

The Basics a DBA Should Know About MySQL



Jože Senegačnik

Oracle ACE Director

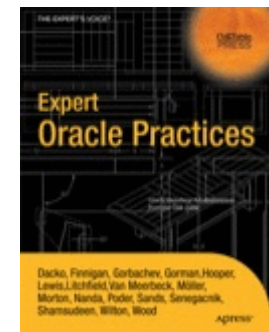
joze.senegacnik@dbprof.com

About the Speaker

Jože Senegačnik

- Owner of DbProf d.o.o. – manager
- First experience with Oracle Version 4 in 1988
- 27 years of experience with Oracle RDBMS.
- Proud member of the OakTable Network www.oaktable.net
- Oracle ACE Director
- Co-author of the OakTable book “Expert Oracle Practices” by Apress (Jan 2010)
- VP of Slovenian OUG (SIOUG) board
- CISA – Certified IS auditor
- Blog about Oracle: <http://joze-senegacnik.blogspot.com>

- PPL(A) – private pilot license PPL(A) / instrument rated IR/SE
- Blog about flying: <http://jsenegacnik.blogspot.com>
- Blog about Building Ovens, Baking and Cooking: <http://senegacnik.blogspot.com>



Introduction

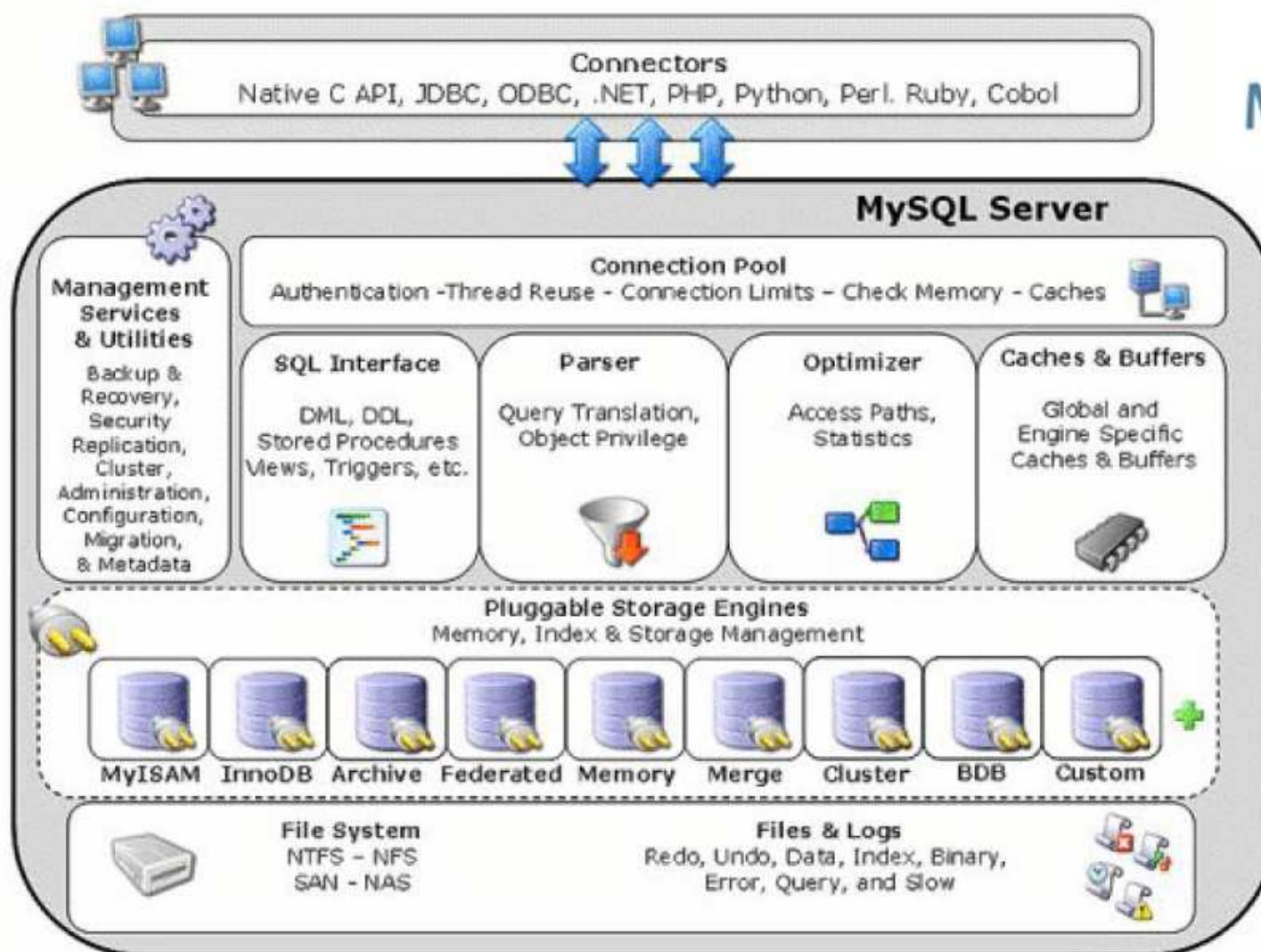
- For last 27 years I was always faithful to Oracle
 - No adultery with MSSQL or other databases ☺
- Got a project to do in MySQL and this was an eye-opening project!
- Last year at ACE Director briefing at Oracle HQ before OOW we had also briefing about MySQL – very interesting one.
 - MySQL is powering Facebook, Twitter, ...
 - So it looks like a mature technology
- I am not an expert on MySQL, just a very beginner!!!!
- Would like to share what I have learned in the project.



First Impressions

- Interface – something like sqlplus exists but is quite different.
- Urgently needed an interface to work with the database like SqlDeveloper or something like
- Found **phpMyAdmin**
 - Written in PHP which I was using as well in my project
 - Satisfied almost all my needs
- Nice tool for interactive work with MySQL database
 - creating databases, creating tables, indexes, referential integrity (if available in used database engine)
 - Databases in MySQL are like schemas in Oracle database
- Things that I have learned:
 - Installing it on my workstation under Windows and Linux
 - SQL language is the same as in Oracle, however functions are available but not the same as in Oracle
 - How to write you functions in database

MySQL Architecture



MySQL User Interface

```
E:\xampp\mysql\bin>mysql -u root -p
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 3
Server version: 5.6.21 MySQL Community Server (GPL)
```



Copyright (c) 2000, 2014, Oracle and/or its affiliates. All rights reserved.

Oracle is a registered trademark of Oracle Corporation and/or its affiliates. Other names may be trademarks of their respective owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

Using mysql interface

```
mysql> show databases;
```

```
+-----+
| Database          |
+-----+
| information_schema |
| atlasptic         |
| cdcol             |
| mysql             |
| performance_schema |
| phpmyadmin        |
| test              |
| webauth           |
+-----+
8 rows in set (0.01 sec)
```

```
mysql> use atlasptic;
mysql> show tables;
```

```
+-----+
| Tables_in_atlasptic |
+-----+
| atlas95              |
| besedila             |
| geo_tetrad           |
| geometry_columns    |
| .....               |
```

```
mysql> show table status;
```



Create Table Command

```
mysql> show create table atlas95;
```

```
CREATE TABLE `atlas95` (  
  `id` int(5) NOT NULL DEFAULT '0',  
  `X` int(6) DEFAULT NULL,  
  `Y` int(6) DEFAULT NULL,  
  `ID_10kmGK` varchar(9) COLLATE utf8_slovenian_ci DEFAULT NULL,  
  `TETRADA` varchar(9) COLLATE utf8_slovenian_ci NOT NULL,  
  `koda` varchar(6) COLLATE utf8_slovenian_ci DEFAULT NULL,  
  `id_vrste` int(6) NOT NULL,  
  `koda_G` varchar(7) COLLATE utf8_slovenian_ci DEFAULT NULL,  
  PRIMARY KEY (`id`),  
  KEY `TETRADA` (`TETRADA`),  
  KEY `id_vrste` (`id_vrste`),  
  KEY `vrsta_tetrada` (`id_vrste`,`TETRADA`)  
) ENGINE=InnoDB DEFAULT CHARSET=utf8 COLLATE=utf8_slovenian_ci
```



Create/Alter View

```
CREATE/ALTER ALGORITHM=UNDEFINED DEFINER=`root`@`localhost` SQL SECURITY
DEFINER VIEW `izvoz_podatkov_all` AS select `v`.`koda` AS
`koda`,`v`.`vrsta_slo` AS `vrsta_slo`,`ob`.`datum` AS
`datum`,`op`.`stevilo` AS `stevilo`,`op`.`id_enote_stetja` AS
`id_enote_stetja`,`op`.`id_statusa_opazovanja` AS
`id_statusa_opazovanja`,`op`.`belezka` AS `belezka`,`ob`.`id_projekta` AS
`id_projekta`,`ob`.`id_tipa_popisa` AS `id_tipa_popisa`,`ob`.`id_vira` AS
`id_vira`,`ob`.`natancnost_vnosa` AS `natancnost_vnosa`,`ob`.`tetrada` AS
`tetrada`,`(case when (isnull(`ob`.`FI`) or (`ob`.`FI` = 0.0)) then
`t`.`phi_centr` else `ob`.`FI` end) AS `FI`,`(case when
(isnull(`ob`.`LAMBDA`) or (`ob`.`LAMBDA` = 0.0)) then `t`.`lambda_centr`
else `ob`.`LAMBDA` end) AS `LAMBDA`,`(case when (isnull(`ob`.`X`) or
(`ob`.`X` = 0.0)) then `t`.`X_centr` else `ob`.`X` end) AS `X`,`(case when
(isnull(`ob`.`Y`) or (`ob`.`Y` = 0.0)) then `t`.`Y_centr` else `ob`.`Y`
end) AS `Y`,`ob`.`opombe` AS `opombe`,`ob`.`ponovitev` AS
`ponovitev`,`p`.`popisovalci` AS `popisovalci`,`ob`.`id_obiska` AS
`id_obiska`,`op`.`id_opazovanja` AS `id_opazovanja` from
((((`obiski_terena` `ob` join `opazovanja` `op`) join `x_vrste` `v`) join
`x_tetrade` `t`) join `obiski_terena_popisovalci_tmp` `p`) where
((`ob`.`id_obiska` = `op`.`id_obiska`) and (`v`.`id_vrste` =
`op`.`id_vrste`) and (`p`.`id_obiska` = `ob`.`id_obiska`) and
(`t`.`TETRADA` = `ob`.`tetrada`) and (`op`.`potrjen` = 1))
```

PHP Interface for MySQL (Yii)

```
public function actionAtlas($vrsta_ptice='')
{
    header('Content-type: application/json; charset=utf-8');
    $result=array();
    $sql = "SELECT t.tetrada, maxx,maxy,minx,miny,lam_min,lam_max,phi_min,phi_max,lam_x,lam_y,phi_x,phi_y, count(*) as stevilo ";
    $sql .= "FROM x_tetrade10 t, atlas95 at, x_vrste v WHERE t.tetrada = at.tetrada AND at.id_vrste = v.id_vrste AND koda_g > 0 ";
    $sql .= "AND v.vrsta_slo = :vrsta GROUP BY t.tetrada, t.lam_min, t.lam_max, t.phi_min, t.phi_max, lam_x, lam_y, phi_x, phi_y";
    $command=Yii::app()->db->createCommand($sql);
    $command->bindValue(":vrsta", $vrsta_ptice, PDO::PARAM_STR);
    foreach($command->query() as $row){
        $result[]=$row['tetrada'];
        $result[]=$row['maxx'];
        $result[]=$row['maxy'];
        $result[]=$row['minx'];
        $result[]=$row['miny'];
        $result[]=$row['lam_min'];
        $result[]=$row['lam_max'];
        $result[]=$row['phi_min'];
        $result[]=$row['phi_max'];
        $result[]=$row['lam_x'];
        $result[]=$row['lam_y'];
        $result[]=$row['phi_x'];
        $result[]=$row['phi_y'];
        $result[]=$row['stevilo'];
    }
    echo json_encode($result);
    Yii::app()->end();
}
```

Bind Variable

Binding

Explain Plan in MySQL

```
EXPLAIN SELECT p.id_popisovalca, EXTRACT( YEAR
FROM o.datum ) AS YEAR, EXTRACT( week
FROM o.datum ) AS week, COUNT( * ) AS stevilo
FROM obiski_terena o, opazovanja z, obiski_terena_popisovalci p
WHERE o.id_obiska = z.id_obiska
AND o.id_obiska = p.id_obiska
AND z.potrjen =1
AND EXTRACT( YEAR
```

+ Options

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	o	ALL	PRIMARY	NULL	NULL	NULL	101339	Using where; Using temporary; Using filesort
1	SIMPLE	p	ref	ID obiska	ID obiska	4	atlasptic.o.id_obiska	1	
1	SIMPLE	z	ref	ID obiska,potrjen	ID obiska	4	atlasptic.o.id_obiska	1	Using where

- ref = table acces by index rowid 😊

Analyze table

```
ANALYZE TABLE obiski_terena
```

+ Options

Table	Op	Msg_type	Msg_text
atlasptic.obiski_terena	analyze	status	OK

Show Indexes

SHOW INDEX FROM opazovanja

Profilni

+ Options

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment
opazovanja	0	PRIMARY	1	id_opazovanja	A	193484	NULL	NULL		BTREE		
opazovanja	1	ID obiska	1	id_obiska	A	193484	NULL	NULL		BTREE		
opazovanja	1	x_EnoteŠtetja_SeznamOpazovanja	1	id_enote_stetja	A	4	NULL	NULL		BTREE		
opazovanja	1	x_StatusOpazovanja_SeznamOpazovanja	1	id_statusa_opazovanja	A	6	NULL	NULL		BTREE		
opazovanja	1	x_TipiŠtetij_SeznamOpazovanja	1	id_tipa_stetja	A	4	NULL	NULL		BTREE		
opazovanja	1	x_Vrste_SeznamOpazovanja	1	id_vrste	A	581	NULL	NULL		BTREE		
opazovanja	1	potrjen	1	potrjen	A	50	NULL	NULL		BTREE		

- Show all indexes for a table

show index from <table_name>

No DUAL Table

```
SELECT USER( )
```

Show : Start row: Number of rows: Headers every rows

+ Options

USER()

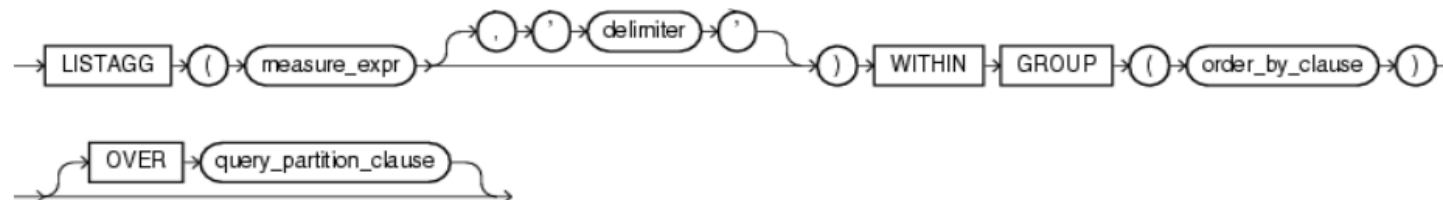
root@localhost

- Select user()
- Select current_user()

User Defined Function in MySQL

LISTAGG

Syntax



```
SELECT department_id "Dept.",  
LISTAGG(last_name, ';' ) WITHIN GROUP (ORDER BY hire_date)  
"Employees"  
FROM employees  
GROUP BY department_id  
ORDER BY department_id;
```

- Needed function like LISTAGG in Oracle
- Developed my own user defined function

User Defined Function in MySQL (2)

```
BEGIN
  DECLARE done INT DEFAULT 0;
  DECLARE m_ime VARCHAR(50);
  DECLARE m_priimek VARCHAR(50);
  DECLARE m_result VARCHAR(1024);
  DECLARE cur1 CURSOR FOR
    select distinct p.first_name as ime, p.last_name as priimek
    from user u, profiles p
    where p.user_id = u.id and u.username in
      (select distinct id_popisovalca
      from obiski_terena_popisovalci where
      id_obiska = pid_obiska);
  DECLARE CONTINUE HANDLER FOR NOT FOUND SET done = 1;
  OPEN cur1;
  SET m_result = '';
  read_loop: LOOP
    FETCH cur1 INTO m_ime, m_priimek;
    IF done THEN
      LEAVE read_loop;
    END IF;
    SET m_result = concat(m_result,trim(m_ime),' ',trim(m_priimek),' ');
  END LOOP;
  CLOSE cur1;
  RETURN substr(m_result,1,char_length(m_result)-2);
END
```

Data Dictionary – Information_Schema

- Since MySQL 5.0 the data dictionary is stored in the information_schema database.
- Contain metadata information
 - Tables
 - Indexes
 - Other
- Allows to create plugins
 - InnoDB plugins
- Data Dictionary Views
- By default information_schema is not exported.

MySQL Plugins

- Since MySQL 5.1 plugin API supports creation of server components.
- Plugins can be loaded at server startup, or loaded and unloaded dynamically at runtime.
- The API for plugins is generic.
- The components supported are typically:
 - storage engines,
 - full-text parser plugins
 - server extensions.
- InnoDB uses INFORMATION_SCHEMA plugins to provide tables that contain information about current transactions and locks.

(Recent tables) ...

- GLOBAL_STATUS
- GLOBAL_VARIABLES
- INNODB_BUFFER_PAGE
- INNODB_BUFFER_PAGE
- INNODB_BUFFER_POO
- INNODB_CMP
- INNODB_CMPMEM
- INNODB_CMPMEM_RES
- INNODB_CMP_RESET
- INNODB_LOCKS
- INNODB_LOCK_WAITS
- INNODB_TRX
- KEY_COLUMN_USAGE
- PARAMETERS
- PARTITIONS
- PLUGINS
- PROCESSLIST
- PROFILING
- REFERENTIAL_CONSTRAINTS
- ROUTINES
- SCHEMATA
- SCHEMA_PRIVILEGES
- SESSION_STATUS
- SESSION_VARIABLES
- STATISTICS
- TABLES
- TABLESPACES
- TABLE_CONSTRAINTS
- TABLE_PRIVILEGES
- TRIGGERS
- USER_PRIVILEGES
- IEWS

Server: localhost » Database: information_schema » Table: USER_PRIVILEGES

Browse Structure SQL Search Export More

⚠ This table does not contain a unique column. Grid edit, checkbox, Edit, Copy and Delete features are not available.

✔ Showing rows 0 - 29 (142 total, Query took 0.0004 sec)

```
SELECT *
FROM USER_PRIVILEGES
LIMIT 0, 30
```

Profiling [Inline] [Edit] [Explain SQL] [Create PHP Code] [Refresh]

Information_Schema

1 Show all > >> Show : Start row: 30 Number of rows: 30


+ Options

GRANTEE	TABLE_CATALOG	PRIVILEGE_TYPE	IS_GRANTABLE
'root'@'localhost'	def	SELECT	YES
'root'@'localhost'	def	INSERT	YES
'root'@'localhost'	def	UPDATE	YES
'root'@'localhost'	def	DELETE	YES
'root'@'localhost'	def	CREATE	YES
'root'@'localhost'	def	DROP	YES
'root'@'localhost'	def	RELOAD	YES
'root'@'localhost'	def	SHUTDOWN	YES
'root'@'localhost'	def	PROCESS	YES
'root'@'localhost'	def	FILE	YES
'root'@'localhost'	def	REFERENCES	YES
'root'@'localhost'	def	INDEX	YES
'root'@'localhost'	def	ALTER	YES
'root'@'localhost'	def	SHOW DATABASES	YES

Process List

SHOW PROCESSLIST

+ Options

 Kill	Id	User	Host	db	Command	Time	State	Info
 Kill	1546765	phpmyadmin	localhost	NULL	Sleep	0		NULL
 Kill	1546766	root	localhost	birdcount	Query	0	NULL	show processlist

- Show all user process

User Information

```
SELECT *
FROM mysql.user
LIMIT 0, 30
```

Show : Start row: Number of rows: Headers every rows

Sort by key:

+ Options

	Host	User	Password	Select_priv	Insert_priv	Update_priv
<input type="checkbox"/> Edit Copy Delete	localhost	root	*59E38C45FAA3A3A1E62DA6D0E1FC55FBD03B333E	Y	Y	Y
<input type="checkbox"/> Edit Copy Delete	dopps1	root	*59E38C45FAA3A3A1E62DA6D0E1FC55FBD03B333E	Y	Y	Y
<input type="checkbox"/> Edit Copy Delete	127.0.0.1	root	*59E38C45FAA3A3A1E62DA6D0E1FC55FBD03B333E	Y	Y	Y
<input type="checkbox"/> Edit Copy Delete	:::1	root	*59E38C45FAA3A3A1E62DA6D0E1FC55FBD03B333E	Y	Y	Y
<input type="checkbox"/> Edit Copy Delete	localhost	debian-sys-maint	*86C19B1E26AB97C2B91613A2E03EE22A74226189	Y	Y	Y
<input type="checkbox"/> Edit Copy Delete	localhost	phpmyadmin	*A65AFABEBF4A8A303C9138A5619A4C6C99A0DCEC	N	N	N
<input type="checkbox"/> Edit Copy Delete	localhost	etherpad	*1447A74FAB097DC28E8F69DE20D1338A902105ED	N	N	N



- Must be a privileged user

Backup & Restore

- Logical backup – like export in Oracle
- Dumped data structure definitions together with data – like script file
- Making Backup

```
E:\mysql\bin>mysqldump -u root -p atlasptic > atlas.bck  
Enter password: *****
```



Database name

- Restoring backup

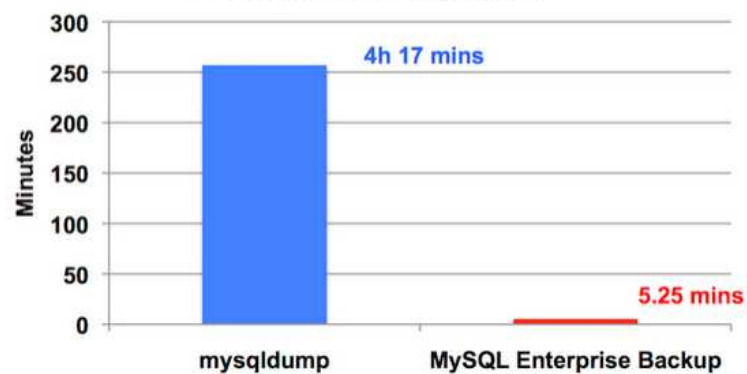
```
mysql -u root -p database_name < atlas.bck  
Enter password: *****
```

- Actually restore is just executing the backup as script

MySQL Enterprise Backup

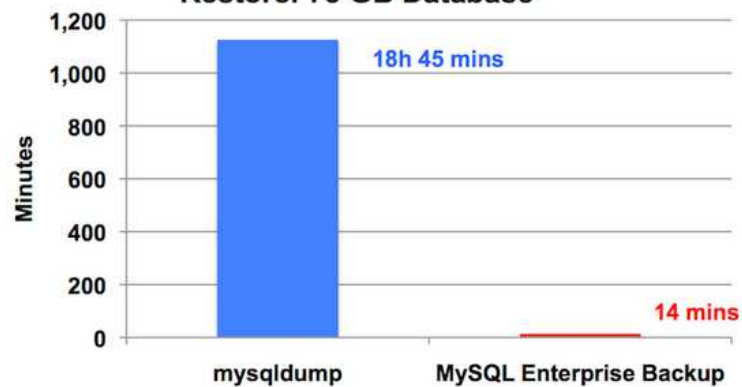
49x Better Performance: Backup

Backup: 73 GB Database



80x Better Performance: Restore

Restore: 73 GB Database



Creating Users Like In Oracle

```
mysql> CREATE USER 'joc'@'localhost' IDENTIFIED BY 'mypass';
```

```
mysql> show grants for joc@localhost;
```

Grants for joc@localhost:

```
GRANT USAGE ON *.* TO 'joc'@'localhost' IDENTIFIED BY  
PASSWORD '*6C8989366EAF75BB670AD8EA7A7FC1176A95CEF4'
```

Creating Users

```
mysql> GRANT ALL ON atlasptic.* TO 'joc'@'localhost'  
->  
Query OK, 0 rows affected (0.00 sec)  
  
mysql> exit  
Bye  
  
E:\xampp\mysql\bin>mysql -u joc -p  
Enter password: *****  
Welcome to the MySQL monitor.  Commands end with ; or \g.  
Your MySQL connection id is 11  
Server version: 5.6.21 MySQL Community Server (GPL)  
  
Copyright (c) 2000, 2014, Oracle and/or its affiliates. All rights reserved.  
  
Oracle is a registered trademark of Oracle Corporation and/or its  
affiliates. Other names may be trademarks of their respective  
owners.  
  
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.  
  
mysql> use atlasptic;  
Database changed  
mysql> create table blah (id int);  
Query OK, 0 rows affected (0.02 sec)
```

```
mysql> show grants;  
+-----+  
| Grants for joc@localhost  
+-----+  
| GRANT USAGE ON *.* TO 'joc'@'localhost' IDENTIFIED BY PASSWORD '*6C8989366EAF75BB670AD8EA7A7FC1176A95CEF4'  
| GRANT ALL PRIVILEGES ON 'atlas'.* TO 'joc'@'localhost'  
| GRANT ALL PRIVILEGES ON 'atlasptic'.* TO 'joc'@'localhost'  
+-----+  
3 rows in set (0.00 sec)
```

MySQL Access Privileges

- **SHOW GRANTS [FOR user@host]**
- Grant tables (must be a privileged user)
 - mysql.db
 - mysql.tables_priv
 - mysql.columns_priv
 - mysql.procs_priv
 - mysql.proxies_priv

```
mysql> show grants\g
+-----+
| Grants for root@localhost |
+-----+
| GRANT ALL PRIVILEGES ON *.* TO 'root'@'localhost' IDENTIFIED BY PASSWORD '*97E181B3CCE5A7C1F22DE8444AEC16F8209B4B2B' WITH GRANT OPTION |
| GRANT PROXY ON ''@'' TO 'root'@'localhost' WITH GRANT OPTION |
+-----+
2 rows in set (0.00 sec)

mysql>
```


Location of Data Files

- Each database is on a separate directory.
- *.frm files describe the structure of each table within the database.
- When using MyISAM tables, the data files are named (*.MYD) and indexes (*.MYI)
- When using InnoDB tables they are stored in InnoDB tablespaces, each of which can have one or more files (similar to Oracle),
- By default all InnoDB data and indexes for all databases on a MySQL server are held in one tablespace, consisting of one file:
/var/lib/mysql/ibdata1.
- InnoDB has 2 log files (like Oracle log files) to support automatic crash recovery.
- By default 2 log files: /var/lib/mysql/ib_logfile0 and /var/lib/mysql/ib_logfile1.
- Undo data is stored within the tablespace file.

InnoDB Tablespace/Logfiles (Linux)

```
root@host:/var/lib/mysql# ls -al
drwx----- 2 mysql mysql      12288 Jun  3 01:01 atlasptic
-rw-rw---- 1 mysql mysql 3768582144 Jun 13 05:20 ibdata1 ← tablespace
-rw-rw---- 1 mysql mysql   5242880 Jun 13 05:20 ib_logfile0 ← logfile
-rw-rw---- 1 mysql mysql   5242880 Jun 13 05:10 ib_logfile1 ← logfile
drwx----- 2 mysql mysql      4096 Feb  4 13:04 performance_schema
drwx----- 2 mysql mysql      4096 Jul 22 2014 phpmyadmin
.....
```

- InnoDB is transactional storage engine
- *.ibd files are tablespaces for individual table (one table per tablespace)

MySQL Managed Via WebAdmin (Linux)

[Module Index](#)
[Help..](#)

MySQL Server Configuration

MySQL server options

MySQL server port Default

MySQL server listening address Any

Allow big tables? Yes No

MySQL Unix socket Default

Databases files directory Default

Default table storage engine

Separate file for each InnoDB table? Yes No

Key buffer size Default bytes

Sort buffer size Default bytes

Network buffer size Default bytes

MyISAM sort buffer size Default bytes

Tables to cache Default

Maximum number of connections Default

Query cache size in bytes Default MB

Maximum packet size Default MB

Initialization File My.ini File

```
[client]
port      = 3306
socket    = "E:/xampp/mysql/mysql.sock"
```

The MySQL server

```
[mysqld]
port= 3306
#log = "jazes.log,,
log_error = "mysql_error.log"
socket = "E:/xampp/mysql/mysql.sock"
basedir = "E:/xampp/mysql"
tmpdir = "E:/xampp/tmp"
datadir = "E:/xampp/mysql/data"
pid_file = "mysql.pid,,
....
```

- Like init.ora in Oracle

Writing SQL Statements

- SQL92 Syntax preferred for joins
- Functions are different than in Oracle ☹️
- Large IN-lists are working very slow
 - where var IN (select
- On contrary EXISTS works very fine
 - where exists (select
- Most of the SQL statements is running extremely fast – updates, deletes are astonishing fast.
- When something slow use EXPLAIN to get information
- Use referential integrity

Benefits – Small Memory Usage



▼ System Information

System hostname ptice.si (127.0.0.1)

Operating system Ubuntu Linux 14.04

Webmin version 1.750

Time on system Sat Jun 13 07:48:07 2015

Kernel and CPU Linux 3.13.0-49-generic on x86_64

Processor information Westmere E56xx/L56xx/X56xx (Nehalem-C), 2 cores

System uptime 71 days, 8 hours, 08 minutes

Running processes 104

CPU load averages 0.04 (1 min) 0.05 (5 mins) 0.05 (15 mins)

CPU usage 0% user, 0% kernel, 0% IO, 100% idle

Real memory 696.95 MB used, 3.86 GB total

Virtual memory 117.92 MB used, 7.45 GB total

Local disk space 51.91 GB used, 71.28 GB total

Package updates 97 package updates are available

Benefits

- Simple & Fast & Reliable
 - So far no outages
 - No problems with data corruption
 - Practically no management required
 - Default setup is more or less sufficient
 - With large number of connections things would get more complicated
 - Uses significantly less memory than Oracle Database
 - Intended to be used mainly for web applications



Thank you for your interest!

Q&A