



# MySQL für Oracle DBAs

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www.fromdual.com

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## Support



## Beratung



## remote-DBA



## Schulung



# Inhalt

## MySQL für Oracle DBAs

- › **Branches und Forks**
- › **Installation und Konfiguration**
- › **Tablespaces**
- › **Connections, Threads und Connectors**
- › **Tools**
- › **User und Schema**
- › **Storage Engine**
- › **Backup, Restore, Recovery**
- › **Performance Tuning**
- › **Hochverfügbarkeit**

# Wie wichtig ist MySQL heute?

- Welche DB habt Ihr heute im Einsatz?

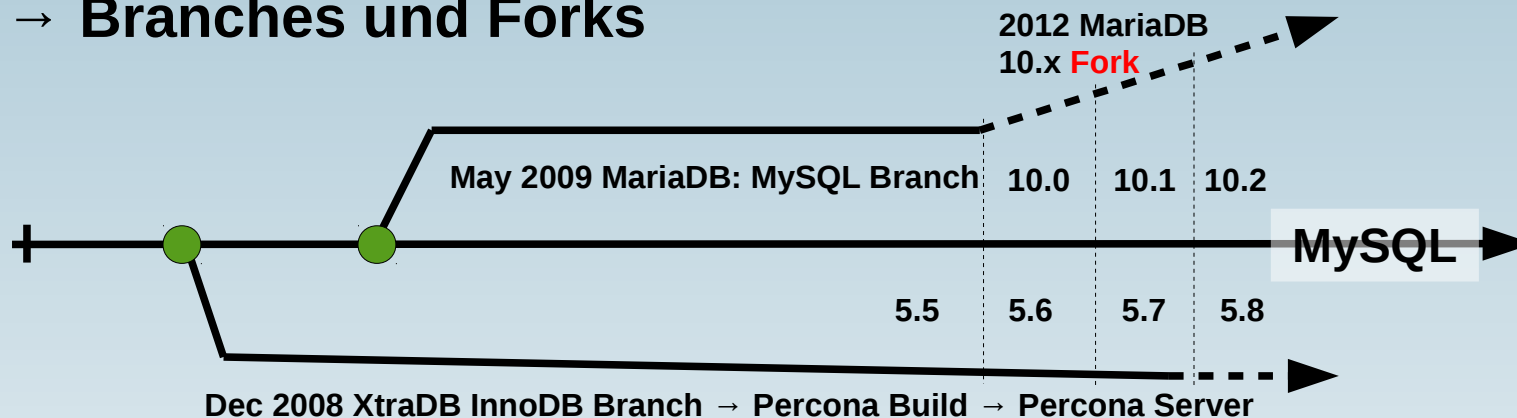
305 systems in ranking, May 2016

Rank			DBMS	Database Model	Score		
May 2016	Apr 2016	May 2015			May 2016	Apr 2016	May 2015
1.	1.	1.	Oracle	Relational DBMS	1462.02	-5.51	+19.93
2.	2.	2.	MySQL +	Relational DBMS	1371.83	+1.72	+77.56
3.	3.	3.	Microsoft SQL Server	Relational DBMS	1142.82	+7.77	+11.79
4.	4.	4.	MongoDB +	Document store	320.22	+7.78	+42.90
5.	5.	5.	PostgreSQL	Relational DBMS	307.61	+3.89	+34.09
6.	6.	6.	DB2	Relational DBMS	185.96	+1.87	-15.09
7.	↑8.	↑8.	Cassandra +	Wide column store	134.50	+4.83	+27.95
8.	↓7.	↓7.	Microsoft Access	Relational DBMS	131.58	-0.39	-14.00
9.	9.	↑10.	Redis +	Key-value store	108.24	-3.00	+13.51
10.	10.	↓9.	SQLite	Relational DBMS	107.26	-0.70	+2.10

<http://db-engines.com/en/ranking>

# Branches und Forks

- MySQL ist Open Source (GPL)
  - d. h. jede/r darf selber ...
  - → Branches und Forks



- Wer setzt MySQL Branch/Fork ein?
- Babylonische Sprachverwirrung steht uns bevor :-(
  - Sybase ASE vs. MS SQL Server
  - Ingres vs. PostgreSQL
- Bsp: Replication, Protocol X, MariaDB Column Store, Window Functions, ...

# MySQL Subskriptionen

- **Nicht Lizenz sondern eine Subskription (Abo) für Support + Tools**
- **MySQL Community Edition (CE)**
  - Open Source MySQL Server
  - + hilf dir selber
- **MySQL Standard Edition (SE)**
  - Open Source oder Commercial MySQL Server
  - + MySQL Support
- **MySQL Enterprise Edition (EE)**
  - Standard Edition (SE)
  - + Enterprise Tools (Monitor, Backup, Audit, ...)
- **MySQL Commercial – OEM, ISV, VAR (Lizenz)**

# Installation

## Oracle: OUI (Oracle Universal Installer)

- **Windows: MySQL installer**

`C:\Program files\mysql\mysql-server-5.7`

- **MySQL Linux:**

- **Pakete: \*.rpm, \*.deb**  
`/usr`

- **Binary Tar-Ball:**

`mysql-5.7.12-linux-x86_64.tar.gz`

- **Über Linux-Distro (oft alt)**

- **Vom Hersteller (MySQL/Oracle, ganz frisch!)**

# Erstellen der Datenbank

- **Paket der Distribution legt Datenbank an:**

- `/var/lib/mysql`

- `C:\Program files\mysql\mysql-server-5.7\data`

- **Von Hand:**

- ```
mysql_install_db --user=mysql --datadir=...
```

- **Mit MySQL 5.7:**

- ```
mysqld --initialize --datadir=...
```



# Konfiguration

- **MySQL Konfigurationsdatei:**
  - `my.cnf` oder `my.ini` (Win)
  - Liegt unter: `/etc/` oder `/etc/mysql`
- **MySQL: kein SPFILE**
- **Änderung in `my.cnf` → Restart oder**
- **`SET GLOBAL variable = wert;`**
- **→ von Hand in `my.cnf` schreiben!**
- **Gutes Template:**
  - <http://fromdual.com/mysql-configuration-file-sample>

# Tablespaces (TS)

- Bis MySQL 5.6: Alles oder Nichts
  - `innodb_file_per_table = { 0 | 1 }`
  - 0 → alle Tabellen im System TS (`ibdata1`)
  - 1 → jede Tabelle in eigenem TS (`*.ibd`)
- Ab MySQL 5.7:
  - Flexible/general Tablespaces:

```
CREATE TABLESPACE customer0001  
  ADD DATAFILE 'customer0001.ibd' ENGINE = InnoDB;
```

```
ALTER TABLE customer0001.invoices  
  TABLESPACE = customer0001;
```

# Starten / stoppen von MySQL [www.fromdual.com](http://www.fromdual.com)

Oracle: `sqlplus / as sysdba STARTUP`

- MySQL automatisch: in Boot-Prozess eingebunden
- von Hand:

```
service mysql [start | stop]
systemctl start mysql.service
```

- Prüfen:

```
ps -ef | grep mysqld
```

- Killen von Hand (nett, dann hart):

```
kill -15 <pid>; kill -9 <pid>
```

- Achtung: bei NICHT crash-safem Storage Engines (MyISAM)!

# Prozess vs. Thread

- MySQL: Threads
- Oracle: Prozess (+ neu auch Threads)
  - RECO, PMON, SMON, DBW0, LGWR, ARC0, ...

```
shell> ps -eLf | grep mysqld
UID          PID    PPID    LWP    CMD
mysql       6411     1    6411  mysqld_safe
mysql       7081   6411    7081  mysqld
mysql       7081   6411    7083  mysqld
mysql       7081   6411    7084  mysqld
mysql       7081   6411    7085  mysqld
```

- Welche?

```
SELECT * FROM performance_schema.threads;
```

# MySQL Thread Architektur

```
mysql> SELECT thread_id, name AS 'thread_name', type, processlist_user AS user
        FROM performance_schema.threads;
```

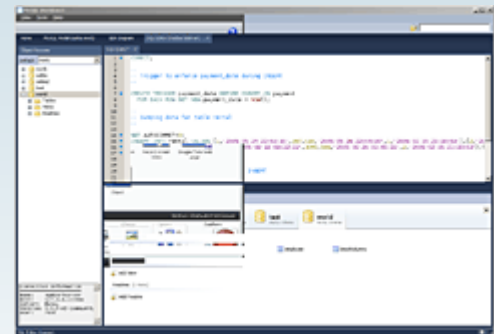
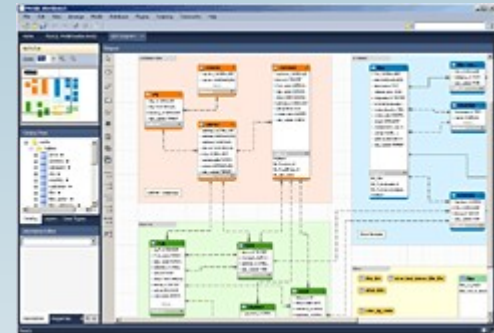
thread_id	thread_name	type	user
1	thread/sql/main	BACKGROUND	NULL
2	thread/innodb/io_ibuf_thread	BACKGROUND	NULL
3	thread/innodb/io_log_thread	BACKGROUND	NULL
4	thread/innodb/io_read_thread	BACKGROUND	NULL
11	thread/innodb/io_write_thread	BACKGROUND	NULL
14	thread/innodb/srv_error_monitor_thread	BACKGROUND	NULL
15	thread/innodb/srv_lock_timeout_thread	BACKGROUND	NULL
16	thread/innodb/srv_monitor_thread	BACKGROUND	NULL
17	thread/innodb/srv_master_thread	BACKGROUND	NULL
18	thread/innodb/srv_purge_thread	BACKGROUND	NULL
19	thread/innodb/page_cleaner_thread	BACKGROUND	NULL
20	thread/sql/signal_handler	BACKGROUND	NULL
22	thread/sql/one_connection	FOREGROUND	root
28	thread/sql/one_connection	FOREGROUND	oli

# Connections / Connectors

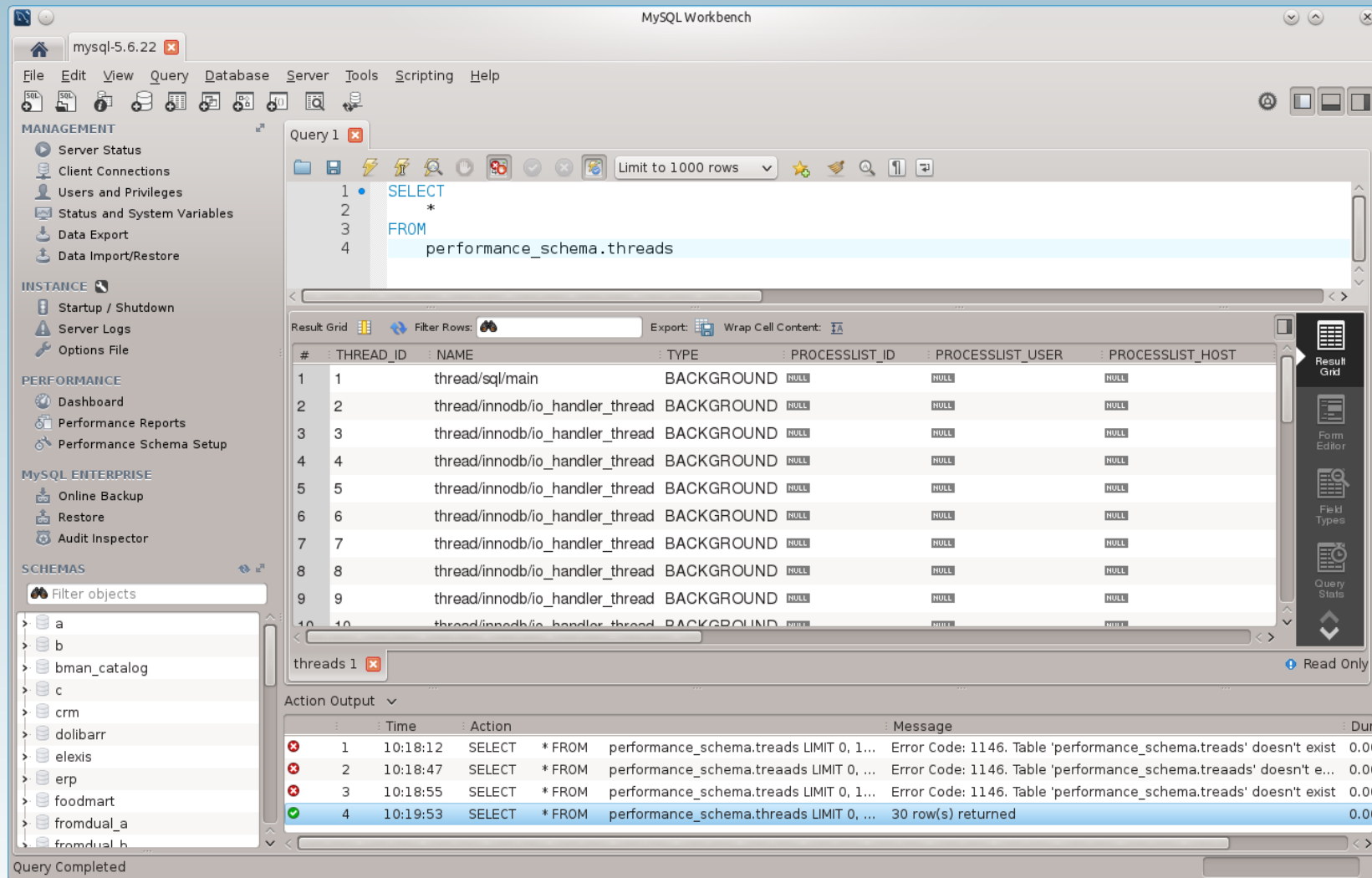
- **Verbindung**
  - In MySQL billig: oft KEIN Connection-Pooling
  - 1 Verbindung = 1 Thread → 1 Query → 1 Core
  - MySQL skaliert heute (5.7) mit der Hardware (144 cores)!
  - Thread Pool (1000e von Verbindungen)
- **MySQL Port: 3306**
- **Connectors:**
  - JDBC/ODBC
  - PHP, Perl, Python, Ruby, .NET

# Tools

- Tools:
  - `sqlplus` → `mysql`
  - `srvmgr1` → `mysqladmin`
- MySQL Workbench
  - Admin
  - Query Browser
  - ER - Diagrammer
- Heidi SQL, phpMyAdmin



# Query Browser



The screenshot shows the MySQL Workbench interface. The query editor contains the following SQL query:

```

1 SELECT
2 *
3 FROM
4 performance_schema.threads

```

The result grid shows a table with the following columns: #, THREAD\_ID, NAME, TYPE, PROCESSLIST\_ID, PROCESSLIST\_USER, and PROCESSLIST\_HOST. The table contains 10 rows of background threads.

#	THREAD_ID	NAME	TYPE	PROCESSLIST_ID	PROCESSLIST_USER	PROCESSLIST_HOST
1	1	thread/sql/main	BACKGROUND	NULL	NULL	NULL
2	2	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL
3	3	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL
4	4	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL
5	5	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL
6	6	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL
7	7	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL
8	8	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL
9	9	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL
10	10	thread/innodb/io_handler_thread	BACKGROUND	NULL	NULL	NULL

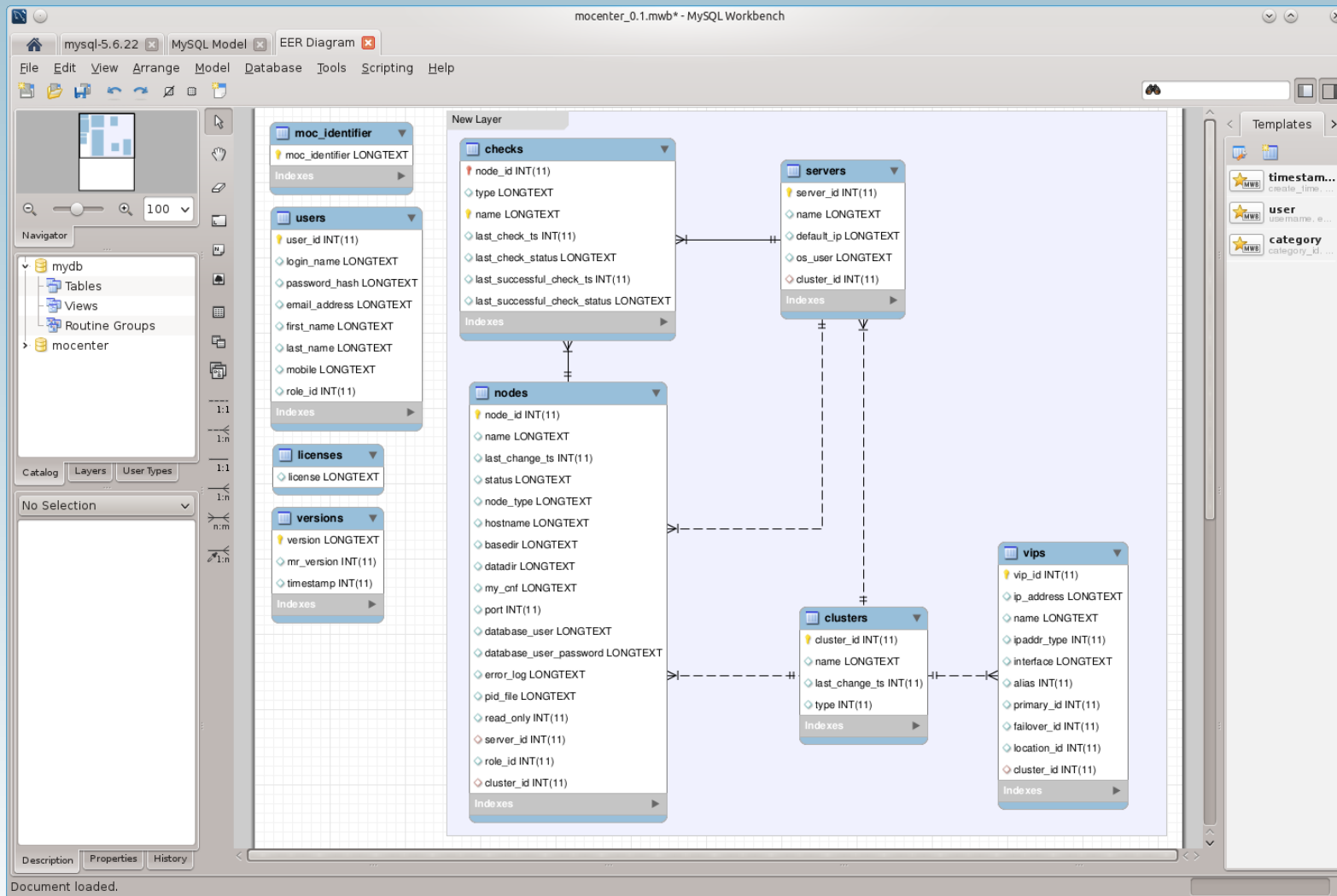
The Action Output pane shows the following log entries:

#	Time	Action	Message	Dur
1	10:18:12	SELECT * FROM performance_schema.treads LIMIT 0, 1...	Error Code: 1146. Table 'performance_schema.treads' doesn't exist	0.00
2	10:18:47	SELECT * FROM performance_schema.treaads LIMIT 0, ...	Error Code: 1146. Table 'performance_schema.treaads' doesn't e...	0.00
3	10:18:55	SELECT * FROM performance_schema.treads LIMIT 0, 1...	Error Code: 1146. Table 'performance_schema.treads' doesn't exist	0.00
4	10:19:53	SELECT * FROM performance_schema.threads LIMIT 0, ...	30 row(s) returned	0.00

The status bar at the bottom indicates "Query Completed".



# ER-Diagrammer



# User und Schema

- **User**
  - `'oli'@'localhost'` → **Unix Socket**
  - `'oli'@'127.0.0.1'` → **TCP von IP**
  - `'oli'@'%'` → **TCP von überall her**
- **Privilegien**
  - **Global: \*.\***, pro Schema , pro Tabelle, pro Spalte
- **Schema (= Database)**
  - **Objekte unabhängig vom User (→ gehört System)**

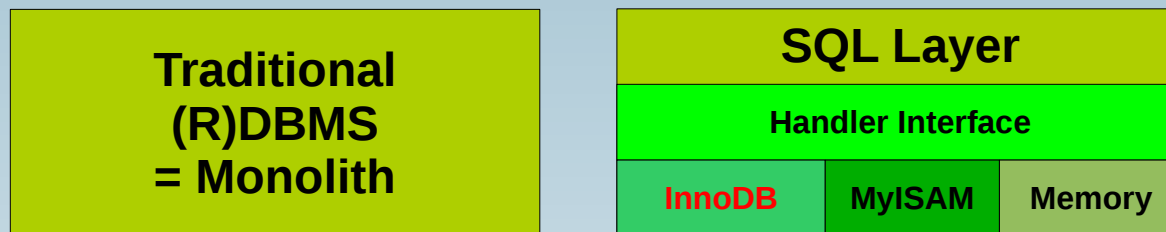
# Wichtigste Befehle

- **SHOW DATABASES;**
- **use mysql;**
- **SHOW TABLES;**
- **SHOW [FULL] PROCESSLIST;**
- **SELECT user, host FROM mysql.user;**
- **SHOW GRANTS FOR user@host;**
- **SHOW GLOBAL VARIABLES;**
- **SHOW GLOBAL STATUS;**
- **SHOW ENGINES;**



# Storage Engines

- MySQL Architektur ist speziell:



- Verschiedene Storage Engines (DB Engine):  
**InnoDB**, MyISAM, MEMORY

```
SELECT * FROM information_schema.tables;
```

- Früher MyISAM ( $\leq 5.1$ )
- heute: InnoDB ( $\geq 5.5$ )

```
SHOW CREATE TABLE test\G
CREATE TABLE `test` (
  ...
) ENGINE=InnoDB;
```

# Backup / Restore

- Logisch vs. physisch
- Logisches Backup mit `mysqldump` (`exp/imp`)
- Physisches Backup mit MySQL Enterprise Backup (MEB) (`rman`)
- Backup:
  - logisch: `mysqldump > full_dump.sql`
  - physisch: `mysqlbackup backup-and-apply-log`
- Restore:
  - logisch: `mysql < full_dump.sql`
  - physisch: `mysqlbackup copy-back`

# Point-in-Time-Recovery

- Binary-Log für Point-in-Time-Recovery
- Binary-Log einschalten
  - `log_bin = binary-log`
  - erfordert DB Neustart
  - ~ Oracle Archive Log (aber nur ähnlich!)
- Bei Backup: Binary-Log und Position merken
- PiTR:
  - `mysqlbinlog --start-position=45678 --stop-datetime=... binary-log.000042 ...`

# Logging

- **Error Log**
  - Fehler und Warnungen (`log_warnings = 2`)
- **Slow Query Log**
  - „langsame“ Abfragen
- **General Query Log**
  - Achtung: „alle“ Abfragen
  - `general_query_log = ON`

# MySQL Upgrade

- **2 Varianten:**
  - **Dump/Restore (logical upgrade) (5 TB DWH?)**
  - **Binary-Upgrade (in-place upgrade) (seit 5.5 supportet)**
- **Vorgehen (ca. 15 min):**
  - **`SET GLOBAL innodb_fast_shutdown = 0;`**
  - **DB stoppen**
  - **alte Pakete deinstallieren**
  - **neue Pakete installieren**
  - **DB starten**
  - **`mysql_upgrade`**
- **Major Releases NICHT überspringen (5.5 -X-> 5.7)**



# Performance Tuning

- `mysql> SHOW GLOBAL VARIABLES;`
- `mysql> SHOW GLOBAL STATUS;`
- `mysql> SHOW ENGINE INNODB STATUS\G`
- `PERFORMANCE_SCHEMA` (seit 5.6)
- Slow Query Log
- Query Execution Plan:  
`mysql> EXPLAIN SELECT * FROM test;`

# Slow Query Log

- Systematischer Ansatz mit etwas Vorlauf:

Variable_name	Value
slow_query_log	OFF
slow_query_log_file	slow.log
log_queries_not_using_indexes	OFF
long_query_time	0.500000

- Kann dynamisch eingeschaltet werden:
  - SET GLOBAL slow\_query\_log = 1;
- Profile vom Slow Query Log:
  - shell> mysqldump\_slow -s t slow.log > slow.profile
  - shell> pt\_query\_digest slow.log > slow.digest

# Optimiere das Query!

- Was machen mit den langsamen Abfragen?
- Query Execution Pläne (QEP) erstellen!
  - `mysql> EXPLAIN SELECT ...`
- Interpretieren von QEP:

```
EXPLAIN SELECT * FROM emp where name = 'Oli';
```

select_type	table	type	possible_keys	key	key_len	ref	rows
SIMPLE	emp	ALL	last	NULL	NULL	NULL	261369

Operation

Genutzter  
Index

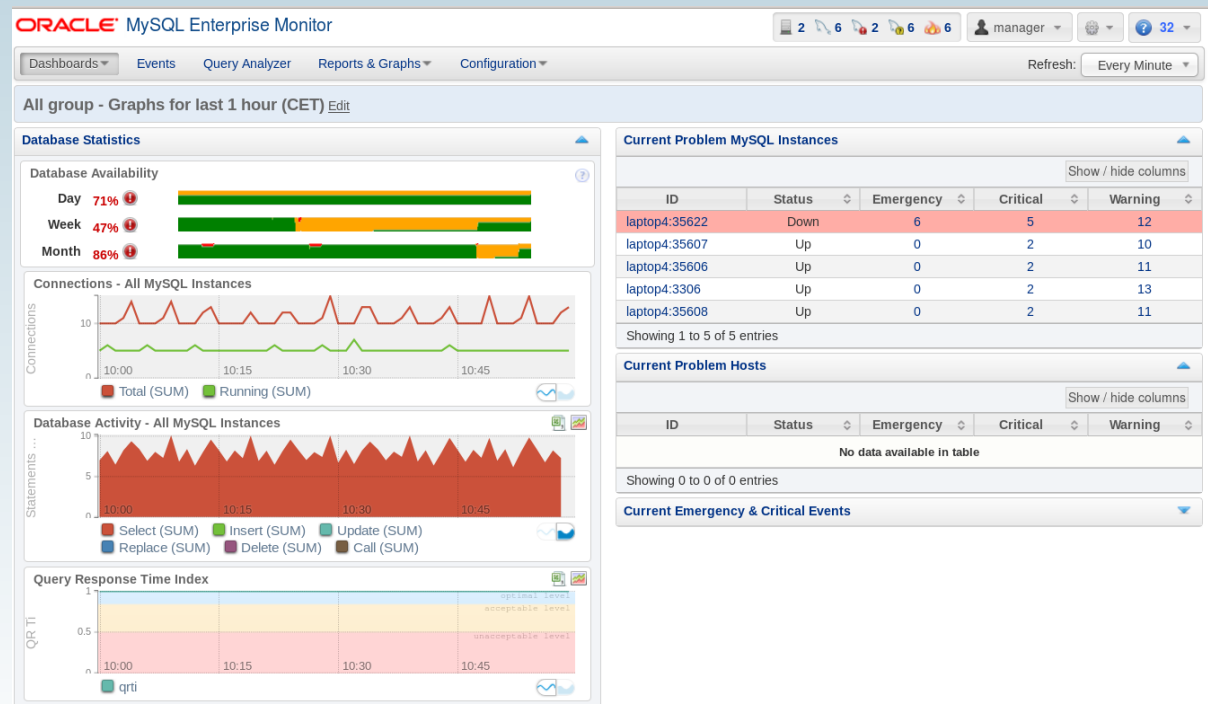
Angelangte  
Zeilen

# EXPLAIN Type Operationen

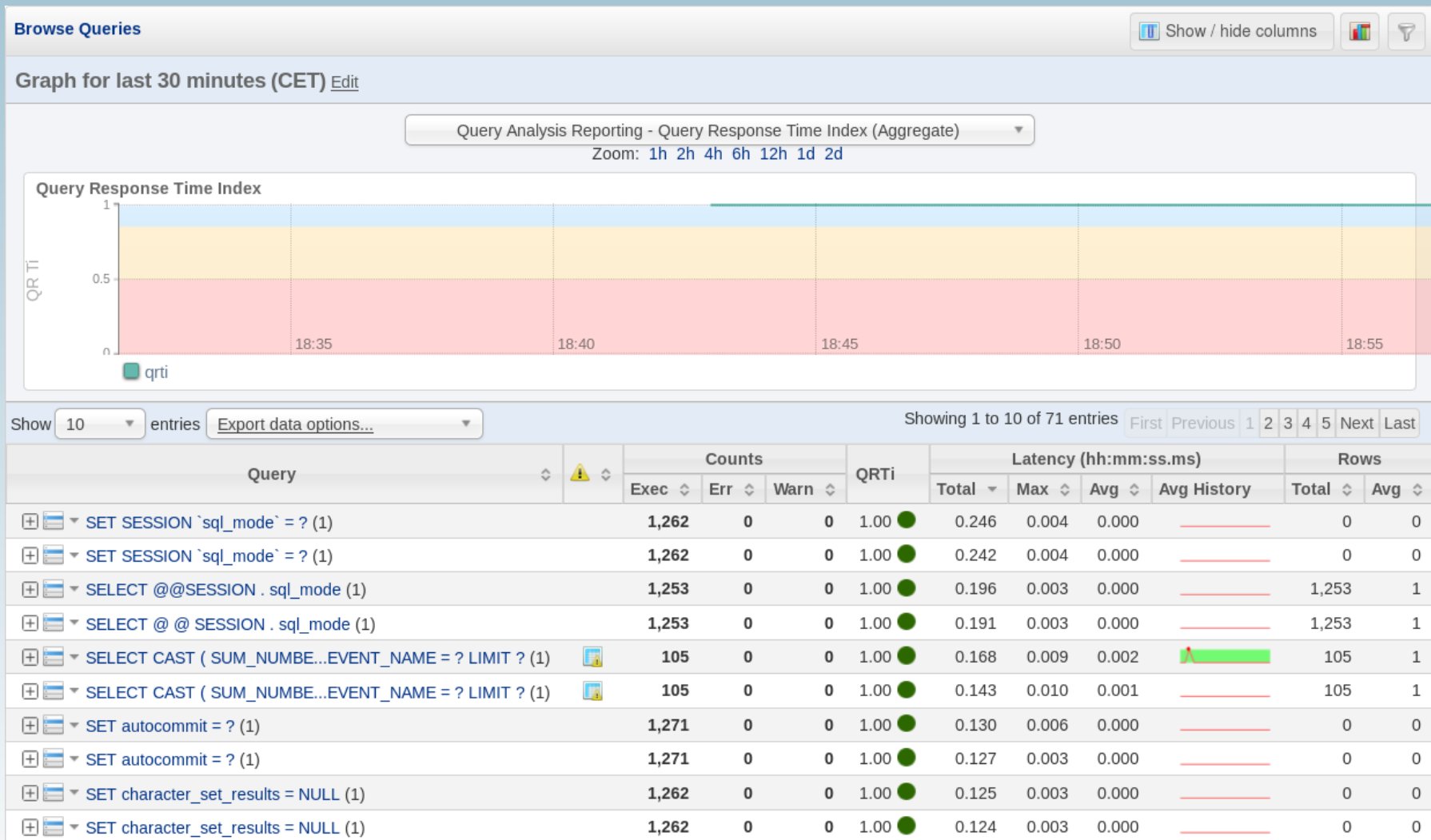
<p>billig</p> <p>↑</p> <p>↓</p> <p>teuer</p>	<b>const</b>	Höchstens eine passende Zeile, wird wie Konstante behandelt
	<b>eq_ref</b>	Ein Zeile pro Zeile aus vorheriger Tabelle (Primary Key- / Unique Key-Join)
	<b>ref</b>	Mehrere Zeilen pro Zeile aus vorheriger Tabelle (non-Unique Key-Join, Datenmenge nimmt zu!)
	<b>fulltext</b>	Der Join wird mittels FULLTEXT Index gelöst
	<b>index_merge</b>	Mehrere Index-Suchen werden gemerged
	<b>xxx_subquery</b>	Subqueries
	<b>range</b>	Index Range Scan
	<b>index</b>	Full Index Scan (IFFS)
	<b>ALL</b>	Full Table Scan

# Monitoring von MySQL

- MySQL Enterprise Monitor (MEM)
- Oracle Cloud Control (OEM/OMS) mit MySQL Plug-in
- 3<sup>rd</sup> Party Tools



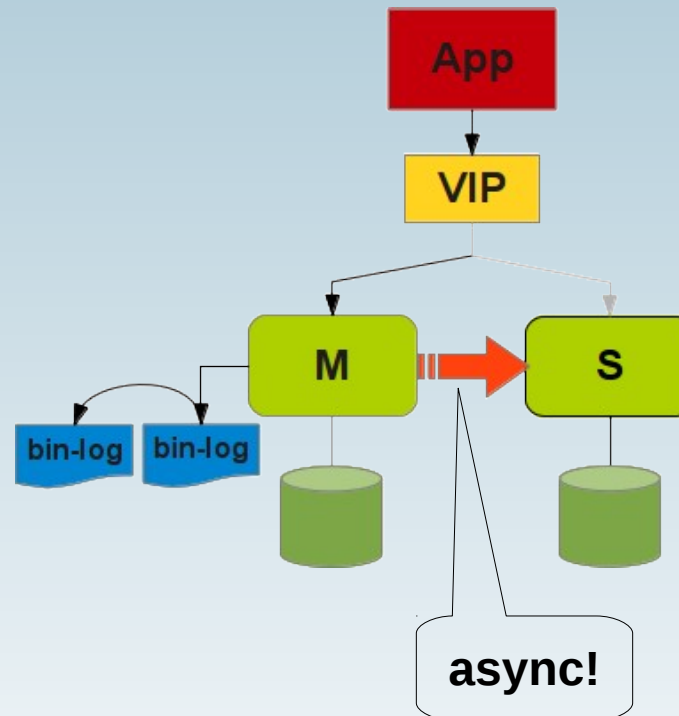
# Graphisch: Query Analyzer



# Hochverfügbarkeit

- **aktiv/passiv Failover-Cluster**
  - dito
- **Master/Slave Replikation**
  - Data-Guard
- **Galera Cluster für MySQL**
  - Oracle RAC

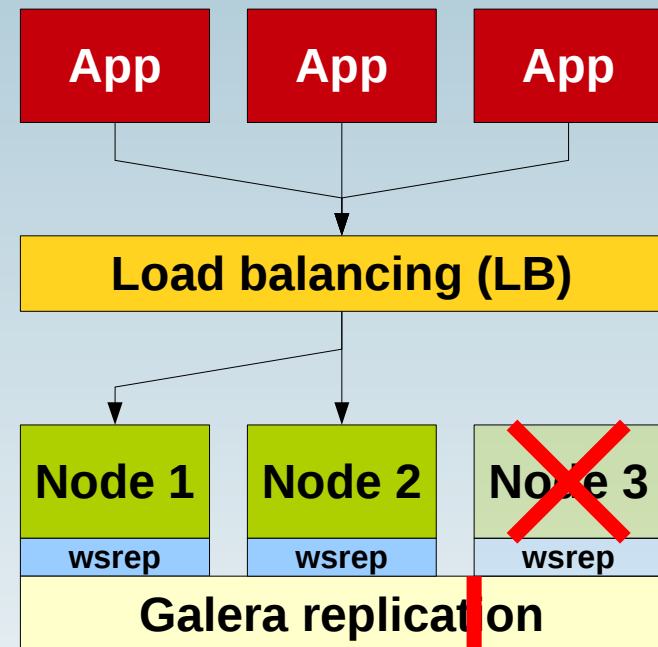
# MySQL Replication





# RAC: Galera Cluster

- Oracle Real Application Cluster (RAC)
- Hardware-Ausfall
- Wartungsarbeiten
  - HW/OS/DB Upgrade
- 5x9 HA: 99.999%



# Q & A



[www.fromdual.com](http://www.fromdual.com)



**Fragen ?**

**Diskussion?**

**Wir haben Zeit für ein persönliches Gespräch...**

- **FromDual bietet neutral und unabhängig:**
  - **Support für MySQL, Galera und MariaDB**
  - **Beratung**
  - **Schulung**
  - **Remote-DBA**

**[www.fromdual.com/presentations](http://www.fromdual.com/presentations)**