Big Data Infrastructure and Technologies

Practice A0 – Getting familiar with SQL

SQL Basics and Tools, Data Modeling

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Outline

- Data model
- Basic SQL commands and scripting
- Database: MySQL, building and using

- Skip to slide #34 for SQL exercises
- Use http://w3schools.com/sql/ online tutorial for exercises

Practice and Assignments - Recommendations

- Importance of following instructions
  - To achieve expected learning outcome
  - It is important to go beyond minimum required and reflect on experience
- Correctly naming files and providing ID (meta)data
  - Data management literacy is important
  - Not all are doing it correct/literate
- Correctly labeling you instances, buckets, snapshots
  - Few students did this
  - All other instance names are of wide variety…
- Self-learning is a key approach in IT and Computer Science
  - Find necessary information, tutorial, template

Reporting (if required) – Best practice

Report content

- Task, objectives
- Artefact
- Answer
- Analysis
- Conclusion

Why do you need a Data model

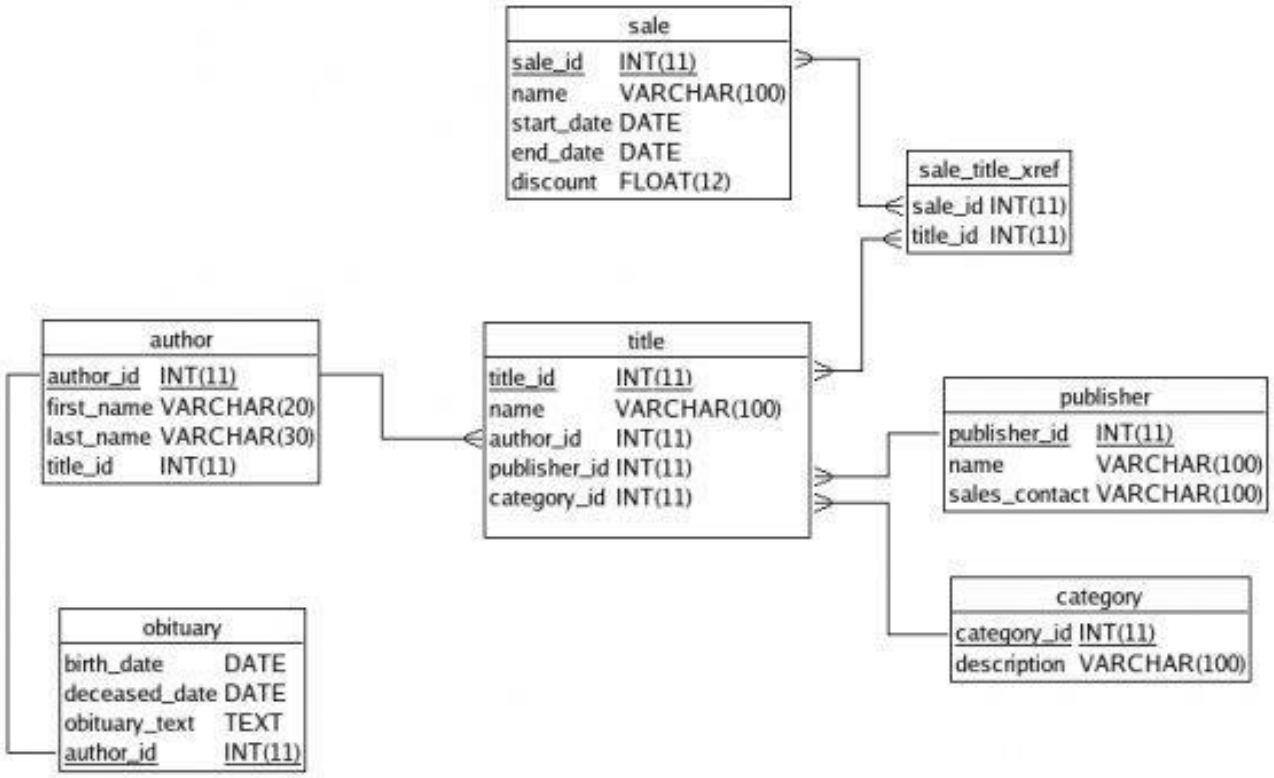
The Datamodel is fundamental for consistency of the data used with the business applications and websites

- To structure information and processes
- Maintain compatibility between systems and applications
- Guarantee consistent integration of all information
- Maintain overall consistency of website
- Efficiency
- Scalability

Layered Data model

1. Conceptual design
   - Identify important entities and their relations
2. Logical design
   - Specification of attributes of entities
3. Physical design
   - Representation of the logical design with machines
     - In this course: “relational database”

Relational database – Relational datamodel



- Relational model: tables with references
- Optimisation through Indexes and data constraints
- Support for “Access control”
- Examples: **MySQL**, Postgres, Oracle, MS SQL Server, MS Access, …

Relational Database design

- Tables (including columns and rows)
- Relations
- Indexes

Table: columns and rows

Column or field

Table title

Property 1	Property 2	Property 3	Property 4	Property 5	Property 6	Property 7	Property 8
Value 1	Value 2	Value 3	Value 4	Value 5	Value 6	Value 7	Value 8

Property (attribute)

Row or record or entity

Element (data value)

Step-by-step Example: Book shop sell data

Books sell

Author 1	Author 2	Title	ISBN	Price	Client name	Client address	Purchase date
Robin Nixon		Learning PHP, MySQL, and JavaScript	596157135	24.99	Don Johnson	4 New York Plaza, New York, NY 10004	Jan 03 2008
David Sklar	Adam Trachtenberg	PHP Cookbook	596101015	44.99	Emma Brown	1565 Rainbow Road, Los Angeles, CA 90014	Mar 03 2009
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- There is a lot wrong with this table!

Good data model

When is a data model "good"?

If there is:

- Logical reflection of entities in tables
- Relations between tables with indexes ("keys")

with the aim of:

- Retaining data integrity: trusted data
- Preventing inefficiencies in space/storage and time/performance in accessing data and working with data
- Consistent presentation of relations between entities
- Maintainable and scalable, in particular with the future growth

Good data model

When is a data model "good"?

If there is:

- Logical ref
- Relations b

with the aim c

Good approach is continuously asking:

"What questions/requests should my database (and application) answer"

- Retaining data integrity: trusted data
- Preventing inefficiencies in space/storage and time/performance in accessing data and working with data
- Consistent presentation of relations between entities
- Maintainable and scalable, in particular with the future growth

What is the goal?

- Balance between a "pure" logical design and "practical" physical design.

Normalisation

- First normal form (1NF)
- Second normal form (2NF)
- Third normal form (3NF)
- Fourth normal form (4NF)
- Fifth normal form (5NF)

Advice:

- Start from using standard approaches
- Use common sense as you build your understanding and experience

First Normal Form

A table is in the first normal form if:

- each column has a name and a suitable type
- order of rows or columns has no meaning
- there are no duplicates in rows or columns
- all columns have one value ("atomic")
- each row is unique (has a "primary key")

Example: Bookshop sell data

Books sell

Different columns but the same data (type)

Author 1	Author 2	Title	ISBN	Price	Client name	Client address	Purchase date
Robin Nixon		Learning PHP, MySQL, and JavaScript	596157135	24.99	Don Johnson	4 New York Plaza, New York, NY 10004	Jan 03 2008
David Sklar	Adam Trachtenberg	PHP Cookbook	596101015	44.99	Emma Brown	1565 Rainbow Road, Los Angeles, CA 90014	Mar 03 2009
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Multiple values:
2 authors in one column

There is no primary key in this table: a customer could, for example, purchase multiple copies of a book on the same date

Example: Bookshop sell data

Books sell

Title	ISBN	Price	Client name	Client address	Purchase date
Learning PHP, MySQL, and JavaScript	596157135	24.99	Don Johnson	4 New York Plaza, New York, NY 10004	Jan 03 2008
PHP Cookbook	596101015	44.99	Emma Brown	1565 Rainbow Road, Los Angeles, CA 90014	Mar 03 2009
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Authors moved to a separate table: a book written by several authors appears in several rows with the same ISBN, different author.

A relationship has been created between two tables.

In this case, n:m ("many to many"): a book can have multiple authors, and an author may have written several books.

Second Normal Form (2NF)

A table is in the second normal form if:

- The table is in the first normal form, and
- There are no repeating subsets in the rows.

In other words:

- Elements that belong to each other are placed in the same table.

Or vice versa:

- Elements that do not belong together are placed in different tables.

In other words:

- Each table represents entities with only the attributes directly associated with them. Reference is made to related entities.

One last time, but now more formally:

- All non-primary-key fields are completely dependent on the primary key.

Example: Bookshop sell data

Books sell

Title	ISBN	Price	Client name	Client address	Purchase date
Learning PHP, MySQL, and JavaScript	596157135	24.99	Don Johnson	4 New York Plaza, New York, NY 10004	Jan 03 2008
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Repetition of the same data (: subsets).

- To split to separate tables:
  Book titles, Customers, Purchases
- But then mutual references must be made to maintain the relationships!

These repetitions are "keys": we allow them.

Example: Bookshop sell data

Books

ISBN	Title	Price
596157135	Learning PHP, MySQL, and JavaScript	24.99
596101015	PHP Cookbook	44.99
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Books sell

Client numr	ISBN	Date
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2	596101015	Mar 03 2009
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596005436	David Lane
596006815	Rasmus Lerdorf
596006815	Kevin Tatroe
596006815	Peter MacIntyre

Clients (customers)

Client number	Name	Address	Place	State	Zip
1	Don Johnson	4 New York Plaza	New York	NY	10004
2	Emma Brown	1565 Rainbow Road	Los Angeles	CA	90014
3	Darren Ryder	4758 Emily Drive	Richmond	VA	23219
4	Earl B. Thurston	862 Gregory Lane	Frankfort	KY	40601
5	David Miller	3647 Cedar Lane	Waltham	MA	02154

Book titles, client numbers, purchases also moved to separate tables

Client address are split (atomicity)

Example: Bookshop sell data

Books

ISBN	Title	Price
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These tables are not necessary 1NF: duplicates must be prevented (in other words: there is no primary key).
Solution: to add key column.

Third Normal Form (3NF)

A table is in third normal form if:

- The table is in second normal form, and
- A property can not be obtained from other properties.

In other words:

- All non-key properties are independent of all other non-key properties

Once again, but now more formally:

- There are no transitive dependencies

Example: Bookshop sell data

Books

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Zip is directly related to State and place/city. F.e., Postcode table in Nederland.

Example: Bookshop sell data

Books

ISBN	Title	Price
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596101015	PHP Cookbook	44.99
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3	Darren Ryder	4758 Emily Drive	23219
4	Earl B. Thurston	862 Gregory Lane	40601
5	David Miller	3647 Cedar Lane	02154

Zip codes

Zip	Place	State
10004	New York	NY
90014	Los Angeles	CA
23219	Richmond	VA
40601	Frankfort	KY
02154	Waltham	MA

New table Zipcodes.

Reason not to do this: Extra table costs money and performance.

Another example

- Computable attributes should not be placed in the table
  - Table below is not 3NF: TotalIncBTW can be calculated from TotalExBTW

Orders

Order Nr	Client Nmr	TotalExBTW	TotalIncBTW
1987123	2121	12,34	14,68
2234789	2135	100,00	119,00
3231414	2652	1,24	1,48
4456456	5323	23,28	27,70
5346778	3356	32,43	38,59

How to define tables

- One table for each type of object
- Provided that:
  - Relationship is not 1: 1
  - 2 or more attributes required per object

Example: Tables

- Relation between buildings and apartments 1:n

Apartment Buildings

Address	Year built	Service
Lodewijk laan 304-450	1970	Roof asfalt
Braambos 525-630	1984	CV kettle renew
Kennedy laan 251-365	2001	

Tenants

Name	House number	Building
Jaansen	305	
Pitersen	306	
Klaassen	252	

Example: Tables

- Relation between buildings and apartments 1:n

"primary key"

"foreign key"
(reference key)

Apartment Buildings

ID	Address	Year built	Service
1	Lodewijk laan 304-450	1970	Roof asfalt
2	Braambos 525-630	1984	CV kettle renew
3	Kennedy laan 251-365	2001	

Tenants

Name	House number	Building
Jaansen	305	1
Pitersen	306	1
Klaassen	252	3

MySQL Command Line Shell (CLI)

Login to the server with SSH:

```
$ mysql -u <username> -p
```

Enter password: *<password>*

Mysql can connect to remote server

```
$ mysql -h hostname -u username -p
```

Exit – quit or exit

```
$ mysql exit Bye
```

List databases:

```
mysql > show databases;
```

Select database:

```
mysql > use <databasename>;
```

List tables in a selected database:

```
mysql > show tables;
mysql > drop table <tablename>;
```

SQL statements terminated with ; semicolon:

```
mysql > select * from <table>;
```

```
bitnami@debian: ~/Desktop/mysqlsampledatabase
File  Edit  View  Search  Terminal  Help
+--------------------+
| Database           |
+--------------------+
| information_schema |
| classicmodels      |
| mysql              |
| performance_schema |
| sys                |
| testdb01           |
+--------------------+
6 rows in set (0.00 sec)

mysql> use testdb01
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> select * from Product_Type
    -> ;
+-----------------+-------------------------------+
| PRODUCT_TYPE_CD | NAME                          |
+-----------------+-------------------------------+
| ACCOUNT         | Customer Accounts             |
| INSURANCE       | Insurance Offerings           |
| LOAN            | Individual and Business Loans |
+-----------------+-------------------------------+
3 rows in set (0.00 sec)

mysql> C
```

All SQL command are case insensitive
However, attribute my be case sensitive in some MySQL tools.

Sample MySQL Database testdb01customers Data model

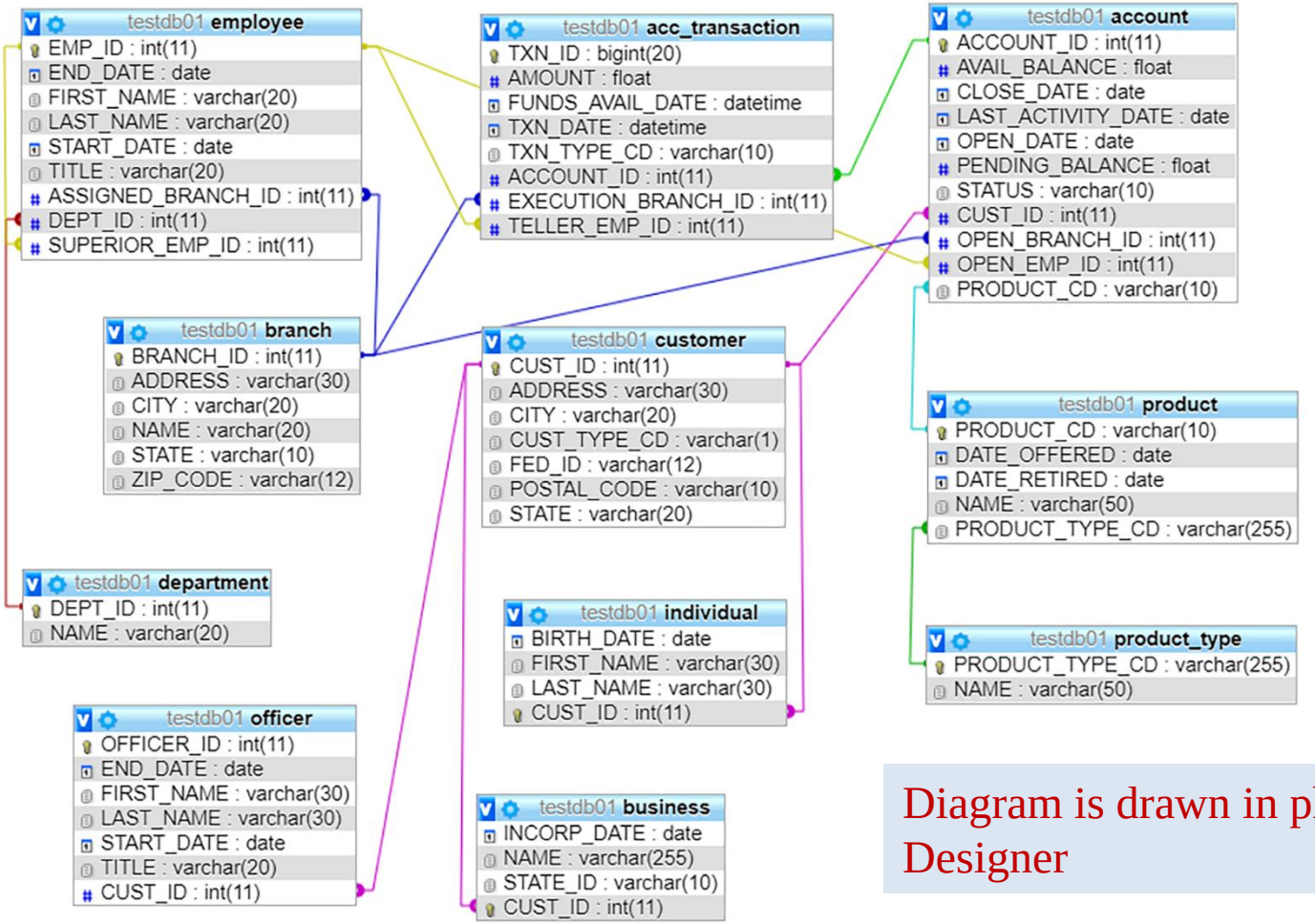
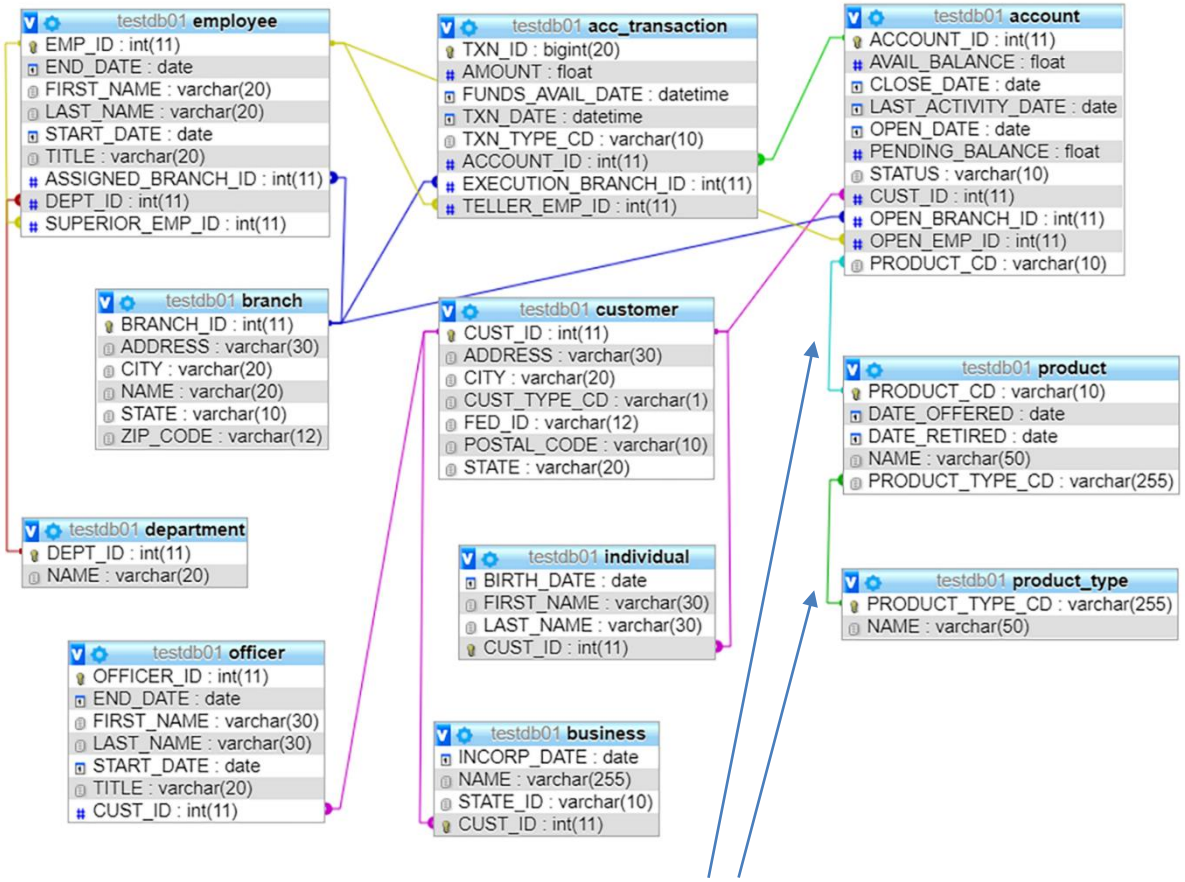


Diagram is drawn in phpMyAdmin Designer

- Learning database testdb01 is available in http://voorbeeldcode.science.uva.nl

Table keys



- Each Product has Product_type
- Each Product_type may have multiple Products
- Each Product may be linked to multiple Accounts

- **Key or index** unlocks access to table
  - Each key consists of one or more fields, or field prefix
- A ***candidate key*** is a field, or combination of fields, that uniquely identifies a database record and a primary key (PK).
- A ***primary key (PK)*** is a candidate key that has been designated to identify unique records in the table throughout the database structure.
- ***Foreign key*** is a primary key of one table used in another table
- **Relation between two tables** is created by assigning a common field to the two tables
  - This common field must be a primary key to one table
- Foreign keys also allow ***cascading*** **deletes and updates**

Table details: column types

String	CHAR VARCHAR TINYTEXT TEXT MEDIUMTEXT LONGTEXT
Byte String	BINARY VARBINARY TINYBLOB BLOB MEDIUMBLOB LONGBLOB
Integer	TINYINT SMALLINT MEDIUMINT INT BIGINT
Date & Time	DATE DATETIME YEAR TIME TIMESTAMP
Decimal	FLOAT DOUBLE DECIMAL
Sets	ENUM SET

MySQL | Data types

Length/Values

Default

Attributes

Index

NullAUTO_INCREMENT

VARCHAR can hold numbers and characters of variable length

Importance of the correct column type selection

- E.g., maximum value
- Can cause service disruption

SQL commands practice

- Use http://w3schools.com/sql/ for exercises

Using databases: SQL

http://w3schools.com/sql/

SQL: Structured Query Language

Most used commands:

- Select row: SELECT … ;
- Change row: UPDATE … ;
- Add row: INSERT … ;
- Delete row: DELETE … ;

http://dev.mysql.com/doc/refman/5.5/en/sql-syntax-data-manipulation.html

Template exercises – General commands

Login to the server with SSH:

```
$ mysql –u <username> –p
```

Enter password: *<password>*

Mysql can connect to remote server

```
$ mysql -h hostname -u username -p
```

Exit – quit or exit

```
$ mysql exit Bye
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List databases:

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```
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mysql > drop table <tablename>;
```

SQL statements terminated with ; semicolon:

```
mysql > select * from <table>;
```

INSERT

Add a row

Two methods, e.g.:

1. INSERT INTO users
   SET username=“jansen”,
   password=“secret#”;

2. INSERT INTO users
   (username, password)
   VALUES (“jansen”, ”secret#”);

```
mysql> SELECT * FROM Product_type;
+-----------------+-------------------------------+
| PRODUCT_TYPE_CD | NAME                          |
+-----------------+-------------------------------+
| ACCOUNT         | Customer Accounts             |
| INSURANCE       | Insurance Offerings           |
| LOAN            | Individual and Business Loans |
+-----------------+-------------------------------+
3 rows in set (0.01 sec)


mysql> INSERT INTO Product_type
    -> SET Product_type_cd="RISK", NAME="Ris assessment";
Query OK, 1 row affected (0.00 sec)


mysql> INSERT INTO Product_type SET Product_type_cd="RISK",
NAME="Ris assessment
";sql> SET Product_type_cd="RISK", NAME="Ris assessment";
mysql> SELECT * FROM Product_type;
+-----------------+-------------------------------+
| PRODUCT_TYPE_CD | NAME                          |
+-----------------+-------------------------------+
| ACCOUNT         | Customer Accounts             |
| INSURANCE       | Insurance Offerings           |
| LOAN            | Individual and Business Loans |
| RISK            | Ris assessment                |
+-----------------+-------------------------------+
4 rows in set (0.00 sec)
```

UPDATE

Change one or more rows

Example:

- UPDATE users
  SET password=“secret#”
  WHERE username=“jansen”
  LIMIT 1;

Only one row to be changed

```
mysql> SELECT * FROM Product_type;
+-----------------+-------------------------------+
| PRODUCT_TYPE_CD | NAME                          |
+-----------------+-------------------------------+
| ACCOUNT         | Customer Accounts             |
| INSURANCE       | Insurance Offerings           |
| LOAN            | Individual and Business Loans |
+-----------------+-------------------------------+
3 rows in set (0.01 sec)

mysql> INSERT INTO Product_type
    -> SET Product_type_cd="RISK", NAME="Ris assessment";
Query OK, 1 row affected (0.00 sec)

mysql> INSERT INTO Product_type SET Product_type_cd="RISK",
NAME="Ris assessment
";sql> SET Product_type_cd="RISK", NAME="Ris assessment";
mysql> SELECT * FROM Product_type;
+-----------------+-------------------------------+
| PRODUCT_TYPE_CD | NAME                          |
+-----------------+-------------------------------+
| ACCOUNT         | Customer Accounts             |
| INSURANCE       | Insurance Offerings           |
| LOAN            | Individual and Business Loans |
| RISK            | Ris assessment                |
+-----------------+-------------------------------+
4 rows in set (0.00 sec)

mysql> UPDATE Product_type
    -> SET NAME="Risk assessment"
    -> WHERE Product_type_cd="RISK"
    -> LIMIT 1;
Query OK, 1 row affected (0.00 sec)
Rows matched: 1  Changed: 1  Warnings: 0

mysql> SELECT * FROM Product_type;
+-----------------+-------------------------------+
| PRODUCT_TYPE_CD | NAME                          |
+-----------------+-------------------------------+
| ACCOUNT         | Customer Accounts             |
| INSURANCE       | Insurance Offerings           |
| LOAN            | Individual and Business Loans |
| RISK            | Risk assessment               |
+-----------------+-------------------------------+
4 rows in set (0.00 sec)
```

DELETE

Delete one or more rows

Example:

- DELETE FROM users WHERE username="jansen" LIMIT 1;

Only one row to be changed

```
mysql> SELECT * FROM Product_type;
+-----------------+-------------------------------+
| PRODUCT_TYPE_CD | NAME                          |
+-----------------+-------------------------------+
| ACCOUNT         | Customer Accounts             |
| INSURANCE       | Insurance Offerings           |
| LOAN            | Individual and Business Loans |
| RISK            | Risk assessment               |
+-----------------+-------------------------------+
4 rows in set (0.00 sec)

mysql> DELETE FROM Product_type WHERE Product_type_cd="RISK"
LIMIT 1;
Query OK, 1 row affected (0.00 sec)

mysql> SELECT * FROM Product_type;
+-----------------+-------------------------------+
| PRODUCT_TYPE_CD | NAME                          |
+-----------------+-------------------------------+
| ACCOUNT         | Customer Accounts             |
| INSURANCE       | Insurance Offerings           |
| LOAN            | Individual and Business Loans |
+-----------------+-------------------------------+
3 rows in set (0.00 sec)

mysql>
```

SELECT

http://w3schools.com/sql/

```
mysql> help select
Name: 'SELECT'
Description:
Syntax:
SELECT
     [ALL | DISTINCT | DISTINCTROW ]
          [HIGH_PRIORITY]
          [STRAIGHT_JOIN]
          [SQL_SMALL_RESULT] [SQL_BIG_RESULT] [SQL_BUFFER_RESULT]
          [SQL_CACHE | SQL_NO_CACHE] [SQL_CALC_FOUND_ROWS]
     select_expr [, select_expr ...]
     [FROM table_references
     [WHERE where_condition]
     [GROUP BY {col_name | expr | position}
          [ASC | DESC], ... [WITH ROLLUP]]
     [HAVING where_condition]
     [ORDER BY {col_name | expr | position}
          [ASC | DESC], ...]
     [LIMIT {[offset,] row_count | row_count OFFSET offset}]
     [PROCEDURE procedure_name(argument_list)]
     [INTO OUTFILE 'file_name'
            [CHARACTER SET charset_name]
            export_options
          | INTO DUMPFILE 'file_name'
          | INTO var_name [, var_name]]
     [FOR UPDATE | LOCK IN SHARE MODE]]
[…]
```

Fetch information from database

- The most widely used and the most rich instruction

Example:

- SELECT name, surname FROM users_table WHERE userid= 1016123;

SELECT

```
Select Emp.Emp_Id,
    Emp.First_Name,
    Emp.Last_Name,
    Emp.Dept_Id
From   Employee Emp;
```

Alias

bitnami@debian: ~

File Edit View Search Terminal Help

```
+--------+------------+-----------+---------+
|      1 | Michael    | Smith     |       3 |
|      2 | Susan      | Barker    |       3 |
|      3 | Robert     | Tyler     |       3 |
|      4 | Susan      | Hawthorne |       1 |
|      5 | John       | Gooding   |       2 |
|      6 | Helen      | Fleming   |       1 |
|      7 | Chris      | Tucker    |       1 |
|      8 | Sarah      | Parker    |       1 |
|      9 | Jane       | Grossman  |       1 |
|     10 | Paula      | Roberts   |       1 |
|     11 | Thomas     | Ziegler   |       1 |
|     12 | Samantha   | Jameson   |       1 |
|     13 | John       | Blake     |       1 |
|     14 | Cindy      | Mason     |       1 |
|     15 | Frank      | Portman   |       1 |
|     16 | Theresa    | Markham   |       1 |
|     17 | Beth       | Fowler    |       1 |
|     18 | Rick       | Tulman    |       1 |
+--------+------------+-----------+---------+
18 rows in set (0.00 sec)

mysql> mysql> SELECT Emp.Emp_Id ,Emp.First_Name
,Emp.Last_Name ,Emp.Dept_Id FROM
Employe

mysql>
```

SELECT – LIMIT

```
Select Emp.Emp_Id,
    Emp.First_Name,
    Emp.Last_Name,
    Emp.Dept_Id
From   Employee Emp
LIMIT 10;
```

```
Select Emp.Emp_Id,
    Emp.First_Name,
    Emp.Last_Name,
    Emp.Dept_Id
From   Employee Emp
LIMIT 10, 5;
```

Other SQL versions use TOP attribute

```
SELECT TOP 10 *  FROM Badges
WHERE name LIKE 'a%';
```

```
mysql> Select Emp.Emp_Id, Emp.First_Name, Emp.Last_Name,
Emp.Dept_Id From   Empl
oyee Emp LIMIT 10;
+--------+------------+-----------+---------+
| Emp_Id | First_Name | Last_Name | Dept_Id |
+--------+------------+-----------+---------+
|      1 | Michael    | Smith     |       3 |
|      2 | Susan      | Barker    |       3 |
|      3 | Robert     | Tyler     |       3 |
|      4 | Susan      | Hawthorne |       1 |
|      5 | John       | Gooding   |       2 |
|      6 | Helen      | Fleming   |       1 |
|      7 | Chris      | Tucker    |       1 |
|      8 | Sarah      | Parker    |       1 |
|      9 | Jane       | Grossman  |       1 |
|     10 | Paula      | Roberts   |       1 |
+--------+------------+-----------+---------+
10 rows in set (0.00 sec)

mysql> Select Emp.Emp_Id, Emp.First_Name, Emp.Last_Name,
Emp.Dept_Id From   Empl
oyee Emp LIMIT 10,5;
+--------+------------+-----------+---------+
| Emp_Id | First_Name | Last_Name | Dept_Id |
+--------+------------+-----------+---------+
|     11 | Thomas     | Ziegler   |       1 |
|     12 | Samantha   | Jameson   |       1 |
|     13 | John       | Blake     |       1 |
|     14 | Cindy      | Mason     |       1 |
|     15 | Frank      | Portman   |       1 |
+--------+------------+-----------+---------+
5 rows in set (0.00 sec)
```

SELECT – WHERE … LIKE

```
Select Emp.Emp_Id,
    Emp.First_Name,
    Emp.Last_Name,
    Emp.Dept_Id
From   Employee Emp;
```

```
Select Emp.Emp_Id,
    Emp.First_Name,
    Emp.Last_Name,
    Emp.Dept_Id
From   Employee Emp
WHERE Emp.Last_Name
LIKE ‘T%’;
```

```
mysql> Select Emp.Emp_Id,       Emp.First_Name,
Emp.Last_Name,      Emp.Dep
t_Id From   Employee Emp;
+--------+------------+-----------+---------+
| Emp_Id | First_Name | Last_Name | Dept_Id |
+--------+------------+-----------+---------+
|      1 | Michael    | Smith     |       3 |
|      2 | Susan      | Barker    |       3 |
|      3 | Robert     | Tyler     |       3 |
|      4 | Susan      | Hawthorne |       1 |
|      5 | John       | Gooding   |       2 |
|      6 | Helen      | Fleming   |       1 |
|      7 | Chris      | Tucker    |       1 |
|      8 | Sarah      | Parker    |       1 |
|      9 | Jane       | Grossman  |       1 |
|     10 | Paula      | Roberts   |       1 |
|     11 | Thomas     | Ziegler   |       1 |
|     12 | Samantha   | Jameson   |       1 |
|     13 | John       | Blake     |       1 |
|     14 | Cindy      | Mason     |       1 |
|     15 | Frank      | Portman   |       1 |
|     16 | Theresa    | Markham   |       1 |
|     17 | Beth       | Fowler    |       1 |
|     18 | Rick       | Tulman    |       1 |
+--------+------------+-----------+---------+
18 rows in set (0.00 sec)
```

```
mysql> Select Emp.Emp_Id, Emp.First_Name, Emp.Last_Name,
Emp.Dept_Id
    -> From   Employee Emp WHERE Emp.Last_Name LIKE "T%";
+--------+------------+-----------+---------+
| Emp_Id | First_Name | Last_Name | Dept_Id |
+--------+------------+-----------+---------+
|      3 | Robert     | Tyler     |       3 |
|      7 | Chris      | Tucker    |       1 |
|     18 | Rick       | Tulman    |       1 |
+--------+------------+-----------+---------+
3 rows in set (0.00 sec)
```

SELECT – ORDER BY

```
Select Emp.Emp_Id,
    Emp.First_Name,
    Emp.Last_Name,
    Emp.Dept_Id
From   Employee Emp
ORDER BY Emp.Last_Name;
```

```
Select Emp.Emp_Id,
    Emp.First_Name,
    Emp.Last_Name,
    Emp.Dept_Id
From   Employee Emp
ORDER BY Emp.Last_Name DESC
LIMIT 10;
```

```
mysql> Select Emp.Emp_Id,       Emp.First_Name,
Emp.Last_Name,      Emp.Dep
t_Id From   Employee Emp ORDER BY Emp.Last_Name;
+--------+------------+-----------+---------+
| Emp_Id | First_Name | Last_Name | Dept_Id |
+--------+------------+-----------+---------+
|      2 | Susan      | Barker    |       3 |
|     13 | John       | Blake     |       1 |
|      6 | Helen      | Fleming   |       1 |
|     17 | Beth       | Fowler    |       1 |
|      5 | John       | Gooding   |       2 |
|      9 | Jane       | Grossman  |       1 |
|      4 | Susan      | Hawthorne |       1 |
|     12 | Samantha   | Jameson   |       1 |
|     16 | Theresa    | Markham   |       1 |
|     14 | Cindy      | Mason     |       1 |
|      8 | Sarah      | Parker    |       1 |
|     15 | Frank      | Portman   |       1 |
|     10 | Paula      | Roberts   |       1 |
|      1 | Michael    | Smith     |       3 |
|      7 | Chris      | Tucker    |       1 |
|     18 | Rick       | Tulman    |       1 |
|      3 | Robert     | Tyler     |       3 |
|     11 | Thomas     | Ziegler   |       1 |
+--------+------------+-----------+---------+
18 rows in set (0.00 sec)

mysql> Select Emp.Emp_Id,       Emp.First_Name,
Emp.Last_Name,      Emp.Dep
t_Id From   Employee Emp ORDER BY Emp.Last_Name Desc
LIMIT 10;

+--------+------------+-----------+---------+
| Emp_Id | First_Name | Last_Name | Dept_Id |
+--------+------------+-----------+---------+
|     11 | Thomas     | Ziegler   |       1 |
|      3 | Robert     | Tyler     |       3 |
|     18 | Rick       | Tulman    |       1 |
|      7 | Chris      | Tucker    |       1 |
|      1 | Michael    | Smith     |       3 |
|     10 | Paula      | Roberts   |       1 |
|     15 | Frank      | Portman   |       1 |
|      8 | Sarah      | Parker    |       1 |
|     14 | Cindy      | Mason     |       1 |
|     16 | Theresa    | Markham   |       1 |
+--------+------------+-----------+---------+
```

SELECT - DISTINCT

SELECT DISTINCT
Product_Type_Cd
from Product;

Selects only distinct, not repeating records

```
mysql> Select Pro.Product_Cd
    ->      ,Pro.Name
    ->      ,Pro.Product_Type_Cd
    -> From   Product Pro;
+------------+-------------------------+-----------------+
| Product_Cd | Name                    | Product_Type_Cd |
+------------+-------------------------+-----------------+
| AUT        | auto loan               | LOAN            |
| BUS        | business line of credit | LOAN            |
| CD         | certificate of deposit  | ACCOUNT         |
| CHK        | checking account        | ACCOUNT         |
| MM         | money market account    | ACCOUNT         |
| MRT        | home mortgage           | LOAN            |
| SAV        | savings account         | ACCOUNT         |
| SBL        | small business loan     | LOAN            |
+------------+-------------------------+-----------------+
8 rows in set (0.00 sec)

mysql> Select Pro.Product_Type_Cd from Product Pro;
+-----------------+
| Product_Type_Cd |
+-----------------+
| ACCOUNT         |
| ACCOUNT         |
| ACCOUNT         |
| ACCOUNT         |
| LOAN            |
| LOAN            |
| LOAN            |
| LOAN            |
+-----------------+
8 rows in set (0.00 sec)

mysql> Select Distinct Pro.Product_Type_Cd from Product Pro;
+-----------------+
| Product_Type_Cd |
+-----------------+
| ACCOUNT         |
| LOAN            |
+-----------------+
2 rows in set (0.00 sec)
```

SELECT - WHERE

```
mysql> Select * From Product Pro Where Pro.Product_Type_Cd = 'LOAN';
+------------+--------------+--------------+-------------------------+-----------------+
| PRODUCT_CD | DATE_OFFERED | DATE_RETIRED | NAME                    | PRODUCT_TYPE_CD |
+------------+--------------+--------------+-------------------------+-----------------+
| AUT        | 2000-01-01   | NULL         | auto loan               | LOAN            |
| BUS        | 2000-01-01   | NULL         | business line of credit | LOAN            |
| MRT        | 2000-01-01   | NULL         | home mortgage           | LOAN            |
| SBL        | 2000-01-01   | NULL         | small business loan     | LOAN            |
+------------+--------------+--------------+-------------------------+-----------------+
4 rows in set (0.00 sec)


mysql> Select Product_cd, Date_Offered, Name, Product_type_cd From Product Pro W
here Pro.Product_Type_Cd = 'LOAN';
+------------+--------------+-------------------------+-----------------+
| Product_cd | Date_Offered | Name                    | Product_type_cd |
+------------+--------------+-------------------------+-----------------+
| AUT        | 2000-01-01   | auto loan               | LOAN            |
| BUS        | 2000-01-01   | business line of credit | LOAN            |
| MRT        | 2000-01-01   | home mortgage           | LOAN            |
| SBL        | 2000-01-01   | small business loan     | LOAN            |
+------------+--------------+-------------------------+-----------------+
4 rows in set (0.00 sec)
```

Select * From Product Pro Where Pro.Product_Type_Cd = 'LOAN’;

Select Product_cd, Date_Offered, Name, Product_type_cd From Product Pro Where Pro.Product_Type_Cd = 'LOAN';

SELECT – WHERE (case sensitive)

```
mysql> Select * From Product Pro Where Pro.Product_Type_Cd = 'LOAN';
+------------+--------------+--------------+-------------------------+-----------------+
| PRODUCT_CD | DATE_OFFERED | DATE_RETIRED | NAME                    | PRODUCT_TYPE_CD |
+------------+--------------+--------------+-------------------------+-----------------+
| AUT        | 2000-01-01   | NULL         | auto loan               | LOAN            |
| BUS        | 2000-01-01   | NULL         | business line of credit | LOAN            |
| MRT        | 2000-01-01   | NULL         | home mortgage           | LOAN            |
| SBL        | 2000-01-01   | NULL         | small business loan     | LOAN            |
+------------+--------------+--------------+-------------------------+-----------------+
4 rows in set (0.00 sec)


mysql> Select Product_cd, Date_Offered, Name, Product_type_cd From Product Pro W
here Pro.Product_Type_Cd = 'LOAN';
+------------+--------------+-------------------------+-----------------+
| Product_cd | Date_Offered | Name                    | Product_type_cd |
+------------+--------------+-------------------------+-----------------+
| AUT        | 2000-01-01   | auto loan               | LOAN            |
| BUS        | 2000-01-01   | business line of credit | LOAN            |
| MRT        | 2000-01-01   | home mortgage           | LOAN            |
| SBL        | 2000-01-01   | small business loan     | LOAN            |
+------------+--------------+-------------------------+-----------------+
4 rows in set (0.00 sec)
```

Select * From product Pro Where Pro.product_type_cd = 'LOAN’;

Select product_cd, date_offered, name, product_type_cd From product Pro Where Pro.product_type_cd = 'LOAN';

SELECT – Aggregate functions

Name	Description
AVG()	Return the average value of the argument
BIT_AND()	Return bitwise and
BIT_OR()	Return bitwise or
BIT_XOR()	Return bitwise xor
COUNT(DISTINCT)	Return the count of a number of different values
COUNT()	Return a count of the number of rows returned
GROUP_CONCAT()	Return a concatenated string
MAX()	Return the maximum value
MIN()	Return the minimum value
STD()	Return the population standard deviation
STDDEV_POP()	Return the population standard deviation
STDDEV_SAMP()	Return the sample standard deviation
STDDEV()	Return the population standard deviation
SUM()	Return the sum
VAR_POP()	Return the population standard variance
VAR_SAMP()	Return the sample variance
VARIANCE()	Return the population standard variance

Examples

- SELECT MAX(temp)FROM temperature;
- SELECT AVG(temp)FROM temperature;

SELECT – COUNT (*)

SELECT COUNT(*)
From Employee Emp
WHERE Emp.Dept_Id='1';

SELECT COUNT(*)
From Employee
WHERE Dept_Id
IS NOT NULL;

SELECT COUNT(*)
From Employee
WHERE Dept_Id !=0;

```
mysql> SELECT COUNT(*) From   Employee Emp WHERE
Emp.Dept_Id='1';
+----------+
| COUNT(*) |
+----------+
|       14 |
+----------+
1 row in set (0.00 sec)

mysql> SELECT COUNT(*) From   Employee WHERE Dept_Id IS NOT
NULL;
+----------+
| COUNT(*) |
+----------+
|       18 |
+----------+
1 row in set (0.00 sec)

mysql> SELECT COUNT(*) From   Employee WHERE Dept_Id != 0;
+----------+
| COUNT(*) |
+----------+
|       18 |
+----------+
1 row in set (0.00 sec)
```

```
mysql> Select Emp.Emp
Emp.Last_Name,
t_Id From   Employee
Emp.Last_Name;
+--------+----------
| Emp_Id | First_Name
+--------+----------
|      2 | Susan
|     13 | John
|      6 | Helen
|     17 | Beth
|      5 | John
|      9 | Jane
|      4 | Susan
|     12 | Samantha
|     16 | Theresa
|     14 | Cindy
|      8 | Sarah
|     15 | Frank
|     10 | Paula
|      1 | Michael
|      7 | Chris
|     18 | Rick
|      3 | Robert
|     11 | Thomas      | Ziegler    |        1 |
+--------+------------+-----------+---------+
18 rows in set (0.00 sec)
```

SELECT – GROUP BY

```
SELECT dept_id, count(*)
From   employee
GROUP BY  dept_id;
```

```
SELECT dept_Id, count(*)
From   employee
GROUP BY  dept_id
HAVING dept_id != ‘1’;
```

```
SELECT dept_id, count(*)
From   employee
GROUP BY  dept_Id
HAVING Count(*) < 5;
```

```
mysql> SELECT Dept_Id, count(*) From   Employee GROUP BY
Dept_Id  HAVING Dept_I
d != 1;
+---------+----------+
| Dept_Id | count(*) |
+---------+----------+
|       2 |        1 |
|       3 |        3 |
+---------+----------+
2 rows in set (0.01 sec)

mysql> SELECT Dept_Id, count(*)
    -> From   Employee
    -> GROUP BY  Dept_Id
    -> HAVING Count(*) < 5;
+---------+----------+
| Dept_Id | count(*) |
+---------+----------+
|       2 |        1 |
|       3 |        3 |
+---------+----------+
2 rows in set (0.00 sec)
```

```
mysql> Select Em
Emp.Last_Name,
t_Id From   Empl
Emp.Last_Name;
+--------+------
| Emp_Id | First
+--------+------
|      2 | Susan
|     13 | John
|      6 | Helen
|     17 | Beth
|      5 | John
|      9 | Jane        | Grossman  |        1 |
|      4 | Susan       | Hawthorne |        1 |
|     12 | Samantha    | Jameson   |        1 |
|     16 | Theresa     | Markham   |        1 |
|     14 | Cindy       | Mason     |        1 |
|      8 | Sarah       | Parker    |        1 |
|     15 | Frank       | Portman   |        1 |
|     10 | Paula       | Roberts   |        1 |
|      1 | Michael     | Smith     |        3 |
|      7 | Chris       | Tucker    |        1 |
|     18 | Rick        | Tulman    |        1 |
|      3 | Robert      | Tyler     |        3 |
|     11 | Thomas      | Ziegler   |        1 |
+--------+------------+-----------+---------+
18 rows in set (0.00 sec)
```

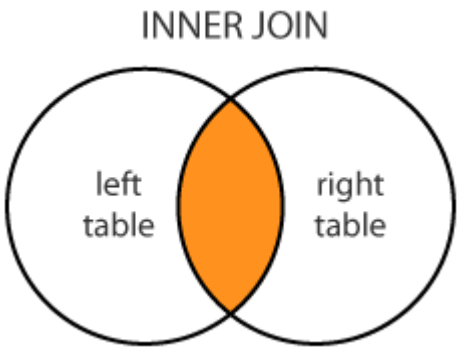
SELECT – JOIN (INNER JOIN)

SELECT **groups.**id, title FROM groups
JOIN projects ON groups.project_id= projects.id;

SELECT firstname, lastname, group_id, title
FROM students
JOIN groups ON students.group_id= groups.id JOIN projects
ON groups.project_id= projects.id
ORDER BY title, group_id;

SELECT title, COUNT(groups.id)
FROM groups
JOIN projects ON
groups.project_id= projects.id
GROUP BY title ORDER BY COUNT(groups.id) DESC;

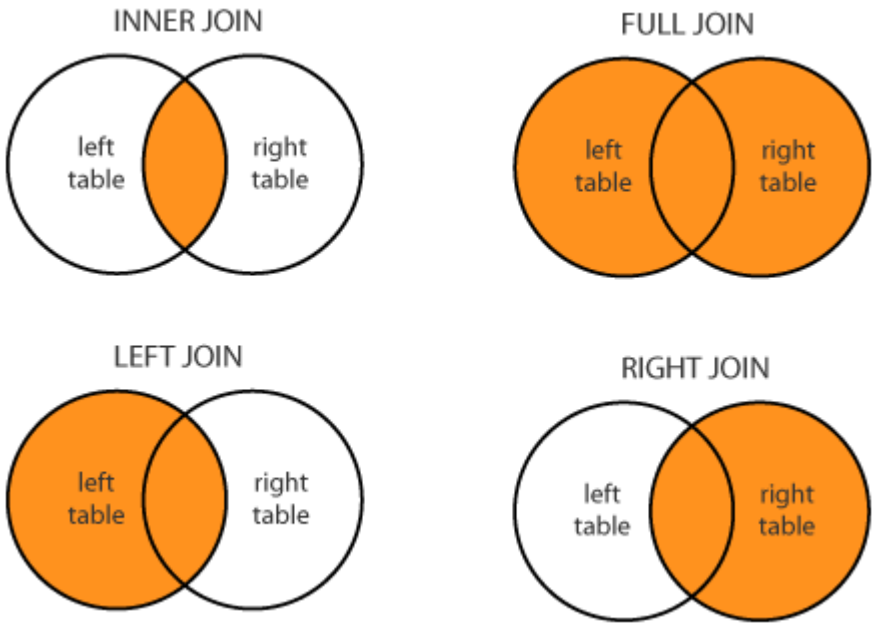
SELECT {column-names}
FROM table-name1
JOIN table-name2
ON column-name1 = column-name2
WHERE condition



SELECT – LEFT JOIN, RIGHT JOIN

```
SELECT title, COUNT(groups.id)
FROM groups
LEFT JOIN projects
ON groups.project_id= projects.id
GROUP BY title ORDER BY
COUNT(groups.id) DESC;
```

```
SELECT title, COUNT(groups.id)
FROM groups
RIGHT JOIN projects
ON groups.project_id= projects.id
GROUP BY title
ORDER BY COUNT(groups.id)
DESC;
```



SELECT

http://w3schools.com/sql/

```
mysql> help select
Name: 'SELECT'
Description:
Syntax:
SELECT
     [ALL | DISTINCT | DISTINCTROW ]
          [HIGH_PRIORITY]
          [STRAIGHT_JOIN]
          [SQL_SMALL_RESULT] [SQL_BIG_RESULT] [SQL_BUFFER_RESULT]
          [SQL_CACHE | SQL_NO_CACHE] [SQL_CALC_FOUND_ROWS]
     select_expr [, select_expr ...]
     [FROM table_references
     [WHERE where_condition]
     [GROUP BY {col_name | expr | position}
          [ASC | DESC], ... [WITH ROLLUP]]
     [HAVING where_condition]
     [ORDER BY {col_name | expr | position}
          [ASC | DESC], ...]
     [LIMIT {[offset,] row_count | row_count OFFSET offset}]
     [PROCEDURE procedure_name(argument_list)]
     [INTO OUTFILE 'file_name'
            [CHARACTER SET charset_name]
            export_options
          | INTO DUMPFILE 'file_name'
          | INTO var_name [, var_name]]
     [FOR UPDATE | LOCK IN SHARE MODE]]
[…]
```

SQL getting started practice

- Installing and using SQL database
- Experimenting with simple examples above

Options SQL database installation for exercises

- LAMP machine (Linux – Apache – MySQL – PHP)
  - The most popular platform for webservers and web applications
- AWS Aurora
  - Cloud based Petabyte scale database compatible with MySQL
- MySQL workbench
  - Convenient client and tool work with SQL databases

Access to MySQL database on LAMP machine

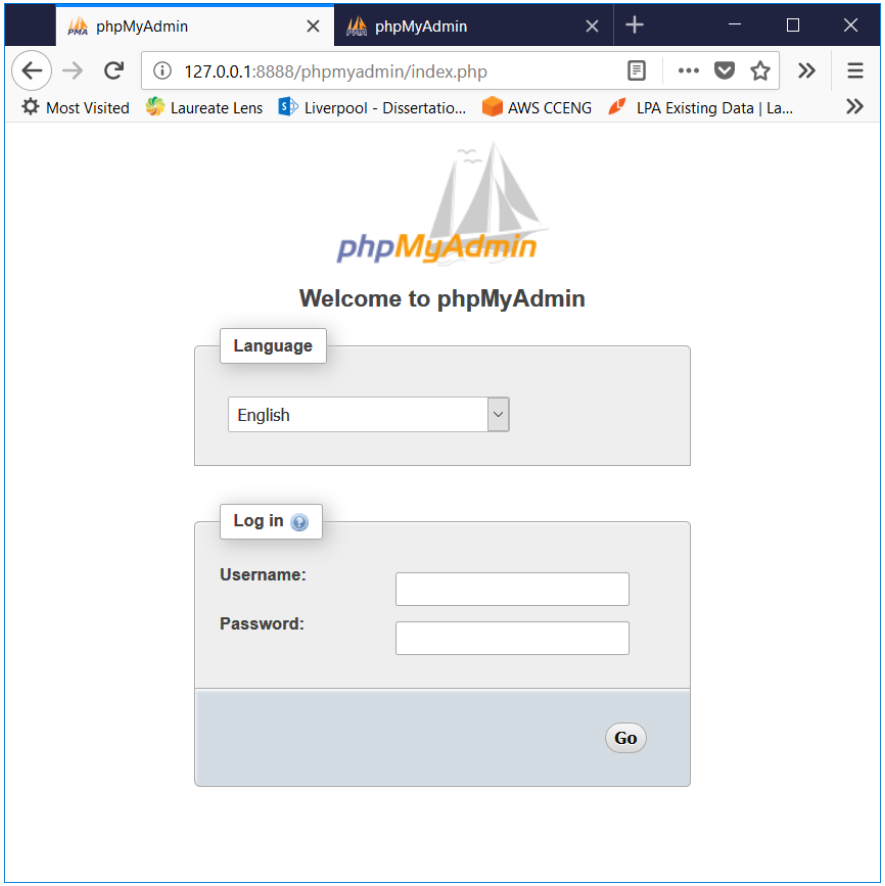
Three methods to access database:

1. With **phpMyAdmin**
   - Easy to use web interface
   - Tip: use this to build your database!
   - "Designer" tool is useful for defining relations and creating graphical schemes
   - Useful for testing and debugging "queries"
2. With a **mysql** command line shell
   - Useful to quickly test and debug queries
3. From **PHP** code (optional)
   - Access your database from PHP programs

Accessing LAMP Server

phpMyAdmin

- Example: http://ec2-54-77-161-187.eu-west-1.compute.amazonaws.com/phpmyadmin/
- Useful tool to manage and build your database
- Login with your username and password



MySQL CLI

- Simple and intuitive
- Try SQL examples above

Login to the server with SSH:

```
$ mysql -u <username> -p
```

Enter password: *<password>*

Mysql can connect to remote server

```
$ mysql -h hostname -u username -p
```

Exit – quit or exit

```
$ mysql exit Bye
```

List databases:

```
mysql > show databases;
```

Select database:

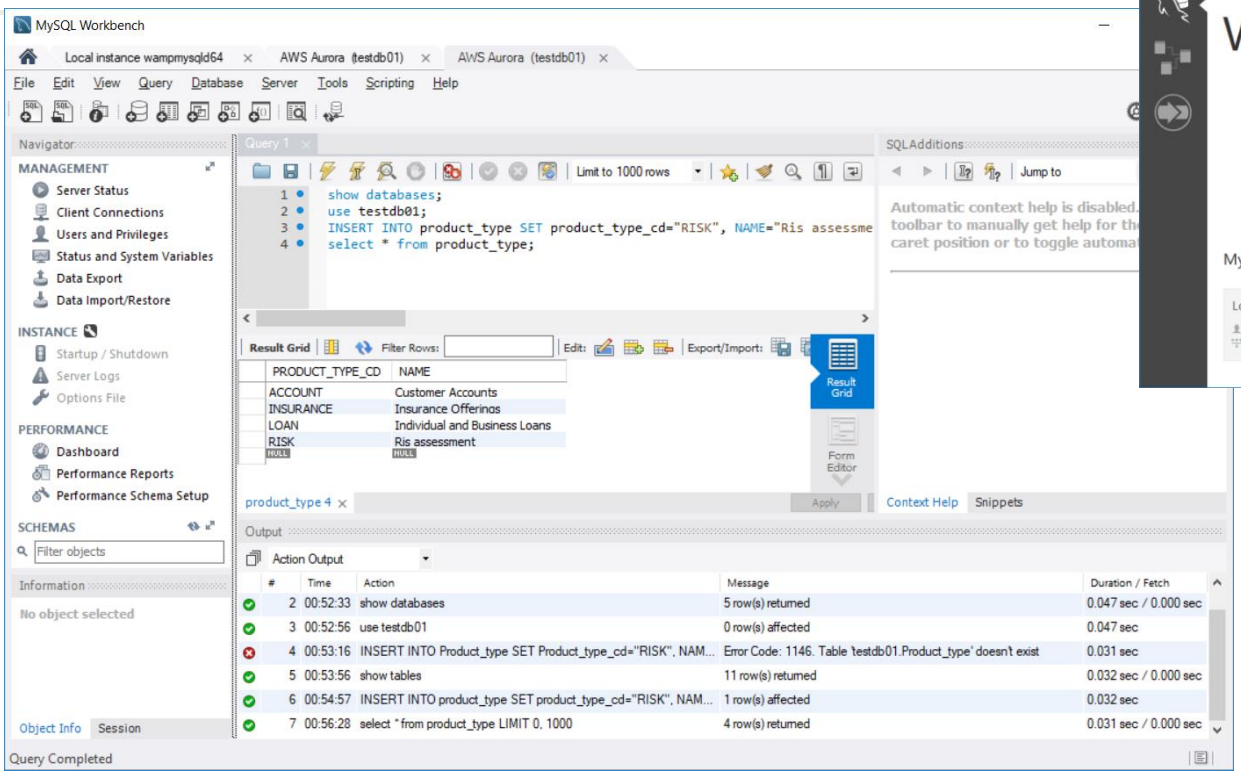
```
mysql > use <databasename>;
```

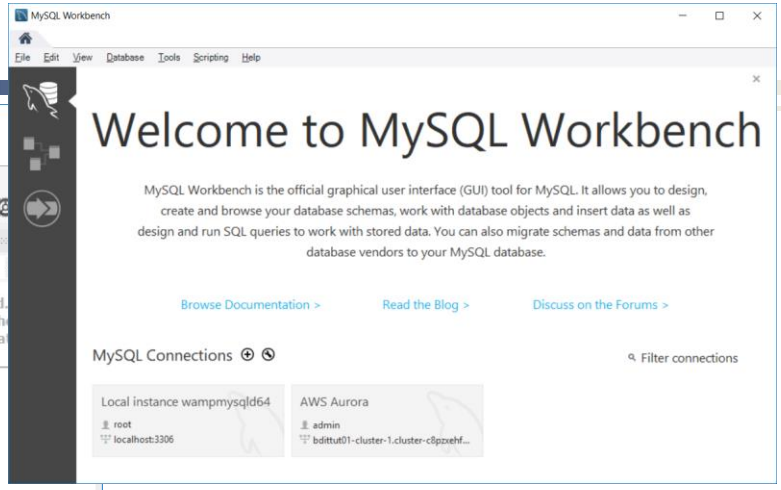
List tables in a selected database:

```
mysql > show tables;
```

AWS Aurora MySQL/PostgreSQL

Accessing MySQL/Aurora

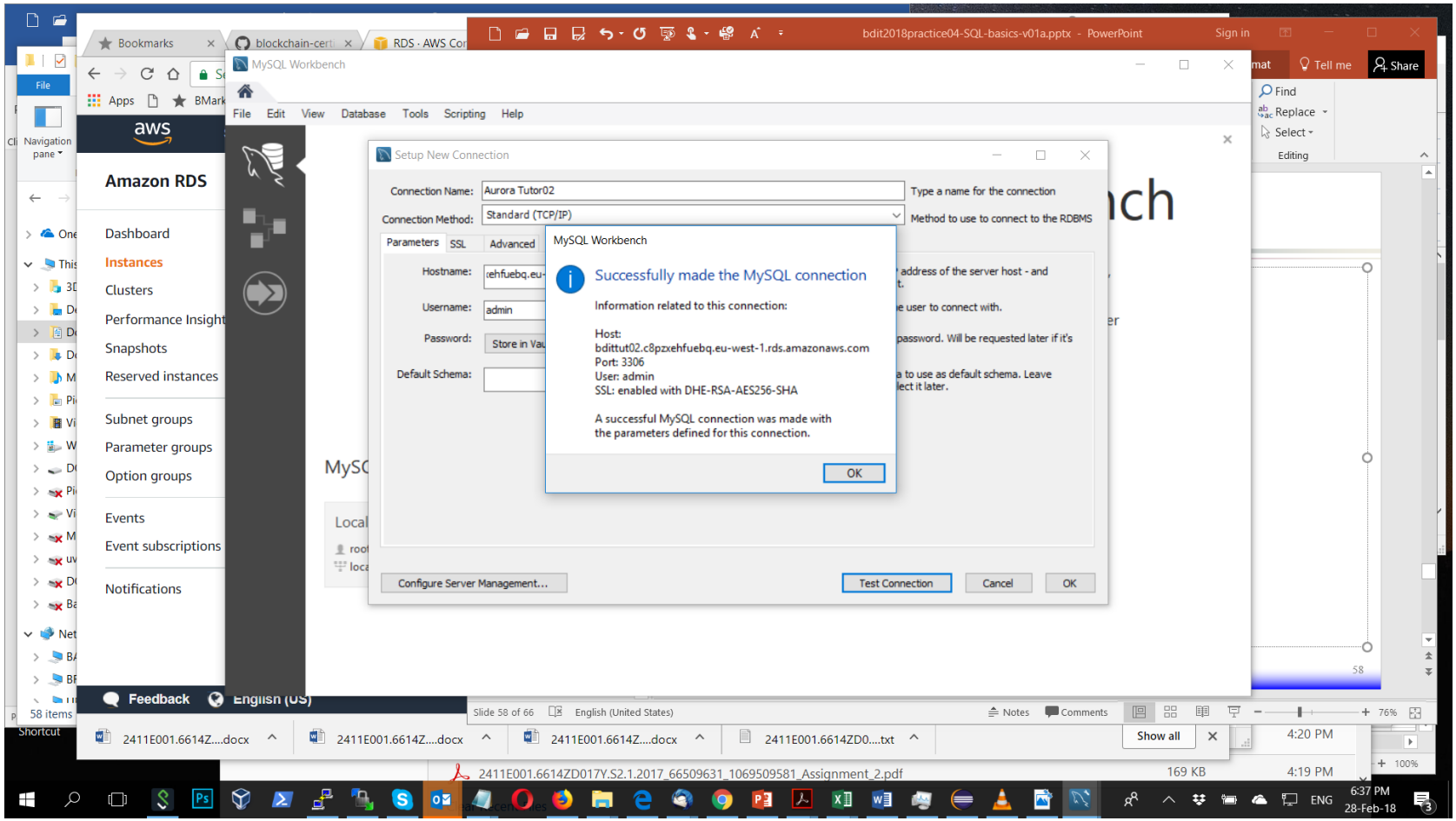




MySQL workbench https://dev.mysql.com/downloads/workbench/

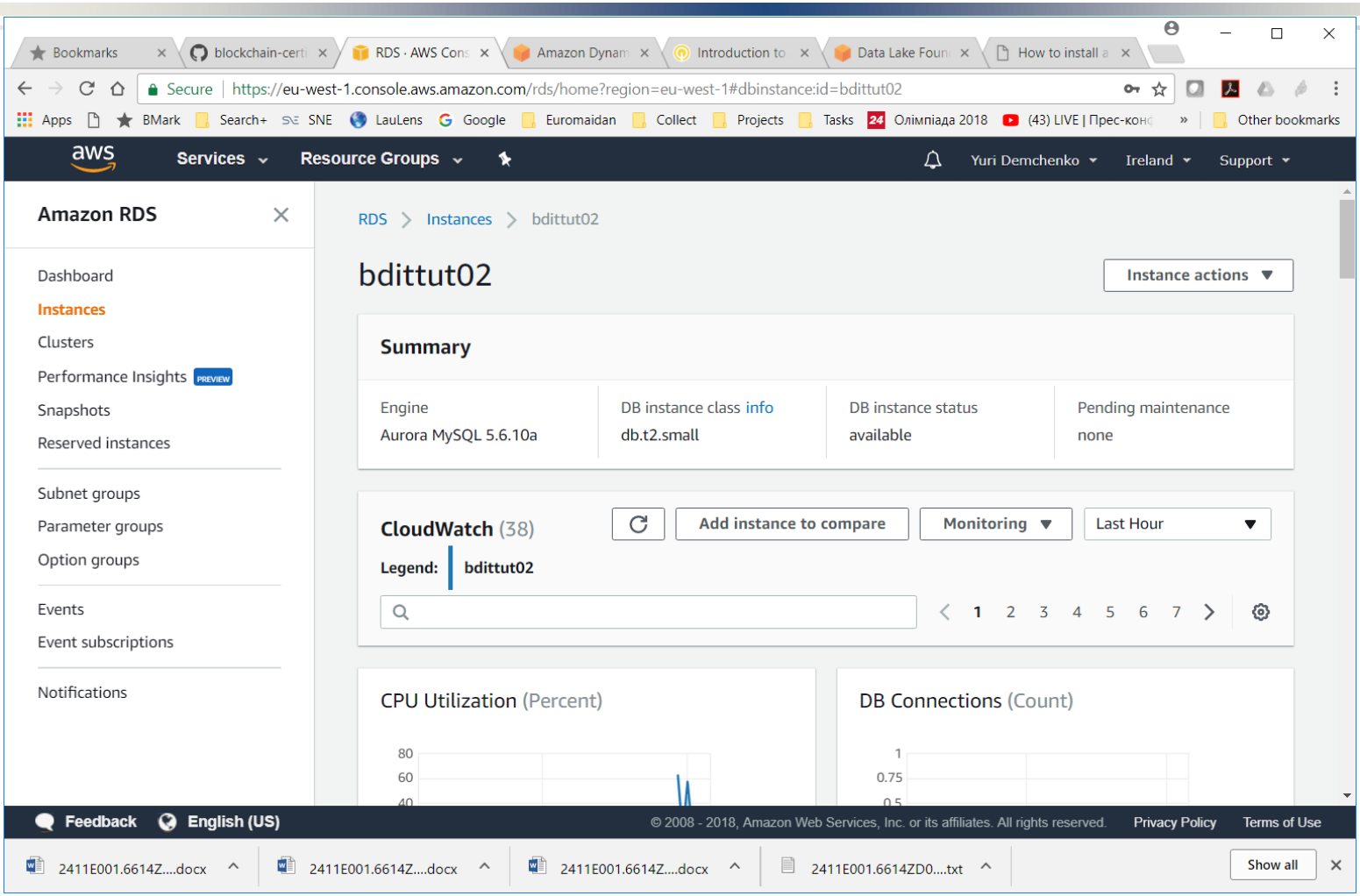
- MySQL workbench connected to Aurora DB
- Use DBMS connector URL bdittut01-cluster-1.cluster-c8pzxehfuebq.eu-west-1.rds.amazonaws.com
- Port 3306

Deploying Aurora cluster



- Cluster name bdittut02
- admin :: bdit2018aurora

Deploying Aurora cluster



Deploying Aurora cluster

Bookmarks | blockchain-certi | RDS · AWS Cons | Amazon Dynam | Introduction to | Data Lake Foun | How to install a

Secure | https://eu-west-1.console.aws.amazon.com/rds/home?region=eu-west-1#dbinstance:id=bdittut02

Apps | BMark | Search+ | SNE | LauLens | Google | Euromaidan | Collect | Projects | Tasks | Олімпіада 2018 | (43) LIVE | Прес-конф | Other bookmarks

aws | Services | Resource Groups | Yuri Demchenko | Ireland | Support

Amazon RDS

- Dashboard
- Instances
- Clusters
- Performance Insights PREVIEW
- Snapshots
- Reserved instances
- Subnet groups
- Parameter groups
- Option groups
- Events
- Event subscriptions
- Notifications

Connect

Endpoint	Port	Publicly accessible
bdittut02.c8pzxehfuebq.eu-west-1.rds.amazonaws.com	3306	Yes

Security group rules (2)

Filter security group rules | 1

Security group	Type	Rule
rds-launch-wizard-3 (sg-72a33808)	CIDR/IP - Inbound	146.50.146.132/32
rds-launch-wizard-3 (sg-72a33808)	CIDR/IP - Outbound	0.0.0.0/0

Details

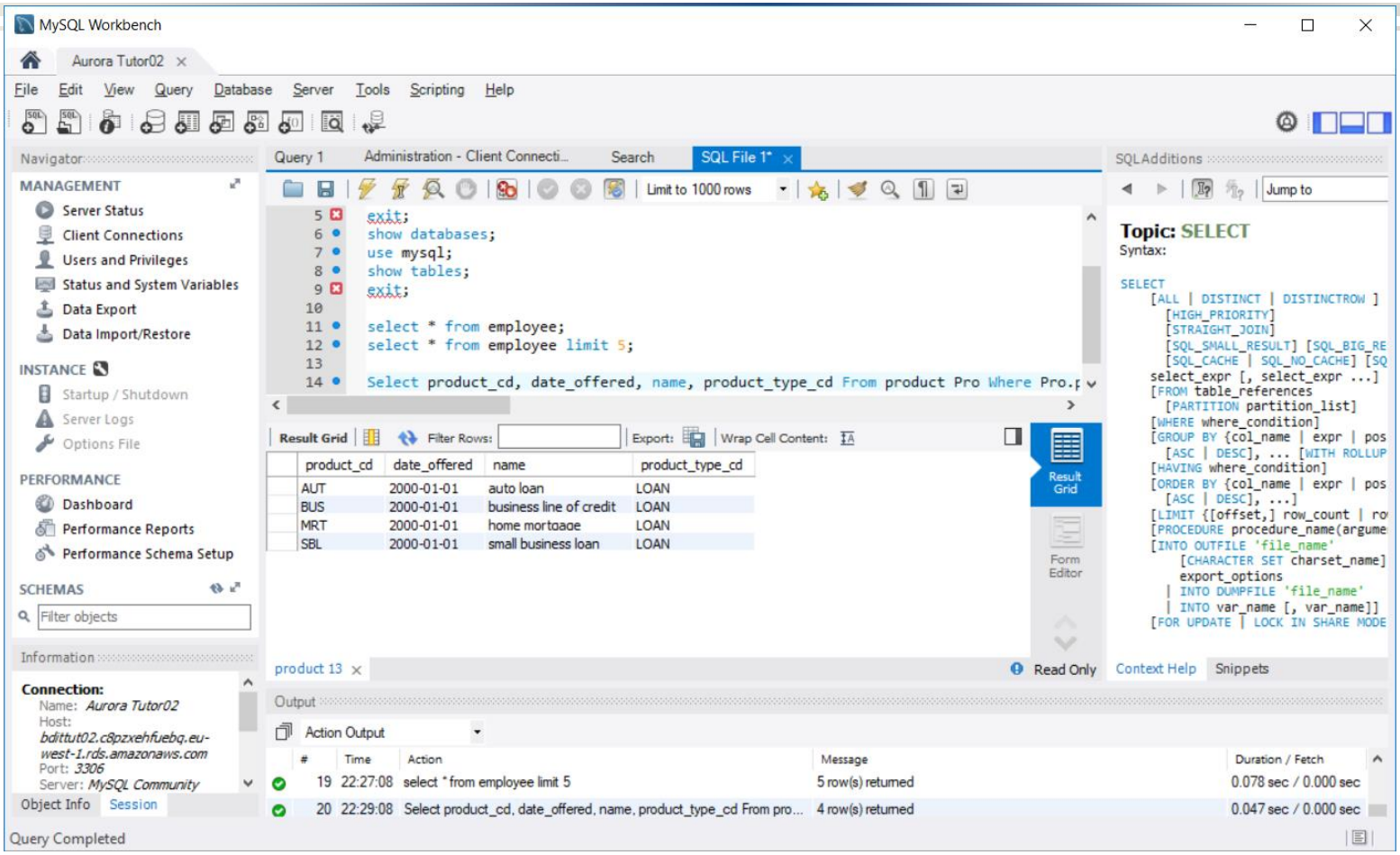
Modify

Configurations	Security and network	Instance and IOPS	Maintenance details
ARN	Availability zone	Instance Class	Auto minor version upgrade

https://eu-west-1.console.aws.amazon.com/ec2/v2/home?region=eu-west-1#SecurityGroups:search=rds-launch-wizard-3

2411E001.6614Z....docx | 2411E001.6614Z....docx | 2411E001.6614Z....docx | 2411E001.6614ZD0....txt | Show all

Example running SQL query in Aurora remotely



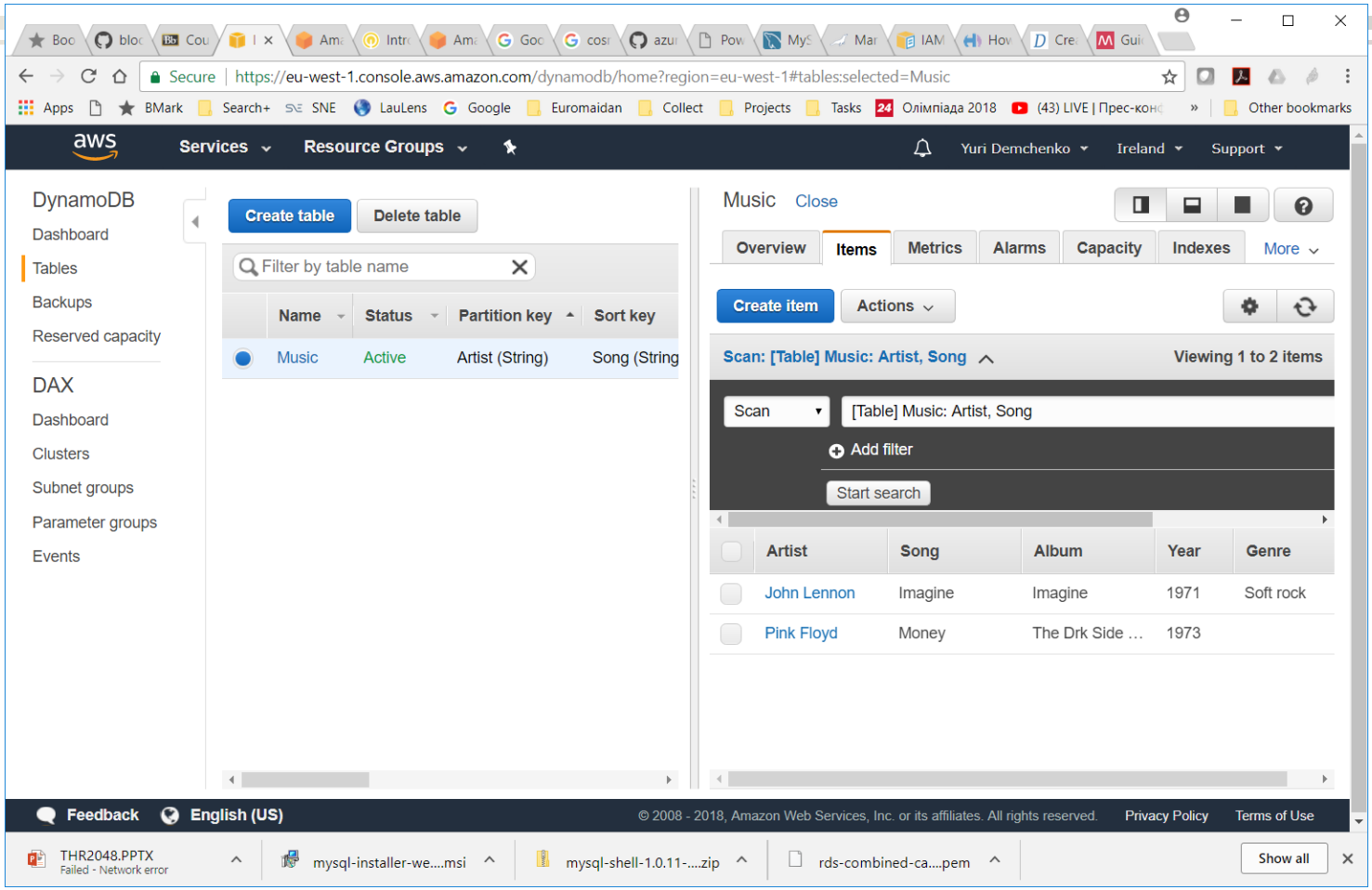
Select product_cd, date_offered, name, product_type_cd From product Pro Where Pro.product_type_cd = 'LOAN';

MySQL CLI to Aurora

MySQL client installed

- mysql -h mycluster-primary.123456789012.us-east-1.rds.amazonaws.com --ssl-ca=[full path]rds-combined-ca-bundle.pem --ssl-verify-server-cert

AWS DynamoDB



- Document based and key-value database
- https://qwiklabs.com/focuses/2376?locale=en

Additional materials