  | Using where |
+------+-------------+--------+------+---------------+------+---------+------+------+-------------+
1 row in set (0.001 sec)
```

Activation - Slow Query Log

Walkthrough

```
## Step 1
## /etc/my.cnf.d/mariadb-server.cnf
## or: debian /etc/mysql/mariadb.conf.d/50-server.cnf
[mysqld]
slow-query-log

## Step 2
mysql>SET GLOBAL long_query_time = 0.000001
mysql>SET long_query_time = 0.000001

## Step 3
## run some time / data
## and look into your slow-query-log
/var/lib/mysql/hostname-slow.log
```

Show queries that do not use indexes

```
SET GLOBAL log_queries_not_using_indexes=ON;
```

Increace verbosity (what system talks about)

```
SET GLOBAL log_slow_verbosity='query_plan,explain'
```

Show queries that have no indexes being used.

```
SET GLOBAL log_queries_not_using_indexes=ON;
```

Reference

- https://mariadb.com/kb/en/slow-query-log-overview/

Percona-toolkit-Installation

Walkthrough

```
## Howto
## https://www.percona.com/doc/percona-toolkit/LATEST/installation.html
```

```
## Step 1: repo installieren mit deb -paket
wget https://repo.percona.com/apt/percona-release_latest.focal_all.deb;
apt update;
apt install -y curl;
dpkg -i percona-release_latest.focal_all.deb;
apt update;
apt install -y percona-toolkit;
```

Training Data

Setup sakila test database

```
cd /usr/src
wget https://downloads.mysql.com/docs/sakila-db.tar.gz
tar xvf sakila-db.tar.gz
cd sakila-db/
ls -la
mysql < sakila-schema.sql
mysql < sakila-data.sql
## verify - database is present
mysql -e 'show databases;';
```

Security and User Rights

Create User/Grant/Revoke - Management of users

Create user

```
create user training@localhost identified by 'yourpassword';
## connect to mysql with this user:
mysql -utraining -p
show grants;
show databases;
```

Drop user (=delete user)

```
drop user training@localhost
```

Change User (e.g. change authentication)

```
## change pass
alter user training@localhost identified by 'newpassword';
```

Set global or db rights for a user

```
grant all on *.* to training@localhost
```

```
## only a specific db
grant all on training.* to training@localhost
```

Revoke global or revoke right from a user

```
revoke select on *.* from training@localhost
## only from a specific db
revoke select on training.* from training@localhost
```

Useful command to find out users:

```
select user,host from mysql.user;
```

Refs:

- https://mariadb.com/kb/en/grant/#the-grant-option-privilege

- https://mariadb.com/kb/en/revoke/

Getting rid of specific user after user permissions changes

Why ?

- You might have changed the grants, but they only reflect after a reconnect

Howto

```
## step 1: git thread_id id of user
MariaDB [information_schema]> select id,user,host,command from processli
st where user='training';
+----+----------+-------------------+---------+
| id | user     | host              | command |
+----+----------+-------------------+---------+
| 75 | training | jochen-wt6y:42026 | Sleep   |
+----+----------+-------------------+---------+
1 row in set (0.001 sec)

## step 2: kill thread_id = connection_id  = id
kill 75
```

Secure with SSL server/client

Variant 1: Setup 1-way ssl encryption

Create CA and Server-Key

```


## On Server - create ca and certificates
sudo mkdir -p /etc/my.cnf.d/ssl
sudo cd /etc/my.cnf.d/ssl

## create ca.
sudo openssl genrsa 4096 > ca-key.pem

## create ca-certificate
## Common Name: MariaDB CA
sudo openssl req -new -x509 -nodes -days 365000 -key ca-key.pem -out ca-cert.pem

## create server-cert
## Common Name: server1.training.local
## Password: --- leave empty ----
sudo openssl req -newkey rsa:2048 -days 365000 -nodes -keyout server-key.pem -out server-req.pem

## Next process the rsa - key
sudo openssl rsa -in server-key.pem -out server-key.pem

## Now sign the key
sudo openssl x509 -req -in server-req.pem -days 365000 -CA ca-cert.pem -CAkey ca-key.pem -set_serial 01 -out
server-cert.pem
```

Verify certificates

```
openssl verify -CAfile ca-cert.pem server-cert.pem


```

Configure Server

```
## create file
## /etc/my.cnf.d/z_ssl.cnf
[mysqld]
ssl-ca=/etc/my.cnf.d/ssl/ca-cert.pem
ssl-cert=/etc/my.cnf.d/ssl/server-cert.pem
ssl-key=/etc/my.cnf.d/ssl/server-key.pem
### Set up TLS version here. For example TLS version 1.2 and 1.3 ##
## Starts from mariadb 10.4.6 not possible before. !!!!
tls_version = TLSv1.2,TLSv1.3
```

```
## Set ownership
chown -vR mysql:mysql /etc/my.cnf.d/ssl/
```

Restart and check for errors

```
systemctl restart mariadb
journalctl -u mariadb
```

Test connection on client

```
## only if we use option --ssl we will connect with ssl
mysql --ssl -uxyz -p -h <ip-of-server>
mysql>status
SSL:                    Cipher in use is TLS_AES_256_GCM_SHA384
```

Force to use ssl

```
## on server
## now client can only connect, when using ssl
mysql> grant USAGE on *.* to remote@10.10.9.144 require ssl;
```

Variant 2: 1-way ssl-encryption but checking server certificate

Prerequisites

```
server1: 192.168.56.103
client1: 192.168.56.104
```

Copy ca-cert to client

```
## on server1
cd /etc/my.cnf.d/ssl
scp ca-cert.pem kurs@192.168.56.104:/tmp

## on clien1
cd /etc/my.cnf.d
mkdir ssl
cd ssl
mv /tmp/ca-cert.pem .
```

Configure client1 - client -config

```
sudo vi /etc/my.cnf.d/mysql-clients.cnf

Append/edit in [mysql] section:

### MySQL Client Configuration ##
ssl-ca=/etc/my.cnf.d/ssl/ca-cert.pem

###  Force TLS version for client too
##tls_version = TLSv1.2,TLSv1.3
#### This option is disabled by default ###
#### ssl-verify-server-cert ###

## only works if you have no self-signed certificate
ssl-verify-server-cert
ssl

## domain-name in hosts setzen
## because in dns
vi /etc/hosts
192.168.56.103 server1.training.local

## now you to connect with hostname
## otherwice no check against certificate can be done
mysql -uext -p -h server1.training.local
```

```
## if it does not work, you get
ERROR 2026 (HY000): SSL connection error: Validation of SSL server certificate failed
```

Variant 3: 2-way - Security (Encryption) - validated on server and client

Client - Create certificate on server

- we are using the same ca as on the server

```
## on server1
cd /etc/my.cnf.d/ssl
## Bitte Common-Name: MariaDB Client
openssl req -newkey rsa:2048 -days 365 -nodes -keyout client-key.pem -out client-req.pem

## process RSA - Key
## Eventually also works without - what does it do ?
## openssl rsa -in client-key.pem -out client-key.pem

## sign certficate with CA
openssl x509 -req -in client-req.pem -days 365 -CA ca-cert.pem -CAkey ca-key.pem -set_serial 01 -out client-
cert.pem
```

Client - Zertifikate validieren

```
openssl verify -CAfile ca-cert.pem client-cert.pem
```

Zertifikate für Client zusammenpacken

```
mkdir cl-certs; cp -a client* cl-certs; cp -a ca-cert.pem cl-certs ; tar cvfz cl-certs.tar.gz cl-certs
```

Zertifikate auf Client transferieren

```
scp cl-certs.tar.gz kurs@192.168.56.104:/tmp
```

Zertifikate einrichten

```
## on client1
## cleanup old config
rm /etc/my.cnf.d/ssl/ca-cert.pem

mv /tmp/cl-certs.tar.gz /etc/my.cnf.d/ssl
cd /etc/my.cnf.d; tar xzvf cl-certs.tar.gz

vi mysql-clients.cnf
[mysql]
ssl-ca=/etc/my.cnf.d/cl-certs/ca-cert.pem
ssl-cert=/etc/my.cnf.d/cl-certs/client-cert.pem
ssl-key=/etc/my.cnf.d/cl-certs/client-key.pem
```

Setup user to use client-certificate

```
## Client certificate needs to be there
ALTER USER 'alice'@'%'
   REQUIRE X509;

## Client certificate needs to be a specific one
ALTER USER 'alice'@'%'
   REQUIRE SUBJECT '/CN=alice/O=My Dom, Inc./C=US/ST=Oregon/L=Portland';

## Reference:
https://mariadb.com/kb/en/securing-connections-for-client-and-server/
```

Test the certificate

```
## on server1 verify: X509 for user
select user,ssl_type from mysql.user where user='ext'
```

```
## connect from client1
## Sollte die Verbindung nicht klappen stimmt auf dem
## Client etwas mit der Einrichtung nicht
mysql -uext -p -h192.168.56.103
mysql> status
```

Ref

- https://www.cyberciti.biz/faq/how-to-setup-mariadb-ssl-and-secure-connections-from-clients/

Secure with ssl for ubuntu/debian

Variant 1: Setup 1-way ssl encryption

Create CA and Server-Key

```
## On Server - create ca and certificates
mkdir -p /etc/mysql/ssl; cd /etc/mysql/ssl

## create ca.
openssl genrsa 4096 > ca-key.pem

## create ca-certificate
## Common Name: MariaDB CA
openssl req -new -x509 -nodes -days 365000 -key ca-key.pem -out ca-cert.pem

## create server-cert
## Common Name: server1.training.local
## Password: --- leave empty ----
openssl req -newkey rsa:2048 -days 365000 -nodes -keyout server-key.pem -out server-req.pem

## Next process the rsa - key
openssl rsa -in server-key.pem -out server-key.pem

## Now sign the key
openssl x509 -req -in server-req.pem -days 365000 -CA ca-cert.pem -CAkey ca-key.pem -set_serial 01 -out server-
cert.pem
```

Verify certificates

```
openssl verify -CAfile ca-cert.pem server-cert.pem
```

Configure Server

```
## create file
## /etc/mysql/mariadb.conf.d/z_ssl.cnf
[mysqld]
ssl-ca=/etc/mysql/ssl/ca-cert.pem
ssl-cert=/etc/mysql/ssl/server-cert.pem
ssl-key=/etc/mysql/ssl/server-key.pem
### Set up TLS version here. For example TLS version 1.2 and 1.3 ##
## Starts from mariadb 10.4.6 not possible before. !!!!
tls_version = TLSv1.2,TLSv1.3
```

```
## Set ownership
chown -vR mysql:mysql /etc/mysql/ssl/
```

Restart and check for errors

```
systemctl restart mariadb
journalctl -u mariadb
```

Test connection on client

```
## only if we use option --ssl we will connect with ssl
mysql --ssl -uxyz -p -h <ip-of-server>
mysql>status
SSL:                    Cipher in use is TLS_AES_256_GCM_SHA384
```

Force to use ssl

```
## on server
## now client can only connect, when using ssl
mysql> grant USAGE on *.* to remote@10.10.9.144 require ssl;
```

Table encryption

Step 1: Set up keys

```
mkdir -p /etc/mysql/encryption;
echo "1;"$(openssl rand -hex 32) > /etc/mysql/encryption/keyfile;

openssl rand -hex 128 > /etc/mysql/encryption/keyfile.key;
openssl enc -aes-256-cbc -md sha1 -pass file:/etc/mysql/encryption/keyfile.key -in /etc/mysql/encryption/keyfile -
out /etc/mysql/encryption/keyfile.enc;

rm -f /etc/mysql/encryption/keyfile;

chown -R mysql:mysql /etc/mysql;
chmod -R 500 /etc/mysql;
```

Step 2: Verify data before encryption

```
cd /var/lib/mysql/mysql
## show content - is there readable content ?

## if strings command not found
apt install -y binutils

strings gtid_slave_pos.ibd
```

Step 3: Setup configuration

```
## vi /etc/my.cnf.d/z_encryption.cnf

[mysqld]
plugin_load_add = file_key_management
file_key_management_filename = /etc/mysql/encryption/keyfile.enc
file_key_management_filekey = FILE:/etc/mysql/encryption/keyfile.key
file_key_management_encryption_algorithm = AES_CTR

innodb_encrypt_tables = FORCE
innodb_encrypt_log = ON
innodb_encrypt_temporary_tables = ON

encrypt_tmp_disk_tables = ON
encrypt_tmp_files = ON
encrypt_binlog = ON
aria_encrypt_tables = ON

innodb_encryption_threads = 4
innodb_encryption_rotation_iops = 2000
```

Step 4: Restart server

```
systemctl restart mariadb
```

Step 5: Verify encryption

```
cd /var/lib/mysql/mysql
strings gtid_slave_pos.ibd
mysql
```

```
use information_schema;
select * from innodb_tablespaces_encryption;
SELECT CASE WHEN INSTR(NAME, '/') = 0
                   THEN '01-SYSTEM TABLESPACES'
                   ELSE CONCAT('02-', SUBSTR(NAME, 1, INSTR(NAME, '/')-1)) END
                     AS "Schema Name",
         SUM(CASE WHEN ENCRYPTION_SCHEME > 0 THEN 1 ELSE 0 END) "Tables Encrypted",
         SUM(CASE WHEN ENCRYPTION_SCHEME = 0 THEN 1 ELSE 0 END) "Tables Not Encrypted"
FROM information_schema.INNODB_TABLESPACES_ENCRYPTION
GROUP BY CASE WHEN INSTR(NAME, '/') = 0
                   THEN '01-SYSTEM TABLESPACES'
                   ELSE CONCAT('02-', SUBSTR(NAME, 1, INSTR(NAME, '/')-1)) END
ORDER BY 1;
```

Step 6: disable encryption runtime

```
SET GLOBAL innodb_encrypt_tables = OFF;
```

```
## Create a user that is not allowed to do so .... no set global
create user noroot@'localhost' identified by 'password';
grant all on *.* to noroot@'localhost';
revoke super on *.* from noroot@'localhost';
```

working with mysqlbinlog and encryption

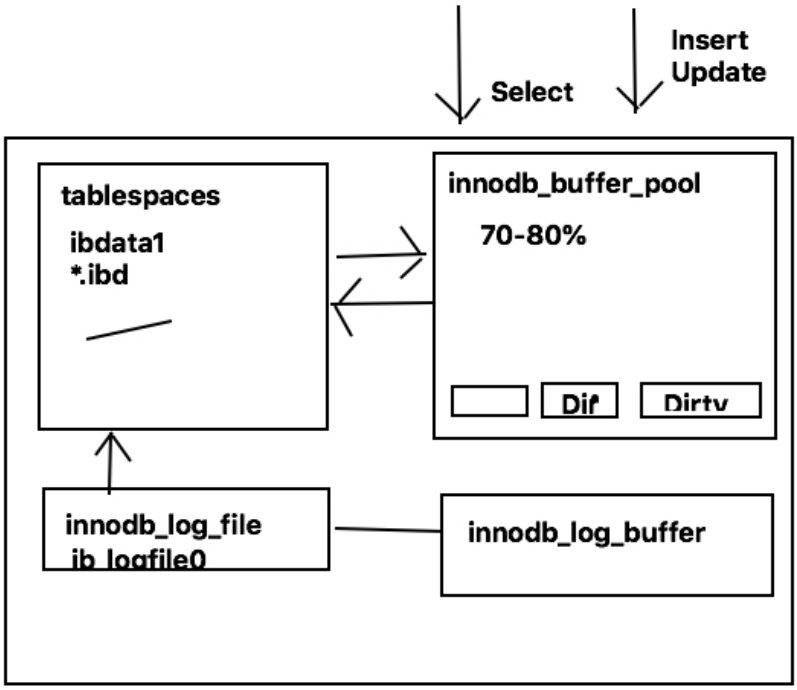
```
mysqlbinlog -vv --read-from-remote-server --socket /run/mysqld/mysqld.sock mysqld-bin.000003 | less
```

Ref:

- https://mariadb.com/de/resources/blog/mariadb-encryption-tde-using-mariadbs-file-key-management-encryption-plugin/

InnoDB - Storage Engine

InnoDB - Storage Engine - Structure



Important InnoDB - configuration - options to optimized performance

Innodb buffer pool

- How much data fits into memory
- Free buffers = pages of 16 Kbytes
- Free buffer * 16Kbytes = free innodb buffer pool in KByte

```
pager grep -i 'free buffers'
show engine innodb status \G
Free buffers       7905
1 row in set (0.00 sec)
```

```
show status like '%free%';
```

Overview innodb server variables / settings

- https://dev.mysql.com/doc/refman/5.7/en/innodb-parameters.html

Change innodb_buffer_pool

```
## /etc/mysql/mariadb.conf.d/50-server.cnf
## 70-80% of memory on dedicated mysql
[mysqld]
innodb-buffer-pool-size=4G
```

```
##
systemctl restart mariadb
```

```
##
mysql
mysql>show variables like 'innodb%buffer%';
```

innodb_flush_method

```
Ideally O_DIRECT on Linux, but please test it, if it really works well.
```

innodb_flush_log_at_trx_commit

```
When is fliushing done from innodb_log_buffer to log.
Default: 1 : After every commit
-> best performance 2. -> once per second

## Good to use 2, if you are willing to loose 1 second of data on powerfail
```

innodb_flush_neighbors

```
## on ssd disks set this to off, because there is no performance improvement
innodb_flush_neighbors=0

## Default = 1
```

skip-name-resolv.conf

```
## work only with ip's - better for performance
## vi /etc/mysql/mariadb.conf.d/50-server.cnf
skip-name-resolve
```

- https://nixcp.com/skip-name-resolve/

Ref:

- https://dev.mysql.com/doc/refman/5.7/en/innodb-buffer-pool-resize.html

Privilegs for show engine innodb status

```
 show engine innodb status \G
ERROR 1227 (42000): Access denied; you need (at least one of) the PROCESS privilege(s) for this operation
```

Backup and Restore (Point-In-Time aka PIT)

General

Define your goal

- Full backup of database-server (specific to PIT - point-in-time)
- Simply backup some specific databases (with data) - (e.g. 1 database out of 20)
  - Backup Structure and Data seperately in multiple files - (For further work - e.g. for developers)
  - Extract data from a specific table (because of problems that came up)

Backup with mysqldump - best practices

best practice minimal options

```
mysqldump --all-databases --events --routines > /usr/src/all-databases.sql
```

Useful options for PIT

```
## —quick not needed, because included in —opt which is enabled by default

## on local systems using socket, there are no huge benefits concerning --compress
## when you dump over the network use it for sure
mysqldump --all-databases --single-transaction --gtid --master-data=2 --routines --events --flush-logs >
/usr/src/all-databases.sql;
```

With PIT_Recovery you can use --delete-master-logs (not using replication)

- All logs before flushing will be deleted

```
mysqldump --all-databases --single-transaction --gtid --master-data=2 --routines --events --flush-logs --compress
--delete-master-logs > /usr/src/all-databases.sql;
```

Alternative - flushing logs

- https://mariadb.com/kb/en/purge-binary-logs/

Version with zipping

```
mysqldump --all-databases --single-transaction --gtid --master-data=2 --routines
--events --flush-logs --compress | gzip > /usr/src/all-databases.sql.gz
```

Performance Test mysqldump (1.7 Million rows in contributions)

```
date; mysqldump --all-databases --single-transaction --gtid --master-data=2 --routines --events --flush-logs --
compress > /usr/src/all-databases.sql; date
Mi 20. Jan 09:40:44 CET 2021
Mi 20. Jan 09:41:55 CET 2021
```

Seperated sql-structure files and data-txt files including master-data for a specific database

```
 # backups needs to be writeable for mysql
 mkdir /backups
 chmod 777 /backups
 chown mysql:mysql /backups
 mysqldump --tab=/backups contributions
 mysqldump --tab=/backups --master-data=2 contributions
 mysqldump --tab=/backups --master-data=2 contributions > /backups/master-data.txt
```

Dump sakila and import it as different database

```
mysqldump sakila > /usr/src/sakila.sql
mysql -e "create database sakilatest"
mysql sakilatest < /usr/src/sakila.sql
```

mariabackup

Installation (Ubuntu/Debian)

```
apt install mariadb-backup
```

Walkthrough (Backup)

```
## user eintrag in /root/.my.cnf
vi /root/.my.cnf
```

```
[mariabackup]
user=root
## pass is not needed here, because we have the user root with unix_socket - auth
```

```
mkdir /backups
## target-dir needs to be empty or not present
mariabackup --target-dir=/backups/20230511 --backup
## apply ib_logfile0 to tablespaces
## after that ib_logfile0 ->  0 bytes
mariabackup --target-dir=/backups/20230511 --prepare
```

Walkthrough (Recover)

```
systemctl stop mariadb
mv /var/lib/mysql /var/lib/mysql.bkup
mariabackup --target-dir=/backups/20230511 --copy-back
chown -R mysql:mysql /var/lib/mysql
systemctl start mariadb
```

Ref.

https://mariadb.com/kb/en/full-backup-and-restore-with-mariabackup/

mariadbackup incremental

Prerequisites: Setup user to be used in /root/.my.cnf

```
## user eintrag in /root/.my.cnf
[mariabackup]
user=root
## pass is not needed here, because we have the user root with unix_socket - auth
```

Backup-Phase

Day 1: First full backup (directory always needs to be empty)

```
## create some data
mysql -e "create schema if not exists backuptest"
mysql -e "create table if not exists data (id int, content varchar(50), primary key(id))" backuptest
mysql -e "insert into data (id, content) values (1, 'day1 - dataset 1'),(2, 'day 1 - dataset 2')" backuptest
mysql -e "select * from data" backuptest

## create a folder for our backup
mkdir -p /var/mariadb

## Day 1: let us do the full backup
mariabackup --backup --target-dir=/var/mariadb/backup/
```

Day 2: Let us add some data and then do the incremental backup

```
mysql -e "insert into data (id, content) values (3, 'day2 - dataset 1'),(4, 'day 2 - dataset 2')" backuptest
mysql -e "select * from data" backuptest
## now do the backup - folder inc1 needs to be empty !!!
mariabackup --backup \
   --target-dir=/var/mariadb/inc1/ \
   --incremental-basedir=/var/mariadb/backup/
```

Day 3: Let us even add more more data and the do the incremental backup

```
mysql -e "insert into data (id, content) values (5, 'day3 - dataset 1'),(6, 'day 3 - dataset 2')" backuptest
mysql -e "select * from data" backuptest

## now we do the backup based on the last incremnental backup (so basedir is inc1)

mariabackup --backup \
   --target-dir=/var/mariadb/inc2/ \
   --incremental-basedir=/var/mariadb/inc1/
```

Recovery Phase

Prepare

```
## Step 1: Apply the changes from recovery/redo log of full backup
mariabackup --prepare --target-dir=/var/mariadb/backup

## Step 2: Add the changes from inc1
mariabackup --prepare --target-dir=/var/mariadb/backup --incremental-dir=/var/mariadb/inc1

## Step 3: Add the changes from inc2
mariabackup --prepare --target-dir=/var/mariadb/backup --incremental-dir=/var/mariadb/inc2
```

Copy-Back

```
systemctl stop mariadb
cd /var/lib/
mv mysql mysql.mybkup
mariabackup --copy-back --target-dir=/var/mariadb/backup
chown -R mysql:mysql mysql
systemctl start mariadb
```

```
## Check if we have all data again
mysql -e "select * from data" backuptest
```

Ref:

- https://mariadb.com/kb/en/incremental-backup-and-restore-with-mariabackup/

Migration

Migrating MySQL from 8.0 to mariadb 10.11

Normal route to take

```
1. Create a dump of mysql-dataase

mysqldump --events --routings --all-databases > all-databases.sql

2. Stop MySQL

3. Uninstall mysql

4. mv away data - folder
mv /var/lib/mysql /var/lib/mysql.bkup

5. Install mariadb

6. Start mariadb (we should already be the case)

7. Import data from 1.

mysql < all-databases.sql
```

Problems you might run into ?

```
* MySQL has a new password authentication mechanism
// so probably you need to recreated all passwords

* JSON - datatype are completely different

* user database (double check if users are working)

* Are you using specific feature set from MySQL 8.x

* Are you using virtual columns ?
```

Documentation

Mariadb Server System Variables

- https://mariadb.com/kb/en/server-system-variables/#long_query_time

MySQL - Performance - PDF

- http://schulung.t3isp.de/documents/pdfs/mysql/mysql-performance.pdf

MySQL Performance Blog

- https://www.percona.com/blog/choosing-innodb_buffer_pool_size/

Alternative password authentication (salting)

User statistics

- https://mariadb.com/kb/en/user-statistics/

Misc

When should I use MySQL, when MariaDB

What specfic feature set do you need from MariaDB or MySQL

MariaDB

- Should use it, when you want to use Galera Cluster
- Why ? Because the patch for galera (wsrep-patch) is not in MySQL be default
  - https://galeracluster.com/downloads/#downloads (alternative for mysql)
- But: Galera does not work on Windows
- Oracle Mode for the procedures (but not implemented) well.

MySQL

- Windows: Group Replication which mainly nearly the same as the cluster but available with Windows
- If you want to use Online Physical you need to have subscription (mysqlbackup)

Cluster (MySQL: group replication) ? MariaDB or MySQL

- Always go for galera if possible

Why ?

- Because galera has 14 years of experience under their belt (group replication was invented way later)
- It is rock solid and they are spending time, to make easier and easier to setup on each iteration
- And on windows you have a lot components, which makes things unclear (e.g. Group Replication, InnoDB Cluster on top)

How to decide ?

- Look for the feature you specifically need (cutting edge) and if they are implement in mysql or mariadb
- Important: If you are on system it is hard to move to the other as time goes by (as they divert over time
  - especially, when using cutting edge features)

Working with a software from a specific Vendor

- What support do they have ?

Flashback (MariaDB)

```
DML - Insert / Update -- Revert the 20 minutes from your data, but only DML
```

Architecture of MariaDB

Query Cache Usage and Performance

Performance query cache

- Always try to optimize innodb with disabled query cache first (innodb_buffer_pool)
- If you use query_cache system can only use on CPU-Core. !!

How to enable query cache

```
## have_query_cache means compiled in mysql
## query_cache_type off means not enable by config
-- query cache is diabled
mysql> show variables like '%query_cache%';
+------------------------------+---------+
| Variable_name                | Value   |
+------------------------------+---------+
| have_query_cache             | YES     |
| query_cache_limit            | 1048576 |
| query_cache_min_res_unit     | 4096    |
| query_cache_size             | 1048576 |
| query_cache_type             | OFF     |
| query_cache_wlock_invalidate | OFF     |
+------------------------------+---------+
6 rows in set (0.01 sec)

root@trn01:/etc/mysql/mysql.conf.d# tail mysqld.cnf
[mysqld]
pid-file        = /var/run/mysqld/mysqld.pid
socket          = /var/run/mysqld/mysqld.sock
datadir         = /var/lib/mysql
log-error       = /var/log/mysql/error.log
## By default we only accept connections from localhost
bind-address    = 0.0.0.0
```

```
## Disabling symbolic-links is recommended to prevent assorted security risks
symbolic-links=0
query-cache-type=1

systemctl restart mysql

mysql> show variables like '%query_cache%';
+------------------------------+---------+
| Variable_name                | Value   |
+------------------------------+---------+
| have_query_cache             | YES     |
| query_cache_limit            | 1048576 |
| query_cache_min_res_unit     | 4096    |
| query_cache_size             | 1048576 |
| query_cache_type             | ON      |
| query_cache_wlock_invalidate | OFF     |
+------------------------------+---------+
6 rows in set (0.01 sec)


mysql> show status like '%Qcache%';
+-------------------------+---------+
| Variable_name           | Value   |
+-------------------------+---------+
| Qcache_free_blocks      | 1       |
| Qcache_free_memory      | 1031832 |
| Qcache_hits             | 0       |
| Qcache_inserts          | 0       |
| Qcache_lowmem_prunes    | 0       |
| Qcache_not_cached       | 0       |
| Qcache_queries_in_cache | 0       |
| Qcache_total_blocks     | 1       |
+-------------------------+---------+
8 rows in set (0.00 sec)

## status in session zurücksetzen.
mysql> flush status;
Query OK, 0 rows affected (0.00 sec)
```

Performance bottleneck - mutex

https://mariadb.com/de/resources/blog/flexible-mariadb-server-query-cache/

Something planned ?

- Nope ;o(Demand is new
- You might be able to use Demand together with maxscale
- Refer to: https://mariadb.com/de/resources/blog/flexible-mariadb-server-query-cache/

```
A mutual exclusion object (mutex) is a programming object that allows multiple program threads to share a resource (such as a folder) but not simultaneously. Mutex is set to unlock when the data is no longer needed or when a routine is finished. Mutex creates a bottleneck effect. The blocking means only one query can look at the Query Cache at a time and other queries must wait. A query that must wait to look in the cache only to find it isn’t in the cache will be slowed instead of being accelerated.
```

Administration

Handling general_log

Activate during runtime

```
## Hint hostname:  myserver
mysql>set global general_log = 1

ls -la /var/lib/mysql/myserver.log
```

Implications

- By default
- Will massively increase in size, because all queries are documented

Truncate while running

```
## will be empty that
cd /var/lib/mysql
> myserver.log

## and keeps on writing in there

## Attention
## Delete logfile does not work, needs restart
## or
## set global general_log = 0; set global general_log = 1 # after deletion
```

Training Data

Setup training data "contributions"

Walkthrough

- Complete process takes about 10 minutes

```
cd /usr/src
apt update; apt install -y git
git clone https://github.com/jmetzger/dedupe-examples.git
cd dedupe-examples
cd mysql_example
## Eventually you need to enter (in mysql_example/mysql.cnf)
## Only necessary if you cannot connect to db by entering "mysql"
## password=<your_root_pw>
./setup.sh
```

Optimal use of indexes

Index and Functions (Cool new feature in MySQL 5.7)

No index can be used on an index:

```
explain select * from actor where upper(last_name) like 'A%';
+----+-------------+-------+------------+------+---------------+------+---------+------+------+----------+--------
-----+
| id | select_type | table | partitions | type | possible_keys | key  | key_len | ref  | rows | filtered | Extra
|
+----+-------------+-------+------------+------+---------------+------+---------+------+------+----------+--------
-----+
|  1 | SIMPLE      | actor | NULL       | ALL  | NULL          | NULL | NULL    | NULL |  200 |   100.00 | Using
where |
+----+-------------+-------+------------+------+---------------+------+---------+------+------+----------+--------
-----+
```

Workaround with virtual columns (possible since mysql 5.7)

```
## 1. Create Virtual Column with upper
alter table sakila add idx_last_name_upper varchar(45) GENERATED ALWAYS AS upper(last_name);
## 2. Create an index on that column
create index idx_last_name_upper on actor (last_name_upper);
```

Now we try to search the very same

```
explain select * from actor where last_name_upper like 'A%';
+----+-------------+-------+------------+-------+---------------------+---------------------+---------+------+----
```

```
--+----------+-------------+
| id | select_type | table | partitions | type  | possible_keys       | key                 | key_len | ref  |
rows | filtered | Extra       |
+----+-------------+-------+------------+-------+---------------------+---------------------+---------+------+----
--+----------+-------------+
|  1 | SIMPLE      | actor | NULL       | range | idx_last_name_upper | idx_last_name_upper | 183     | NULL |
7 |   100.00 | Using where |
+----+-------------+-------+------------+-------+---------------------+---------------------+---------+------+----
--+----------+-------------+
1 row in set, 1 warning (0.00 sec)
```

Preview MySQL 8

- MySQL 8 support functional indexes

Index and Likes

1. like 'Will%' - Index works

explain select last_name from donors where last_name like 'Will%';

2. like '%iams' - Index does not work

```
-- because like starts with a wildcard
explain select last_name from donors where last_name like '%iams';
```

3. How to fix 3, if you are using this often ?

```
## Walkthrough
## Step 1: modify table
alter table donors add last_name_reversed varchar(70) GENERATED ALWAYS AS (reverse(last_name));
create index idx_last_name_reversed on donors (last_name_reversed);

## besser - Variante 2 - untested
alter table donors add last_name_reversed varchar(70) GENERATED ALWAYS AS (reverse(last_name)), add index
idx_last_name_reversed on donors (last_name_reversed);

## Step 2: update table - this take a while
update donors set last_name_reversed = reversed(last_name)
## Step 3: work with it
select last_name,last_name_reversed from donor where last_name_reversed like reverse('%iams');
```

```
## Version 2 with pt-online-schema-change
```

profiling-get-time-for-execution-of.query

- Get better values, how long queries take

Example

```
set profiling = 1
## Step 2 - Execute query
select last_name as gross from donors where last_name like lower('WILLI%')

## Step 3 - Show profiles
show profiles;
+----------+------------+-----------------------------------------------------------------------------------------+
| Query_ID | Duration   | Query                                                                                   |
+----------+------------+-----------------------------------------------------------------------------------------+
|        1 | 0.01993525 | select last_name as gross from donors where last_name like lower('WILLI%')              |
4 rows in set, 1 warning (0.00 sec)

## Step 4 - Show profile for a specific query
mysql> show profile for query 1;
+----------------------+----------+
| Status               | Duration |
+----------------------+----------+
| starting             | 0.000062 |
| checking permissions | 0.000006 |
```

```
| Opening tables       | 0.000021 |
| init                 | 0.000017 |
| System lock          | 0.000007 |
| optimizing           | 0.000007 |
| statistics           | 0.000083 |
| preparing            | 0.000012 |
| executing            | 0.000004 |
| Sending data         | 0.022251 |
| end                  | 0.000005 |
| query end            | 0.000008 |
| closing tables       | 0.000007 |
| freeing items        | 0.001792 |
| cleaning up          | 0.000016 |
+----------------------+----------+
15 rows in set, 1 warning (0.00 sec)
```

Find out cardinality without index

Find out cardinality without creating index

```
select count(distinct donor_id) from contributions;
```

```
select count(distinct(vendor_city)) from contributions;
+------------------------------+
| count(distinct(vendor_city)) |
+------------------------------+
|                         1772 |
+------------------------------+
1 row in set (4.97 sec)
```

Monitoring

What to monitor?

What to monitor

System

- Last auf dem System (top)
- Festplatte (z.B. 85% voll ?) df /var/lib/mysql
- Swap (Wenn geswappt wird ist Hopfen und Malz verloren)

Erreichbarkeit

- Server per ping erreichen (mysqladmin ping -h ziel-ip)
- Einlogbar ? (myadmin ping -h ziel-ip -u control_user

Platte aka IO-Subsystem (iostats)

- http://schulung.t3isp.de/documents/pdfs/mysql/mysql-performance.pdf

--	--	--
Read/Write requests	IOPS (Input/Output operations per second)	--
Average IO wait	Time that queue operations have to wait for disk access	--
Average Read/Write time	Time it takes to finish disk access operations (latency)	--
Read/Write bandwidth	Data transfer from and towards your disk	--

Gneral mysql metrics

```
mysql -E -e "select variable_value from information_schema.session_status where variable_name = 'uptime'";

# max connections
MariaDB [(none)]> show status like 'max_used_connections';
+----------------------+-------+
| Variable_name        | Value |
+----------------------+-------+
| Max_used_connections | 1     |
+----------------------+-------+
```

```
1 row in set (0.001 sec)

MariaDB [(none)]> show variables like 'max_connections';
+-----------------+-------+
| Variable_name   | Value |
+-----------------+-------+
| max_connections | 151   |
+-----------------+-------+
1 row in set (0.001 sec)

mysqladmin status
## you will find uptime here in seconds
```

Metric	Comments	Suggested Alert
Uptime	Seconds since the server was started. We can use this to detect respawns.	When uptime is < 180. (seconds)
Threads_connected	Number of clients currently connected. If none or too high, something is wrong.	None
Max_used_connections	Max number of connections at a time since server started. (max_used_connections / max_connections) indicates if you could run out soon of connection slots.	When connections usage is > 85%.
Aborted_connects	Number of failed connection attempts. When growing over a period of time either some credentials are wrong or we are being attacked.	When aborted connects/min > 3.

InnoDB

Metric	Coments	Suggested Alert
Innodb_row_lock_waits	Number of times InnoDB had to wait before locking a row.	None
Innodb_buffer_pool_wait_free	Number of times InnoDB had to wait for memory pages to be flushed. If too high, innodb_buffer_pool_size is too small for current write load.	None

Query tracking

Metric	Comments	Suggested Alert
Slow_queries	Number of queries that took more than long_query_time seconds to execute. Slow queries generate excessive disk reads, memory and CPU usage. Check slow_query_log to find them.	None
Select_full_join	Number of full joins needed to answer queries. If too high, improve your indexing or database schema.	None
Created_tmp_disk_tables	Number of temporary tables (typically for joins) stored on slow spinning disks, instead of faster RAM.	None
(Full table scans) Handler_read% Number of times the system reads the first row of a table index. (if 0 a table scan is done - because no key was read). Sequential reads might indicate a faulty index. None		

Track Errors

```
journalctl -u mariadb | grep -i Error
```

Ref

- https://blog.serverdensity.com/how-to-monitor-mysql/

Monitoring with pmm (Percona Management Monitoring)

https://pmmdemo.percona.com

Documentation

Replication

Slave einrichten -gtid

Step 1: mariabackup on master

```
mkdir /backups
## target-dir needs to be empty or not present
mariabackup --target-dir=/backups/20210121 --backup
## apply ib_logfile0 to tablespaces
## after that ib_logfile0 ->  0 bytes
mariabackup --target-dir=/backups/20210121 --prepare
```

Step 2: Transfer to new slave (from master)

```
## root@master:
rsync -e ssh -avP /backups/mysqldumpdir/20210121 kurs@10.10.9.144:/home/kurs/
```

Step 3: Setup replication user on master

```
## as root@master
##mysql>
CREATE USER repl@'10.10.9.%' IDENTIFIED BY 'password';
GRANT REPLICATION SLAVE ON *.*  TO 'repl'@'10
```

Step 3a (Optional): Test repl user (connect) from slave

```
## as root@slave
## you be able to connect to
mysql -urepl -p -h10.10.9.110
## test if grants are o.k.
show grants
```

Step 4a: Set server-id on master -> 1

```
[mysqld]
server-id=1

systemctl restart mariadb
###
```

Step 4b: Set server-id on slave -> 3 + same config as server 1

```
[mysqld]
server-id               = 3
## activate master bin log, if this slave might be a master later
log_bin                 = /var/log/mysql/mysql-bin.log

systemctl restart mariadb
### auf dem master config mit rsync rüberschrieben
### root@master
rsync -e ssh -avP /etc/mysql/mariadb.conf.d/z_uniruhr.cnf kurs@10.10.9.144:/home/kurs/
### root@slave
mv /home/kurs/z_uniruhr.cnf /etc/mysql/mariadb.conf.d/
chown root:root /etc/mysql/mariadb.conf.d
systemctl restart mariadb
```

Step 5: Restore Data on slave

```
systemctl stop mariadb
mv /var/lib/mysql /var/lib/mysql.bkup4
mariabackup --target-dir=/backups/20210121 --copy-back
chown -R mysql:mysql/var/lib/mysql
systemctl start mariadb
```

Step 6: master.txt for change command

```
## root@slave
$ cat xtrabackup_binlog_info
mariadb-bin.000096 568 0-1-2

SET GLOBAL gtid_slave_pos = "0-1-2";
## /root/master.txt
## get information from master-databases.sql dump
CHANGE MASTER TO
   MASTER_HOST="10.10.9.110",
   MASTER_PORT=3306,
   MASTER_USER="repl",
   MASTER_PASSWORD="password",
   MASTER_USE_GTID=slave_pos;

mysql < master.txt
## or: copy paste into mysql>

## mysql>
start slave

## in mysql -> show slave status
mysql>show slave status
## Looking for
Slave_IO_Running: Yes
Slave_SQL_Running: Yes
```

Walkthrough

https://mariadb.com/kb/en/setting-up-a-replication-slave-with-mariabackup/

Slave einrichten - master_pos

Step 1: mysqldump on master

```
mkdir -p /backups/mysqldumpdir
## in version 5.5. there is not --git so use it without --gtid
mysqldump --all-databases --single-transaction --master-data=2 --routines --events --compress >
/backups/mysqldumpdir/master-databases.sql;
```

Step 2: Transfer to new slave (from master)

```
## root@master:
rsync -e ssh -avP /backups/mysqldumpdir/master-databases.sql kurs@10.10.9.144:/home/kurs/
```

Step 3 (Optional): Be sure that slave is really fresh (no data yet)

```
## if old not wanted data is present, e.g. other databases, start with fresh-installation by so:
## as root
cd /var/lib
mv mysql mysql.bkup
mariadb-install-db --user=mysql
```

Step 4: Setup replication user on master

```
## as root@master
##mysql>
CREATE USER repl@'10.10.9.%' IDENTIFIED BY 'password';
GRANT REPLICATION SLAVE ON *.*  TO 'repl'@'10
```

Step 4a (Optional): Test repl user (connect) from slave

```
## as root@slave
## you be able to connect to
mysql -urepl -p -h10.10.9.110
## test if grants are o.k.
show grants
```

Step 5a: Set server-id on master -> 1

```
[mysqld]
server-id=1

systemctl restart mariadb
###
```

Step 5b: Set server-id on slave -> 2 + same config as server 1

```
[mysqld]
server-id               = 2
## activate master bin log, if this slave might be a master later
log_bin                 = /var/log/mysql/mysql-bin.log

systemctl restart mariadb
### auf dem master config mit rsync rüberschrieben
### root@master
rsync -e ssh -avP /etc/mysql/mariadb.conf.d/z_uniruhr.cnf kurs@10.10.9.144:/home/kurs/
### root@slave
mv /home/kurs/z_uniruhr.cnf /etc/mysql/mariadb.conf.d/
chown root:root /etc/mysql/mariadb.conf.d
systemctl restart mariadb
```

Step 6: Restore Data on slave

```
## root@slave
cd /home/kurs
mysql < master-databases.sql
```

Step 7: master.txt for change command

```
## root@slave
## /root/master.txt
## get information from master-databases.sql dump
CHANGE MASTER TO
   MASTER_HOST="10.10.9.110",
   MASTER_PORT=3310,
   MASTER_USER="repl",
   MASTER_PASSWORD="password",
   MASTER_LOG_FILE='mysqld-bin.000001',
   MASTER_LOG_POS=568;
## Version 1
mysql < master.txt
## or: copy paste into mysql>

## in mysql -> show slave status
mysql>show slave status
## Looking for
Slave_IO_Running: Yes
Slave_SQL_Running: Yes
```

Step 8: not working on 5.5.

```
Switch to using gtid later on:

show slave status; # look for using_gtid
stop slave;
CHANGE MASTER TO MASTER_USE_GTID = slave_pos;
show slave status; # look for using_gtid
start slave;
```

Walkthrough

https://mariadb.com/kb/en/setting-up-a-replication-slave-with-mariabackup/

MaxScale installieren

Why do Loadbalancing with MaxScale ?

- Cluster node transparent to application
  - Application does not see single nodes
- If one node fails you will have no downtime
  - In opposite: To talking to this node directly

License Implications since 2.x

- MariaDB MaxScale >= 2.0 is licensed under MariaDB BSL.
- maximum of three servers in a commercial context.
  - Any more, and you'll need to buy their commercial license.
- MariaDB MaxScale 2.1.0 will be released under BSL 1.1 from the start
- Each release transitions in about max 4 years to GPL

The MaxScale load-balancer and its components

- Routers
- Listeners
- Filters
- Servers (backend database server)

Filters

- Logging Filters
- Statement rewriting filters
- Result set manipulation filters
- Firewill filter
- Pipeline control filters
  - e.g. tee and send to a second server
- Ref: https://mariadb.com/kb/en/mariadb-maxscale-25-regex-filter/

Documentation - maxctrl

- https://mariadb.com/kb/en/mariadb-maxscale-25-maxctrl/

Installation and Setup

Installation

```
apt update
apt install apt-transport-https curl

## Setting up the repos
curl -sS https://downloads.mariadb.com/MariaDB/mariadb_repo_setup | sudo bash
## Installing maxscale
apt install maxscale
```

Setup (Part 1: MaxScale db-user)

- Do this on one of the galera nodes
- Adjust IP !!

```
## IP FROM MAXSCALE
## Setup privileges on cluster nodes
## It is sufficient to set it on one node, because
## it will be synced to all the other nodes
## on node 1
CREATE USER 'maxscale'@'10.10.11.139' IDENTIFIED BY 'P@ssw0rd';
##
GRANT SELECT ON mysql.db TO 'maxscale'@'10.10.11.139';
```

```
GRANT SELECT ON mysql.user TO 'maxscale'@'10.10.11.139';
GRANT SELECT ON mysql.tables_priv TO 'maxscale'@'10.10.11.139';
##
GRANT SELECT ON mysql.columns_priv TO 'maxscale'@'10.10.11.139';
GRANT SELECT ON mysql.proxies_priv TO 'maxscale'@'10.10.11.139';
##
GRANT SHOW DATABASES ON *.* TO 'maxscale'@'10.10.11.139';
## Needed for maxscale
GRANT SELECT ON mysql.procs_priv TO 'maxscale'@'10.10.11.139';
GRANT SELECT ON mysql.roles_mapping TO 'maxscale'@'10.10.11.139';

## Additionally for cluster operations (rejoin,switchover,failover for master/slave replications
## these permissions are needed
GRANT super, reload, process, show databases, event on *.* to 'maxscale'@'10.10.11.139';
## GRANT select on mysql.user to 'maxscale'@'10.10.11.139';
```

```
## On maxscale - server
apt update
apt install mariadb-client
## Test the connection
## Verbindung sollte aufgebaut werden
mysql -u maxscale -p -h <ip-eines-der-nodes>
mysql>show databases
```

SETUP (PART 2: CONFIGURATION)

```
## /etc/maxscale.cnf

[maxscale]

threads=auto
syslog=0
maxlog=1
log_warning=1
log_notice=1
log_info=0
log_debug=0

[TheMonitor]
type=monitor
module=mariadbmon
servers=server1,server2,server3
user=maxscale
password=P@ssw0rd
auto_rejoin=true
auto_failover=true

[RW-Split-Router]
type=service
router=readwritesplit
servers=server1,server2,server3
user=maxscale
password=P@ssw0rd
max_slave_connections=100%


[RW-Split-Listener]
type=listener
service=RW-Split-Router
protocol=MariaDBClient
port=3306

[server1]
type=server
address=142.93.98.60
port=3306
```

```
protocol=MariaDBBackend

[server2]
type=server
address=142.93.103.153
port=3306
protocol=MariaDBBackend

[server3]
type=server
address=142.93.103.246
port=3306
protocol=MariaDBBackend
```

```
## Start

systemctl start maxscale
```

```
## What does the log say ?

## /var/log/maxscale/maxscale.log
```

maxctrl

```
maxctrl list servers
maxctrl show server server1
maxctrl list services
maxctrl show service ReadWrite-Split-Router
```

Reference: MaxScale-Proxy mit Monitoring

MaxScale MariaDB-Monitor

Walkthrough:Automatic Failover Master Slave

https://mariadb.com/kb/en/mariadb-maxscale-25-automatic-failover-with-mariadb-monitor/

Tools

pt-query-digist - analyze slow logs

Requires

- Install percona-toolkit

Usage

```
## first enable slow_query_log
set global slow_query_log = on
set global long_query_time = 0.2
## to avoid, that i have to reconnect with new session
set session long_query_time = 0.2

## produce slow query - for testing
select * from contributions where vendor_last_name like 'W%';
mysql > quit

##
cd /var/lib/mysql
## look for awhile wih -slow.log - suffix
pt-query-digest mysql-slow.log > /usr/src/report-slow.txt
less report-slow.txt
```

pt-online-schema-change howto

Requirements

- Install percona-toolkit

What does it do ?

```
## Altering table without blocking them
## Do a dry-run beforehand
pt-online-schema-change --alter "ADD INDEX idx_city (city)" --dry-run D=contributions,t=donors
##
pt-online-schema-change --alter "ADD INDEX idx_city (city)" --execute D=contributions,t=donors
```

Problems -> high cpu load

```
## fine - tune params
## e.g. --max-load
## refer to docs
https://www.percona.com/doc/percona-toolkit/3.0/pt-online-schema-
change.html#:~:text=pt%2Donline%2Dschema%2Dchange%20works%20by%20creating%20an%20empty,it%20with%20the%20new%20one.
```

Diagnosis and measurement of performance

Best practices to narrow down performance problems

Pre-Requisites

- System is slow

Analyze - Checklist - Step 1

```
## Are there slow queries ?
## look for time
show full processlist

### or time - in seconds
select * from information_schema.processlist where time > 10;
```

Re-Execute SELECT or where from UPDATE / DELETE

```
## Is it still slow ?
## Eventually kill
mysql>show processlist
mysql>--kill <Thread-id>
mysql>-- example
mysql>kill 44
```

Explain what is going on

```
Explain Select....
```

Performance and optimization of SQL statements

Do not use '*' whenever possible

Why ?

- You are adding .. to he server:
  - I/O
  - memory
  - CPU
- You are preventing covering indexes

Walkthrough. (Look at the time)

Using '*'

```
## using '* '
pager grep "rows in set";
select * from donors where last_name like 'Willia%'; select * from donors where last_name like 'Willia%';
-- time between 0.02 and 0.04 secs
```

```
-- 2424 rows in set (0.02 sec)
-- reset pager
pager

## corresponding Explain (QEP)
explain select * from donors where last_name like 'Willia%';
+----+-------------+--------+------------+-------+-------------------+-------------------+---------+------+------
+----------+-----------------------+
| id | select_type | table  | partitions | type  | possible_keys     | key               | key_len | ref  | rows |
filtered | Extra                 |
+----+-------------+--------+------------+-------+-------------------+-------------------+---------+------+------
+----------+-----------------------+
|  1 | SIMPLE      | donors | NULL       | range | donors_donor_info | donors_donor_info | 213     | NULL | 4748 |
100.00 | Using index condition |
+----+-------------+--------+------------+-------+-------------------+-------------------+---------+------+------
+----------+-----------------------+
1 row in set, 1 warning (0.00 sec)
```

using specific fields

```
pager grep 'rows in set'; select last_name,first_name from donors where last_name like 'Willia%'; pager;
PAGER set to 'grep 'rows in set''
2424 rows in set (0.01 sec)
```

```
 explain select last_name,first_name from donors where last_name like 'Willia%';
+----+-------------+--------+------------+-------+-------------------+-------------------+---------+------+------
+----------+--------------------------+
| id | select_type | table  | partitions | type  | possible_keys     | key               | key_len | ref  | rows |
filtered | Extra                    |
+----+-------------+--------+------------+-------+-------------------+-------------------+---------+------+------
+----------+--------------------------+
|  1 | SIMPLE      | donors | NULL       | range | donors_donor_info | donors_donor_info | 213     | NULL | 4748 |
100.00 | Using where; Using index |
+----+-------------+--------+------------+-------+-------------------+-------------------+---------+------+------
+----------+--------------------------+
1 row in set, 1 warning (0.00 sec)
```

- Uses cover index (indicator in Extra: using index)

Ref:

- https://www.oreilly.com/library/view/high-performance-mysql/9780596101718/ch04.html

Be aware of subselects - Example 1

Optimizer-hints (and why you should not use them)

Tell the optimizer what to do and what not to do

- https://dev.mysql.com/doc/refman/5.7/en/optimizer-hints.html#optimizer-hints-syntax

Replication

Replikation Read/Write

- https://proxysql.com/blog/configure-read-write-split/

Performance

Best Practices

Indexes

2 Indexes vs. Combined Index

- In most cases a combined index is better than 2 indexes.

Joins

Field-Type

- Do not use varchar() or char() aka string types of join field
- better: integer (unsigned) && same size

- e.g. actor_id id int unsigned

Views

General

- Only use views with merge
- NO temptable please, these CANNOT be indexed.

Where

No functions in where please

- Why ? Index cannot be used.
- example:
  - select first_name from actor where upper(first_name) like 'A%'

Alternative solution

- use a virtual field and index virtual field (possible from mysql > 5.7)
- Massive improvements in mysqL 8

Example sys-schema and Reference

Examples

```
mysql> select * from sys.host_summary\G
*************************** 1. row ***************************
                   host: localhost
             statements: 1347
     statement_latency: 7.55 m
 statement_avg_latency: 336.50 ms
           table_scans: 15
              file_ios: 612857
       file_io_latency: 1.66 m
   current_connections: 1
     total_connections: 7
          unique_users: 1
        current_memory: 0 bytes
total_memory_allocated: 0 bytes
1 row in set (0.01 sec)
```

Ref:

- https://github.com/mysql/mysql-sys/blob/master/README.md

Change schema online (pt-online-schema-change)

- https://www.percona.com/doc/percona-toolkit/3.0/pt-online-schema-change.html

Optimizer-Hints

Tell the optimizer what to do and what not to do

- https://dev.mysql.com/doc/refman/5.7/en/optimizer-hints.html#optimizer-hints-syntax

Upgrading / Patching

Upgrade vom 10.3 (Distri Ubuntu 20.04) -> 10.4 (MariaDB-Foundation)

Prerequisites

```
Ubuntu 20.04
MariaDB-Server from Distri

Install new 10.4 from Mariadb.org
```

Prepare

- Create backup of system (with mariabackup and/or mysqldump)

Steps

```
## 1. systemctl stop mariadb
## 2. apt remove mariadb-*
```

```
## 3. Doublecheck if components left: apt list --installed | grep mariadb
## 4. Setup repo for mariadb
## 5. apt update
## 6. apt install mariadb-server

## 7. systemctl enable --now mariadb # enable for next reboot and start immediately
## necessary for redhat

## 8. Doublecheck if mysql_upgrade was done
cat /var/lib/mysql_upgrade_info
```

Important - Check mysql - configuration structure

```
## Which directories are loaded in
/etc/mysql/my.cnf

## Eventually move files to the right directory
## As needed in migration from 10.3 (Distri) to 10.4 (mariadb.org) on Ubuntu 20.04
```

Documentation

- https://mariadb.com/kb/en/upgrading-from-mariadb-103-to-mariadb-104/

Security and User Rights

Create User/Grant/Revoke - Management of users

Create user

```
create user training@localhost identified by 'yourpassword';
## connect to mysql with this user:
mysql -utraining -p
show grants;
show databases;
```

Drop user (=delete user)

```
drop user training@localhost
```

Change User (e.g. change authentication)

```
## change pass
alter user training@localhost identified by 'newpassword';
```

Set global or db rights for a user

```
grant all on *.* to training@localhost
```

```
## only a specific db
grant all on training.* to training@localhost
```

Revoke global or revoke right from a user

```
revoke select on *.* from training@localhost
## only from a specific db
revoke select on training.* from training@localhost
```

Useful command to find out users:

```
select user,host from mysql.user;
```

Refs:

- https://mariadb.com/kb/en/grant/#the-grant-option-privilege
- https://mariadb.com/kb/en/revoke/

Getting rid of specific user after user permissions changes

Why ?

- You might have changed the grants, but they only reflect after a reconnect

Howto

```
## step 1: git thread_id id of user
MariaDB [information_schema]> select id,user,host,command from processli
st where user='training';
+----+----------+-------------------+---------+
| id | user     | host              | command |
+----+----------+-------------------+---------+
| 75 | training | jochen-wt6y:42026 | Sleep   |
+----+----------+-------------------+---------+
1 row in set (0.001 sec)

## step 2: kill thread_id = connection_id  = id
kill 75
```

Disable unix_socket authentication for user

Debug and Setup External Connection

Get Rights of user

Auth with unix_socket

User- and Permission-concepts (best-practice)

Setup external access

Backup and Restore (Point-In-Time aka PIT)

General

Define your goal

- Full backup of database-server (specific to PIT - point-in-time)
- Simply backup some specific databases (with data) - (e.g. 1 database out of 20)
  - Backup Structure and Data seperately in multiple files - (For further work - e.g. for developers)
  - Extract data from a specific table (because of problems that came up)

Backup and Create new database based on backup

```
mysqldump sakila > sakila.sql
mysql -e 'create schema sakilanew'
## or
echo "create schema sakilanew" | mysql

mysql sakilanew < sakila.sql
```

PIT - Point-in-time-Recovery Exercise

Problem coming up

```
## Step 1 : Create full backup (assuming 24:00 o'clock)
mysqldump --all-databases --single-transaction --gtid --master-data=2 --routines --events --flush-logs --delete-
master-logs > /usr/src/all-databases.sql;

## Step 2: Working on data
mysql>use sakila;
mysql>insert into actor (first_name,last_name) values ('john','The Rock');
mysql>insert into actor (first_name,last_name) values ('johanne','Johannson');

## Optional: Step 3: Looking into binary to see this data
cd /var/lib/mysql
## last binlog
```

```
mysqlbinlog --no-defaults -vv mysqldbin.000005

## Step 3: Some how a guy deletes data
mysql>use sakila; delete from actor where actor_id > 200;
## now only 200 datasets
mysql>use sakila; select * from actor;
```

Fixing the problem

```
## find out the last binlog
## Simple take the last binlog

cd /var/lib/mysql
## Find the position where the problem occured
## and create a recovery.sql - file (before apply full backup)
mysqlbinlog --no-defaults -vv --stop-position=857 mysqld-bin.000005 > /usr/src/recover.sql

## Step 1: Apply full backup
cd /usr/src/
mysql < all-databases.sql
mysql> should be 200 or 202
mysql> use sakila; select * from actor;
mysql < recover.sql
mysql> -- now it should have all actors before deletion
mysql> use sakila; select * from actor;
```

Backup / Recover to Network Destination

Assumptions

```
Server 1: 192.168.1.1
Server 2: 192.168.1.2

Create new db -> sakilaremote on server 1
Backup data from sakila on server2 and send to server 1
```

Preparation (on server 1)

```
## is server listening to the outside world
lsof -i | grep mysql

## create user on server
mysql>create user ext@'%' identified by 'mysecretpass'
mysql>grant all on *.* to ext@'%'
```

Testing (on server 1)

```
mysql -uext -p -h 192.168.1.1
mysql>create schema sakilaremote
```

Executing (on server 2)

```
mysqldump sakila | mysql -uext -p -h 192.168.1.1 sakilremote
```

Validating (on server 2)

```
mysql -uext -p -h 192.168.1.1
mysql> use sakilaremote;
mysql> show tables;
```

Flashback

- Redoes insert/update/delete entries from binlog (binlog_format = 'ROW')

Referenz:

- https://mariadb.com/kb/en/flashback/

Use xtrabackup for MariaDB 5.5

For mariadb 5.5 you can use xtrabackup instead of mariabackup

- https://www.percona.com/doc/percona-xtrabackup/2.4/index.html

Documentation / Literature

Effective MySQL

- https://www.amazon.com/Effective-MySQL-Optimizing-Statements-Oracle/dp/0071782796

MariaDB Galera Cluster

- http://schulung.t3isp.de/documents/pdfs/mariadb/mariadb-galera-cluster.pdf

MySQL Galera Cluster

- https://galeracluster.com/downloads/