Introduction to MySQL

Database Systems

Agenda

- Bureaucracy…
- Database architecture overview
- Buzzwords
- SSH Tunneling
- Intro to MySQL
- Comments on homework

Homework #1

- Submission date is on the website.. (No late arrivals will be accepted)
- Work should be done in pairs
- Submission is done via moodle, by one of the partners.
- Submit a pdf file, with the full names and IDs of both partners on top of the page
- Use the format described in the assignment

Project

- Hard work, but practical.
- Work in groups of 4
- Project goal: to tackle and resolve real-life DB related development issues
- One stage, with a check point in he middle
- Use JAVA (SWT)

- Thinking out of the box will be rewarded

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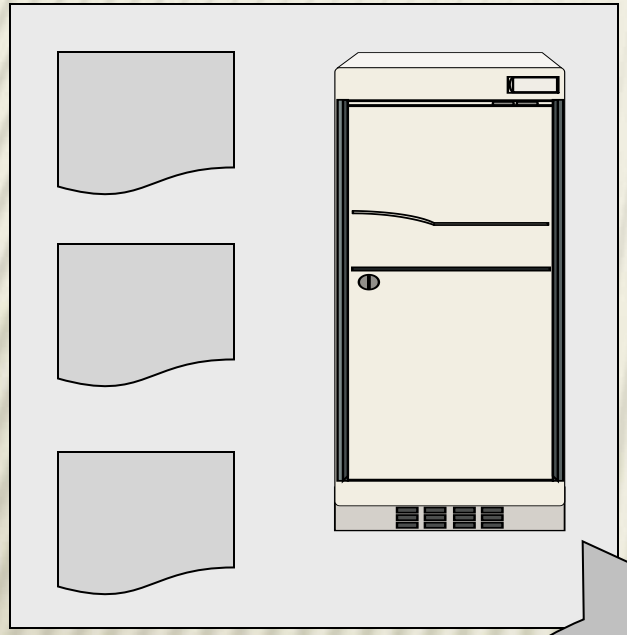
DB System from lecture #1

"Two tier database system"



connection

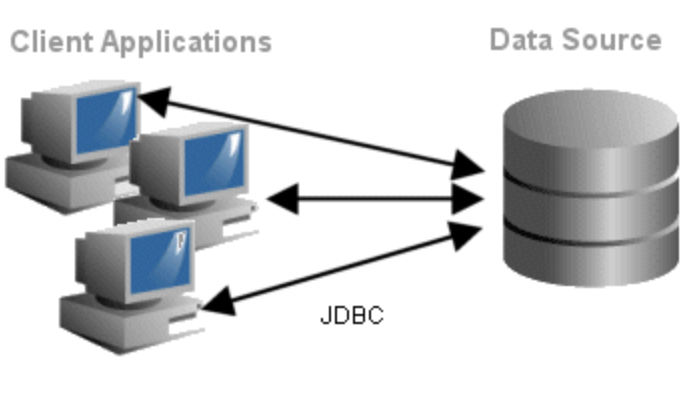
(ODBC, JDBC)

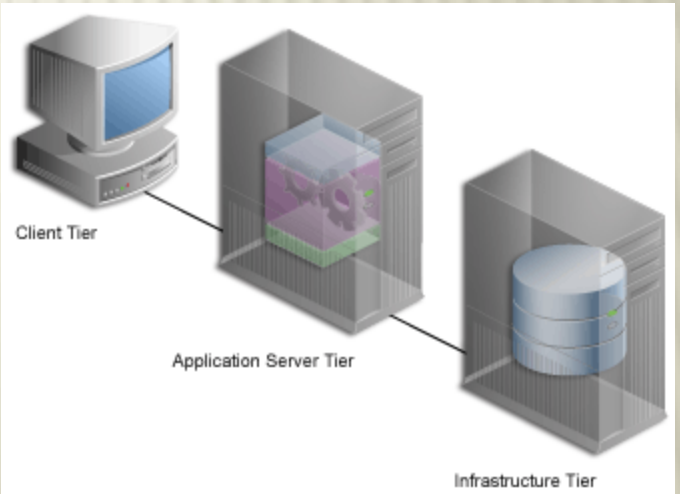
Data files

Database server (someone else's C program)

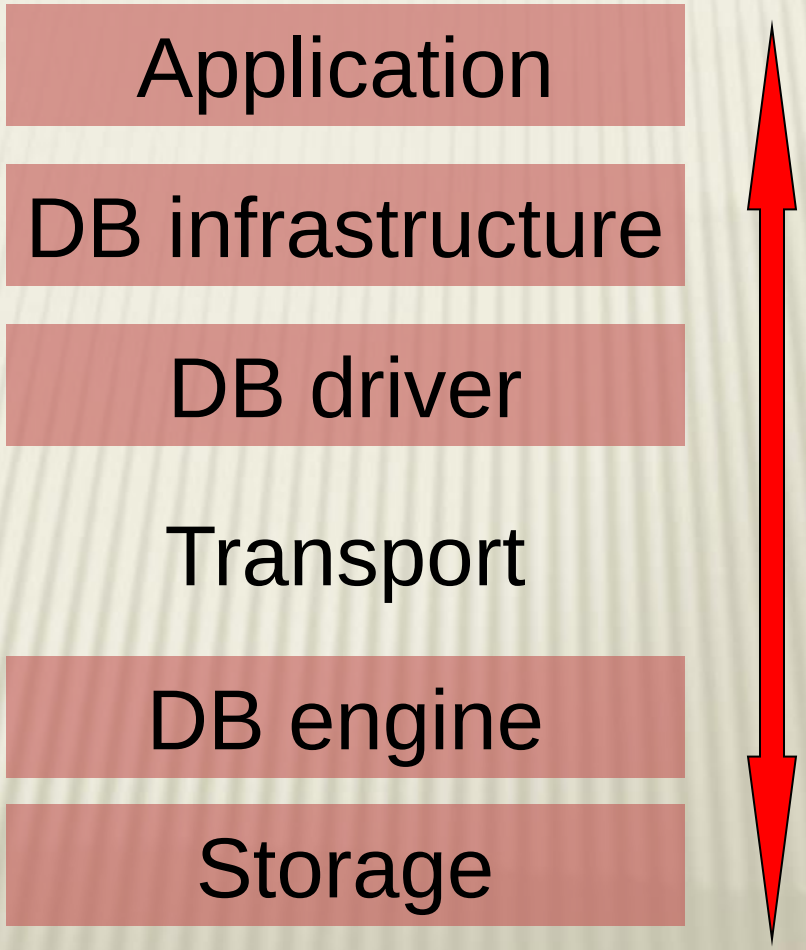
Applications

1,2,3 tiers

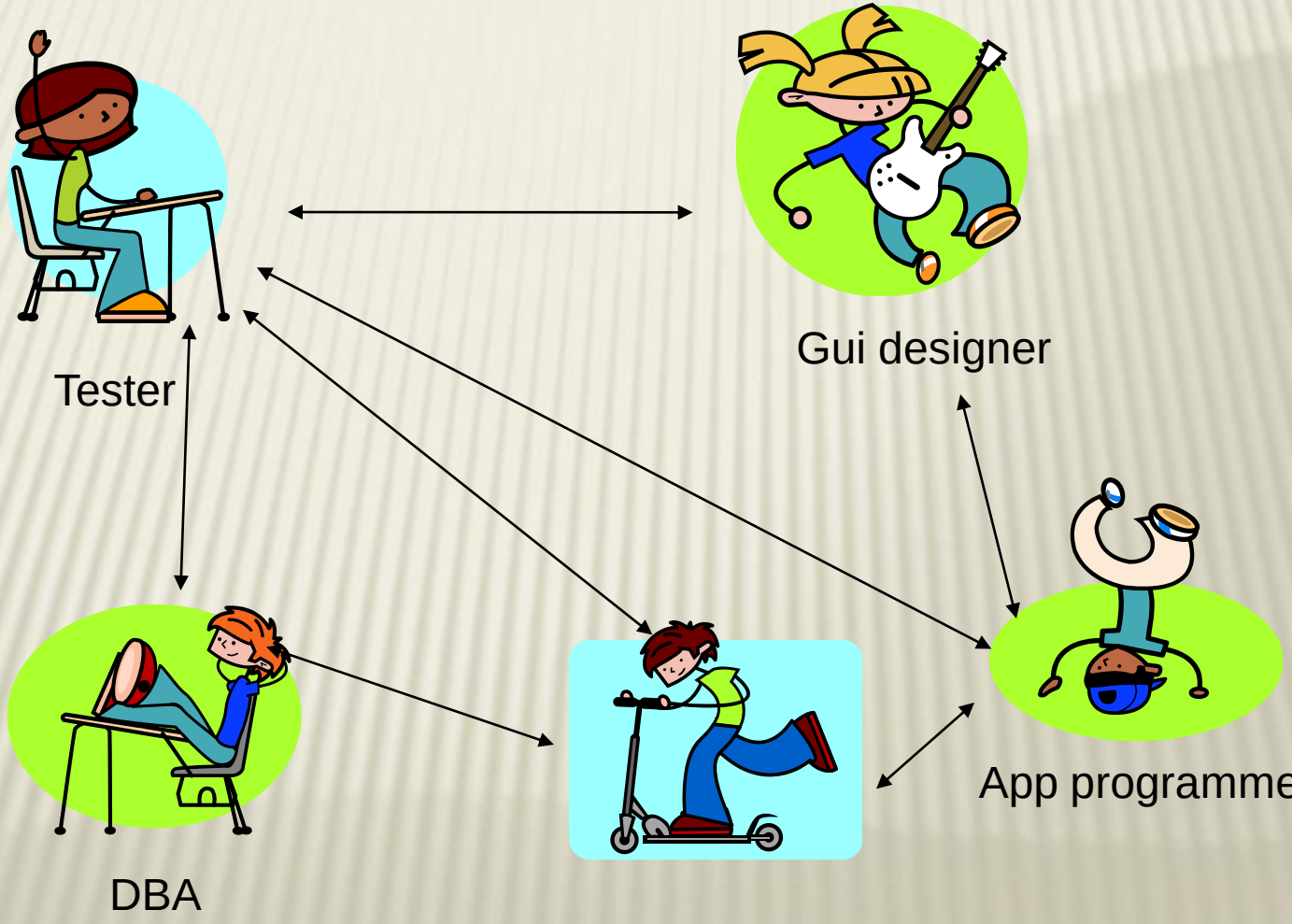

Client Applications
Data Source
JDBC


Client Tier
Application Server Tier
Infrastructure Tier

Abstractly (DB) system layers may include

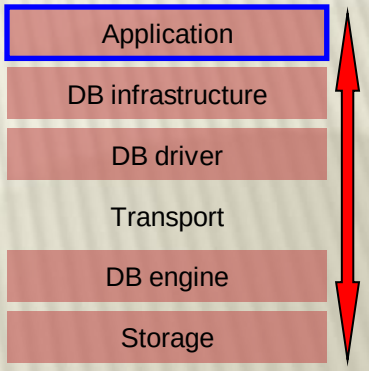


Why?



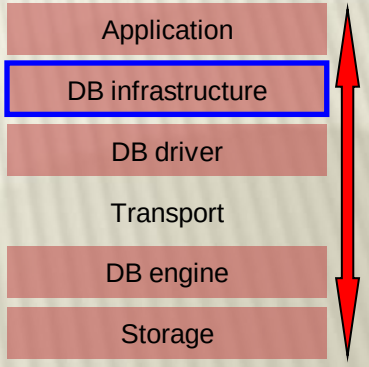
Application layer

- Why should it actually use database?
  - Persistence layer
  - Access data storage
  - Interfacing between systems
  - Large volumes
  - Scalability
  - Redundancy



Infrastructure layer

- Goals:
  - Database “hiding”
  - Schema abstraction
  - Encapsulation of db mechanisms
- How: (In two words)

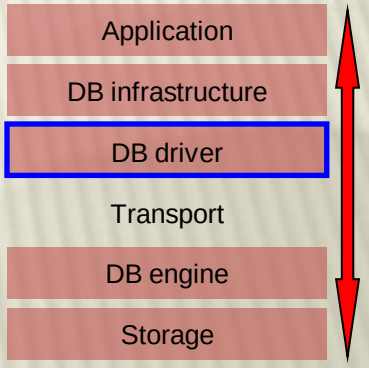


Model Abstraction

- Could be a part of your application – or an external package
  - E.g., hibernate

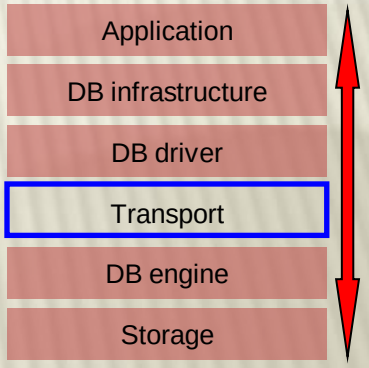
DB driver / bridge

- Used for:
  - API for database connectivity
  - Protocol converter
  - Performance improvements
  - Transaction management
- Examples:
  - In a minute…



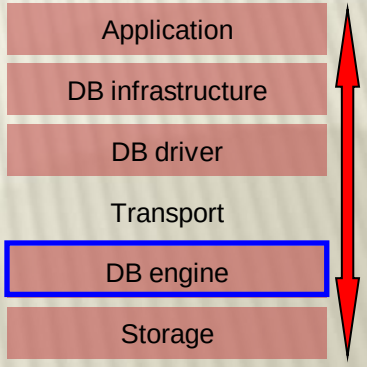
Transport

- Mainly TCP but not only
- Secure
- Efficient
- Fast (but not fast enough)



DB engine

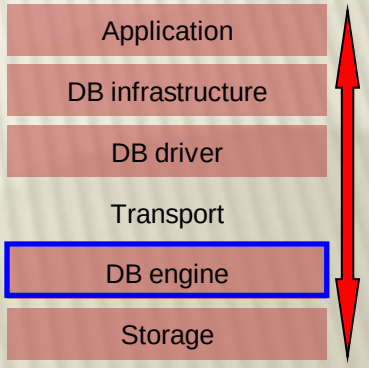
- Total management of the DB environment including
  - Security
  - Scalability
  - Fault tolerant (disaster management)
  - Monitoring
  - Services
- Large DB engines include Microsoft SQL Server, Oracle, SyBase, MySQL, etc.



DB engine (2)

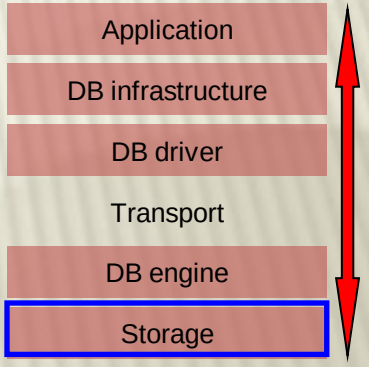
DB engine management includes:

- + Databases/Tables/Fields
- Creation/removal/modification/optimization
- + Connections/Users/Roles
- Security/monitoring/logging
- + Jobs/Processes/Threads
- Scheduling/balancing/managing



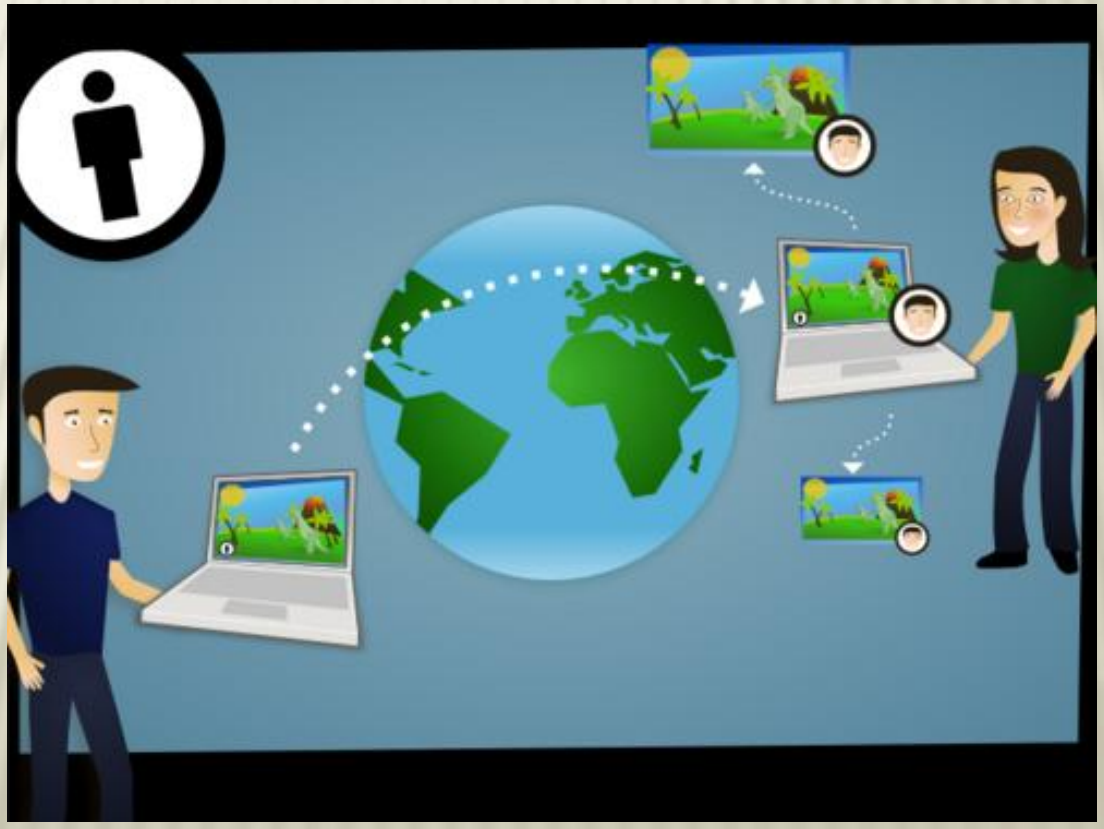
Storage

- NAS/SAN, Raid and other stuff
  - We are interested in the storage-engine interface



A real-life example

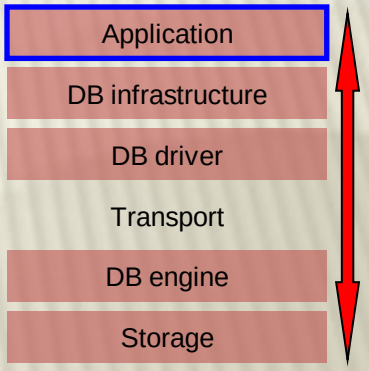
- We want to build an image sharing Website
- What is our data?



The application

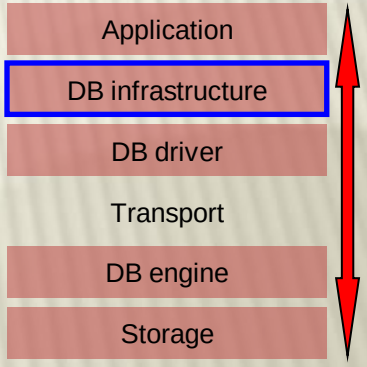
- GUI
- Application-User Management
  - Do not confuse with DB users!
- Image processing
- And so on…

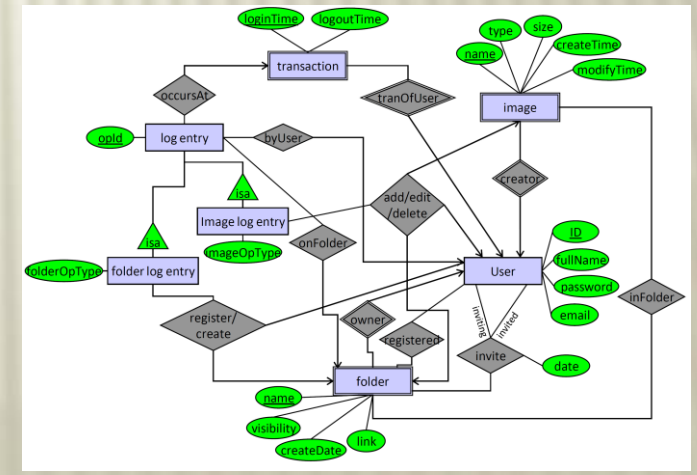
- The application needs storage for the images, albums, users, tags…



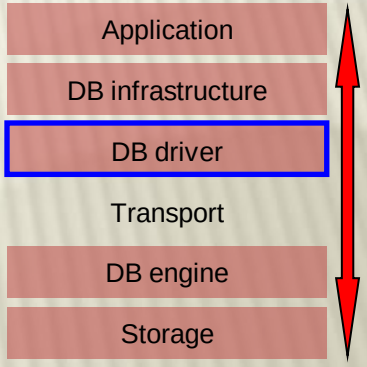
Infrastructure

- This layer wraps
  - Entities in our application (Images, users,…)
  - Relations between entities (Image creator, followers,…)
  - Common operations (upload/edit/delete image,…)
- Some of these may be created by an automatic process

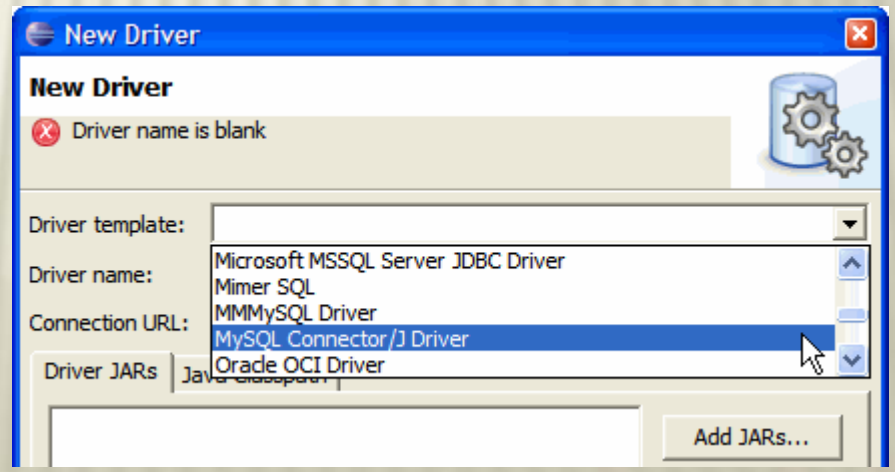




DB driver / bridge

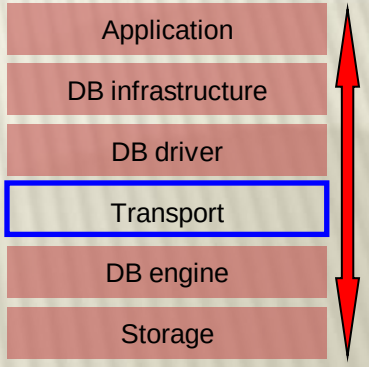


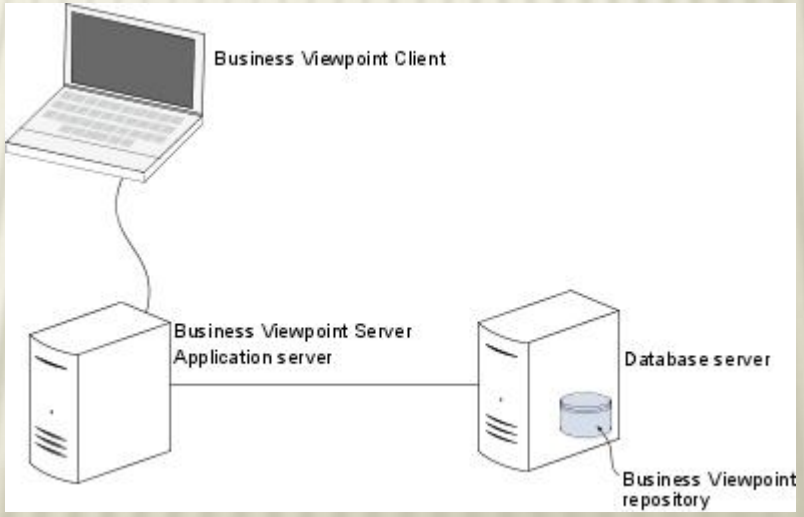
- Not written by us
- Used by the infrastructure
- E.g., to upload an image we use an insert command to the image table (and perhaps others)
- We want the type of DB used to be configurable



Transport

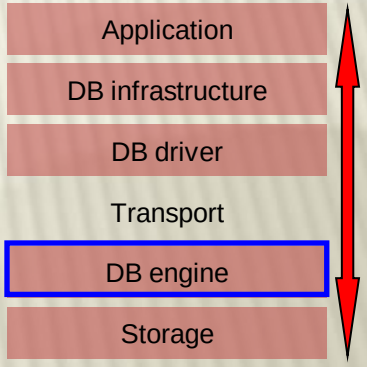
- Our application servers connect to the database server

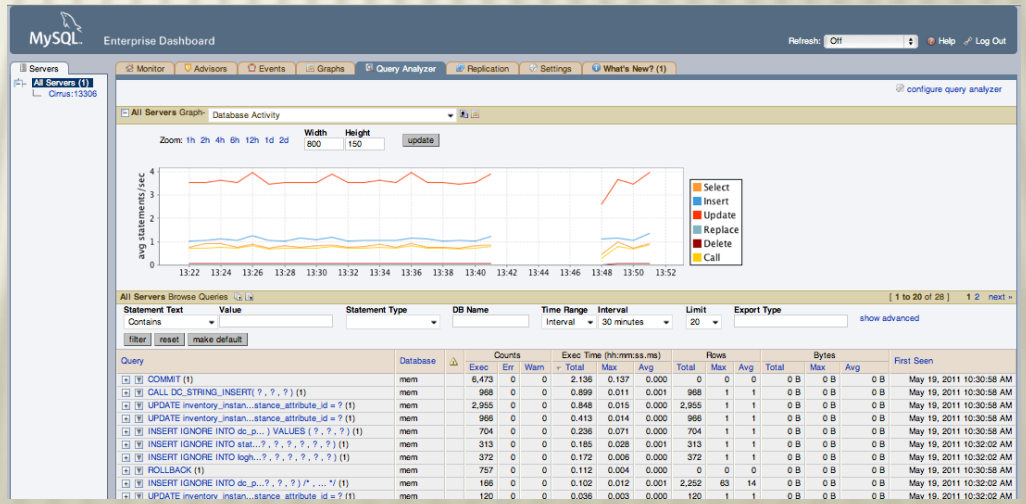




DB engine

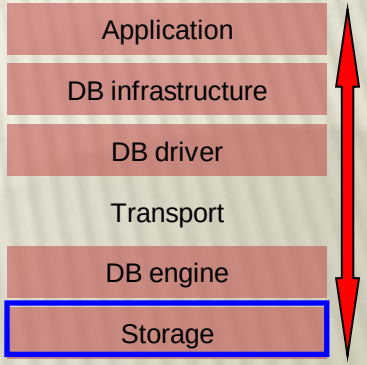
- The db stores
  - Our tables with the data (Images, users, etc.)
  - Optimization components (Indexes, triggers)
  - Predefined operations (procedures, functions)
- Executes the requests we sent
  - E.g., insert an image





Storage

- The data is physically stored on our machines



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Terms...

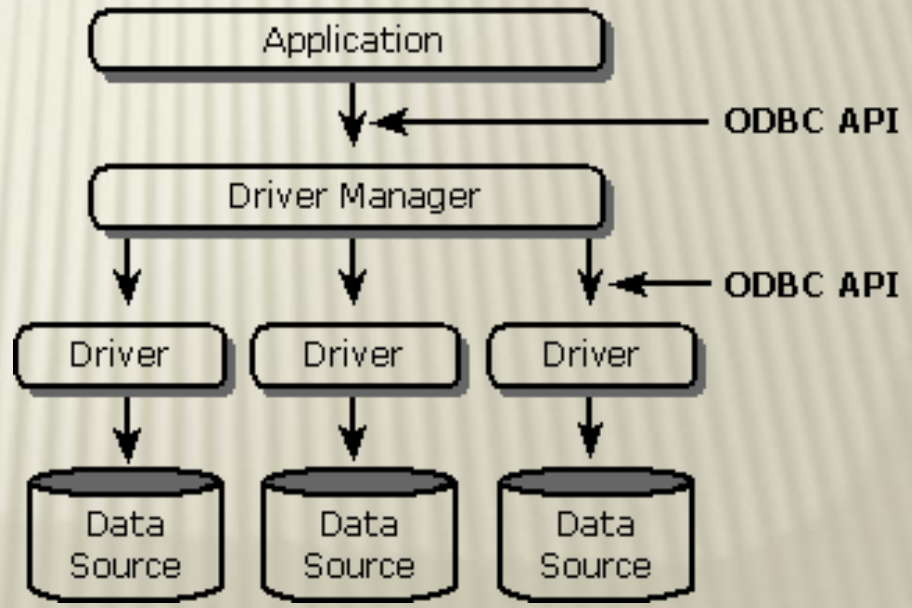
- ODBC
- ADO
- OLE-DB
- MDAC/UDA
- JDBC
- ORM

ODBC, OLEDB and ADO

- Various standards have been developed for accessing database servers.
- Some of the important standards are
  - **ODBC** (Open DataBase Connectivity) is the early standard for relational databases.
  - **OLE DB** (Object Linking and Embedding) is Microsoft's object-oriented interface for relational and other databases.
  - **ADO** (ActiveX Data Objects) is Microsoft's standard providing easier access to OLE DB data for the non-object-oriented programmer. Latest – ADO.NET

ODBC

- Open Database Connectivity (ODBC) is a standard software API method for using database management systems (DBMS)
- Maximum interoperability



ODBC

Examples of common tasks:

- Selecting a data source and connecting to it.
- Submitting an SQL statement for execution.
- Retrieving results (if any).
- Processing errors.
- Committing or rolling back the transaction enclosing the SQL statement.
- Disconnecting from the data source.

MDAC… UDA

- UDA (Universal Data Access) and/or MDAC (Microsoft Data Access Components) include ADO, OLE DB, and ODBC.

JDBC

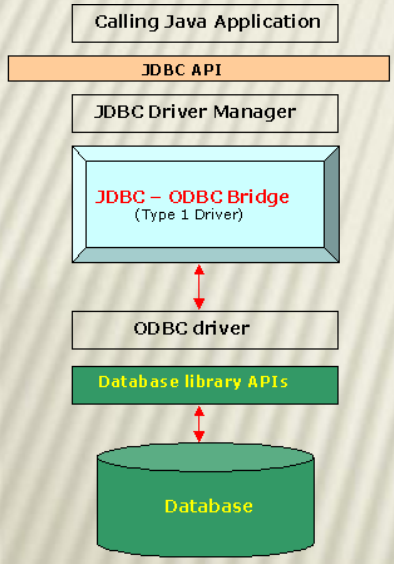
- Java DB connectivity API
- Similar to ODBC
- Why do you need it:
  - Pure Java
  - Simple API
  - Well….Multi-platform

JDBC

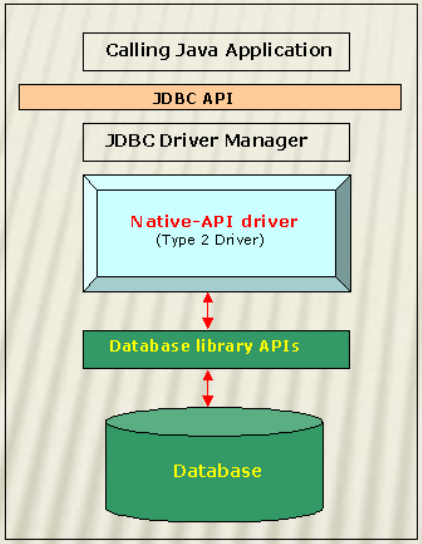
- API includes:
  - DriverManager, Connection, Statement, ResultSet, SQLException, DataSource
- JDBC Type Driver:
  - Type 1 - (JDBC-ODBC Bridge) drivers.
  - Type 2 - native API for data access which provide Java wrapper classes
  - Type 3 - 100% Java, makes use of a middle-tier between the calling program and the database..
  - Type 4 - They are also written in 100% Java and are the most efficient among all driver types. Calls directly into the vendor-specific database protocol.

JDBC Types

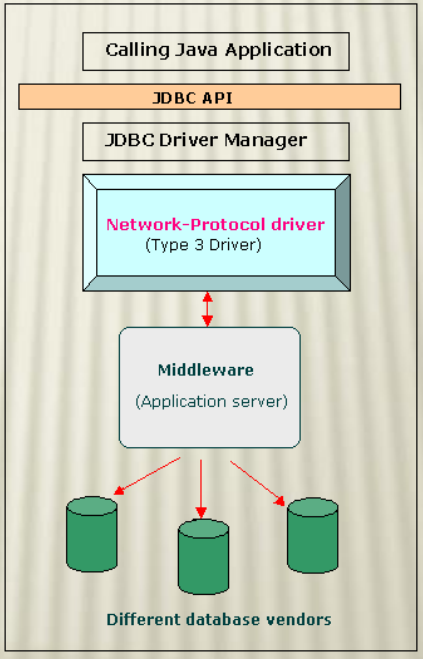
Type 1



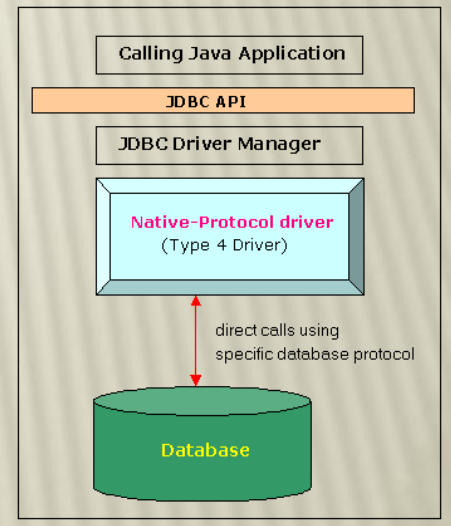
Type 2



Type 3



Type 4



ORM

- **Object-Relational mapping** is a programming technique for converting data between incompatible type systems in relational databases and object-oriented programming languages.

- For example: Hibernate

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Connecting…

You need:

- **IP**
- **Port**

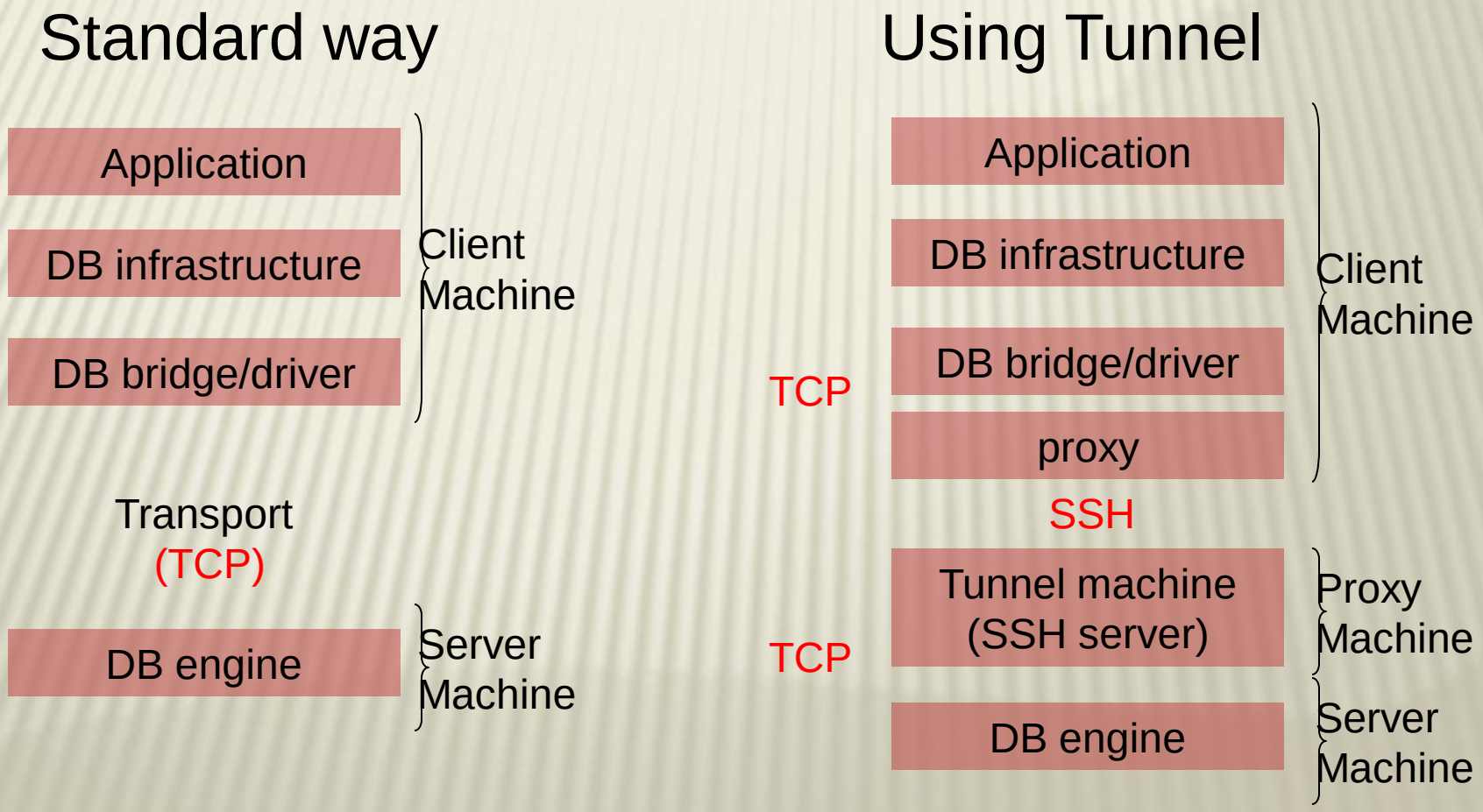
- Home install: IP=localhost
  TAU's server: IP=mysqlsrv.cs.tau.ac.il

- MySQL default port is 3306

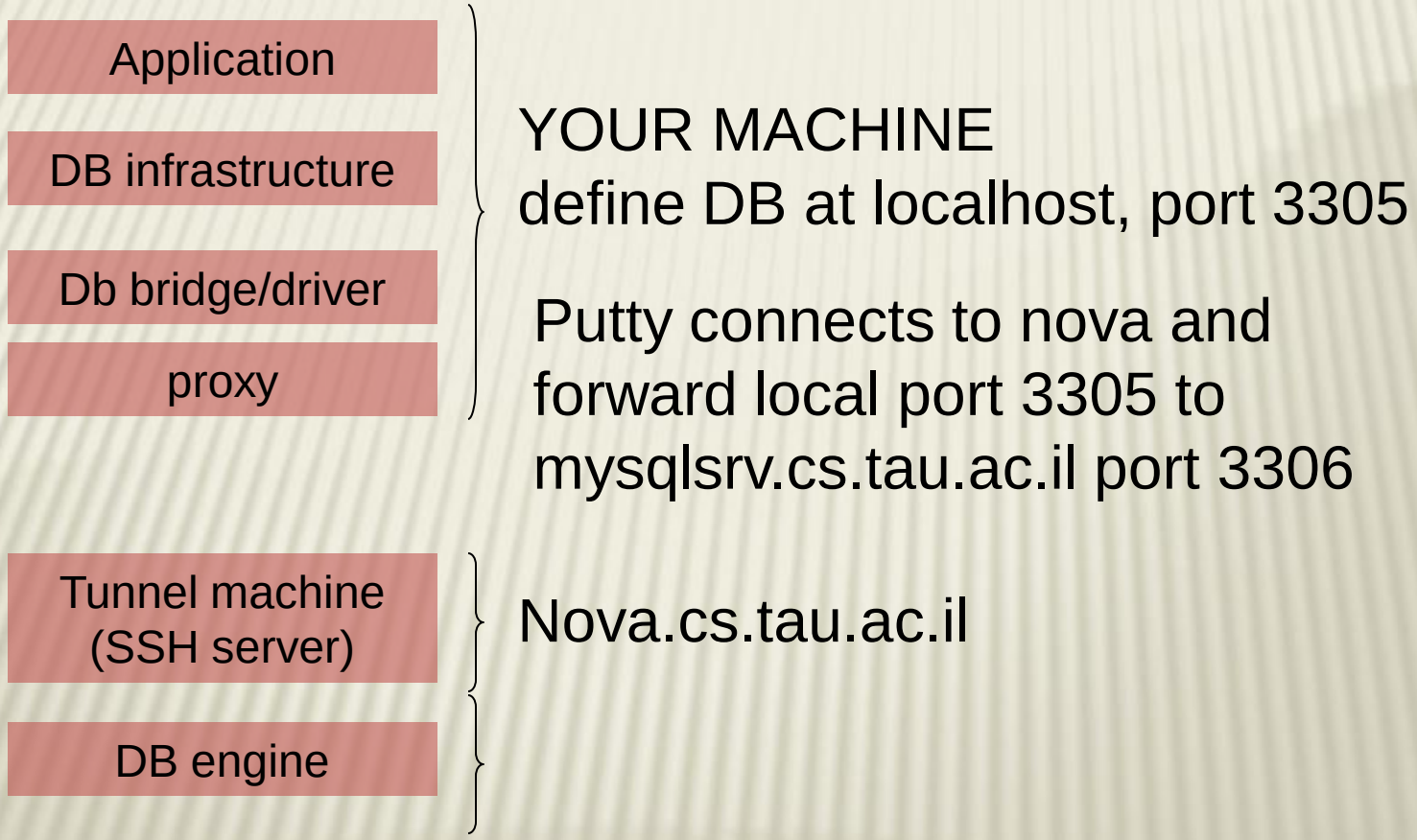
is it really that easy??

Welcome to

SSH

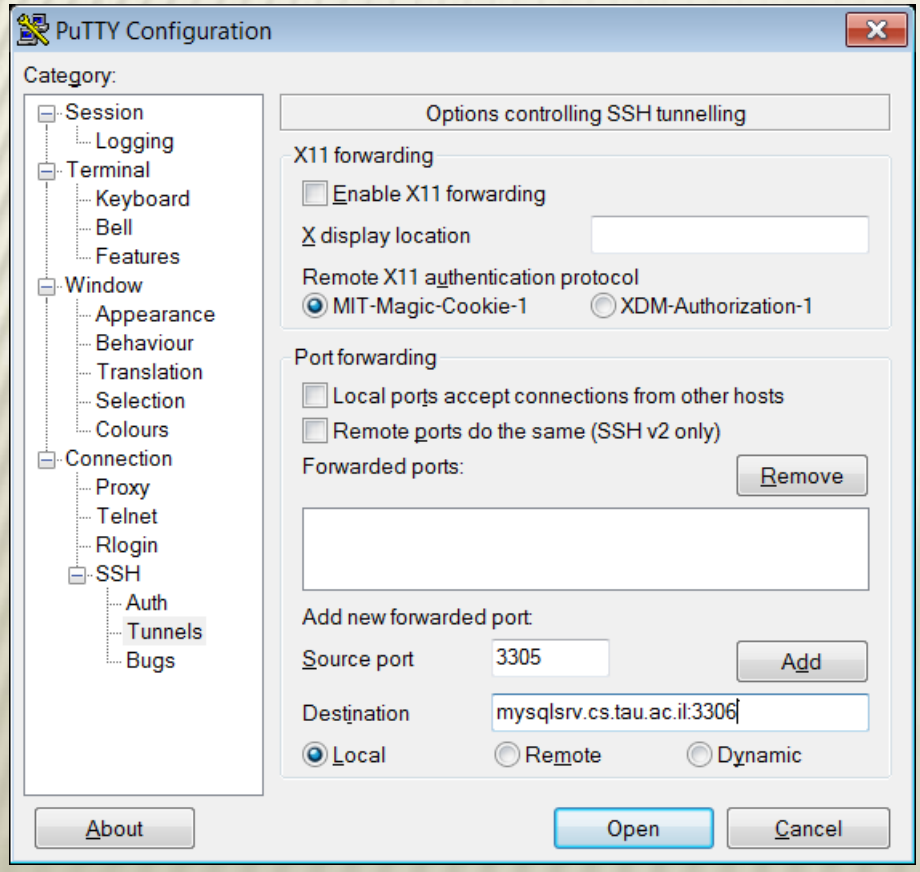

Standard way
Application
DB infrastructure
DB bridge/driver
Client Machine
Transport (TCP)
DB engine
Server Machine
Using Tunnel
Application
DB infrastructure
DB bridge/driver
proxy
Client Machine
TCP
SSH
Tunnel machine (SSH server)
Proxy Machine
TCP
DB engine
Server Machine

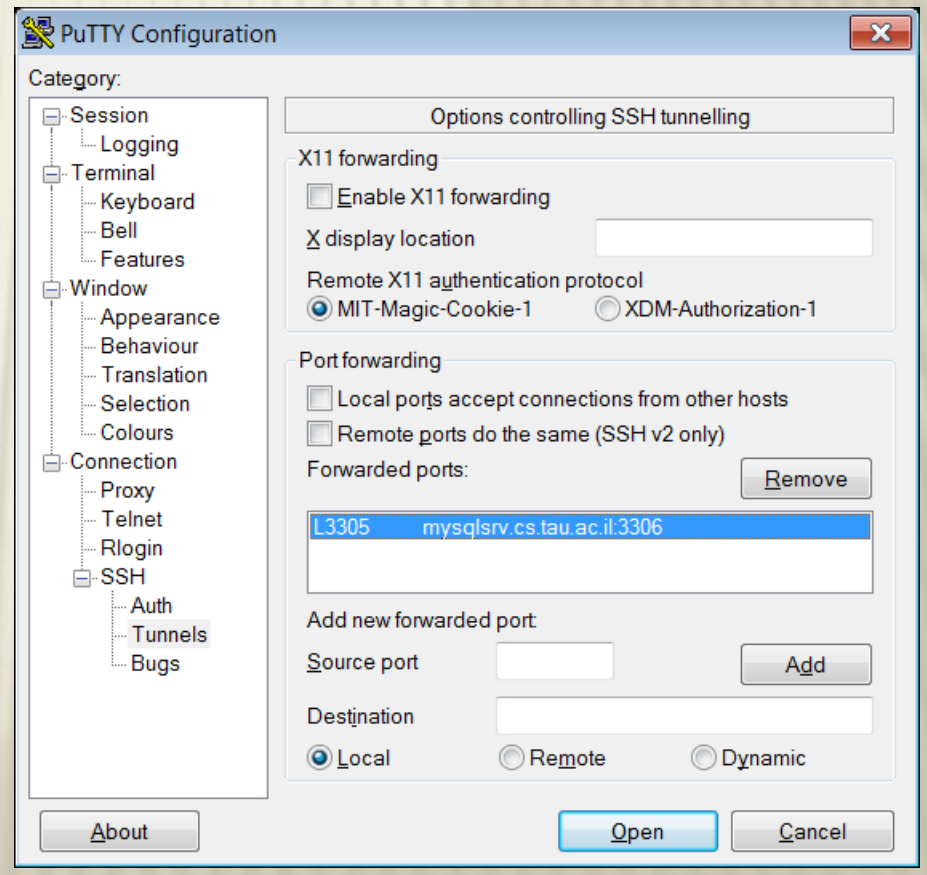
SSH in TAU


Application
DB infrastructure
Db bridge/driver
proxy
YOUR MACHINE
define DB at localhost, port 3305
Putty connects to nova and
forward local port 3305 to
mysqlsrv.cs.tau.ac.il port 3306
Tunnel machine
(SSH server)
Nova.cs.tau.ac.il
DB engine

SSH in TAU

- Putty





Don’t forget to

- CHECK THE CONNECTION GUIDE!! (course website)

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Products we will be using

- MySQL (Community Server – Home)
- MySQL (Enterprise Edition – TAU)

- MySQL Workbench (GUI Tool..)

- MySQL Connector (J) – In two weeks…

Free to download on www.mysql.com

TAU Server settings..

- You can create your own user (schema) by following the connection guide link (course website..)
- For the project, each group will get a dedicated user+schema

"Sakila" Schema (For hw1)

- We will use the "Sakila" schema
  http://dev.mysql.com/doc/sakila/en/sakila.html
- Install and download from
  http://dev.mysql.com/doc/index-other.html

- Already installed on TAU's server:
  username: *sakila*
  password: *sakila*
  schema:*sakila*

MySQL Command

- How to run:

  http://www.cs.tau.ac.il/system/faq/development/databases/mysql2

  → mysql -u sakila -h mysqlsrv.cs.tau.ac.il sakila –p

- Common commands:

  - "show databases;"
  - "show tables;"
  - "select.. ;"

→ Don't forget the ;

Install MySQL at Home

- MySQL Community Server
  http://www.mysql.com/downloads/mysql/

- MySQL Workbench
  http://www.mysql.com/downloads/workbench/

- (You might need to download Microsoft Visual C++ 2010 Redistributable Package)
  (32bit) http://www.microsoft.com/download/en/details.aspx?id=5555
  (64bit) http://www.microsoft.com/download/en/details.aspx?id=14632

MySQL Workbench

Installation only at home…

Demo Time ☺

- Startup the Server..

Demo Time ☺

- Server Administration
  - → run the local instance
  - → create users
  - → export/import

Demo Time ☺

- SQL Development
  - → browse the schema
  - → create/alter tables
  - → run queries
  - → export results

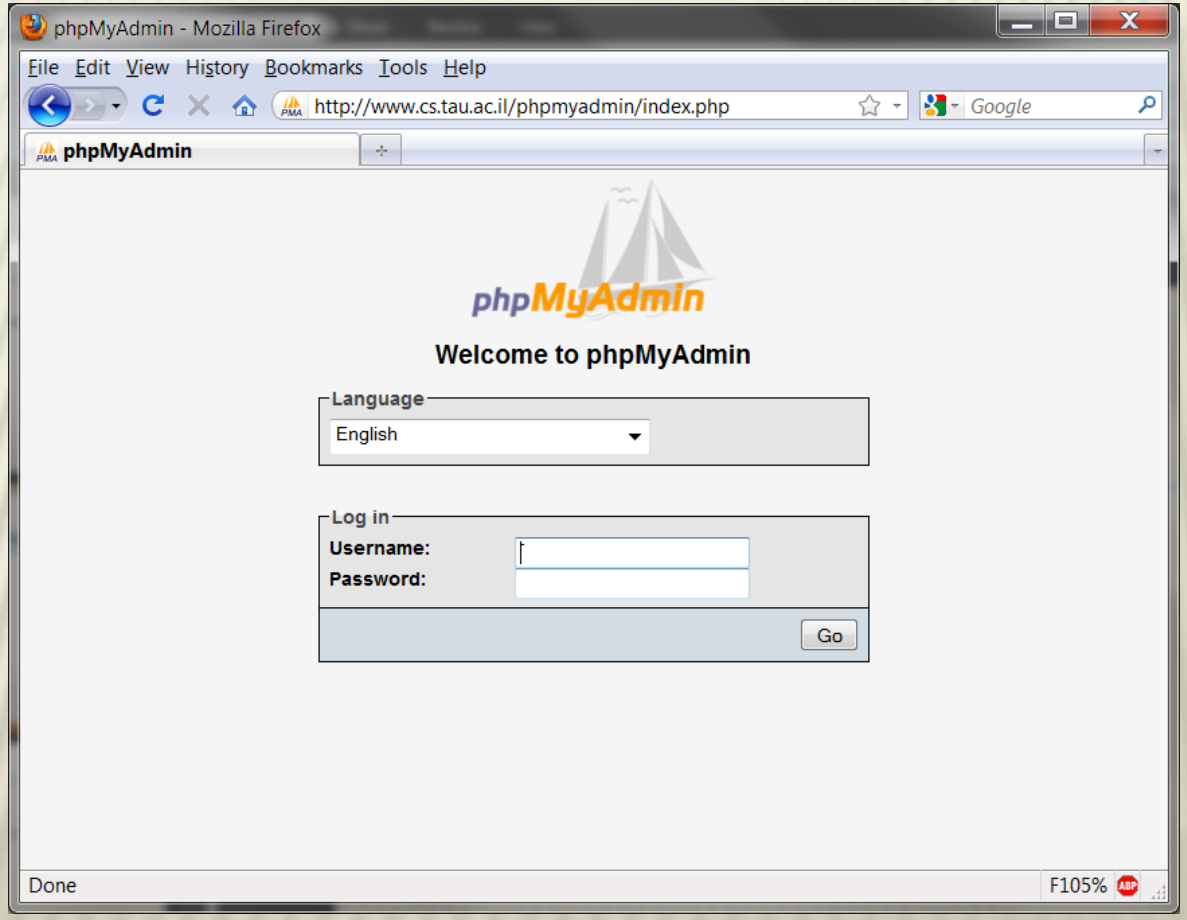
Demo Time ☺

- Install the “sakila” schema

Demo Time ☺

- Data Modeling
  → browse / alter the schema

phpMyAdmin


phpMyAdmin - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://www.cs.tau.ac.il/phpmyadmin/index.php
Google
phpMyAdmin
phpMyAdmin
Welcome to phpMyAdmin
Language
English
Log in
Username:
Password:
Go
Done
F105%

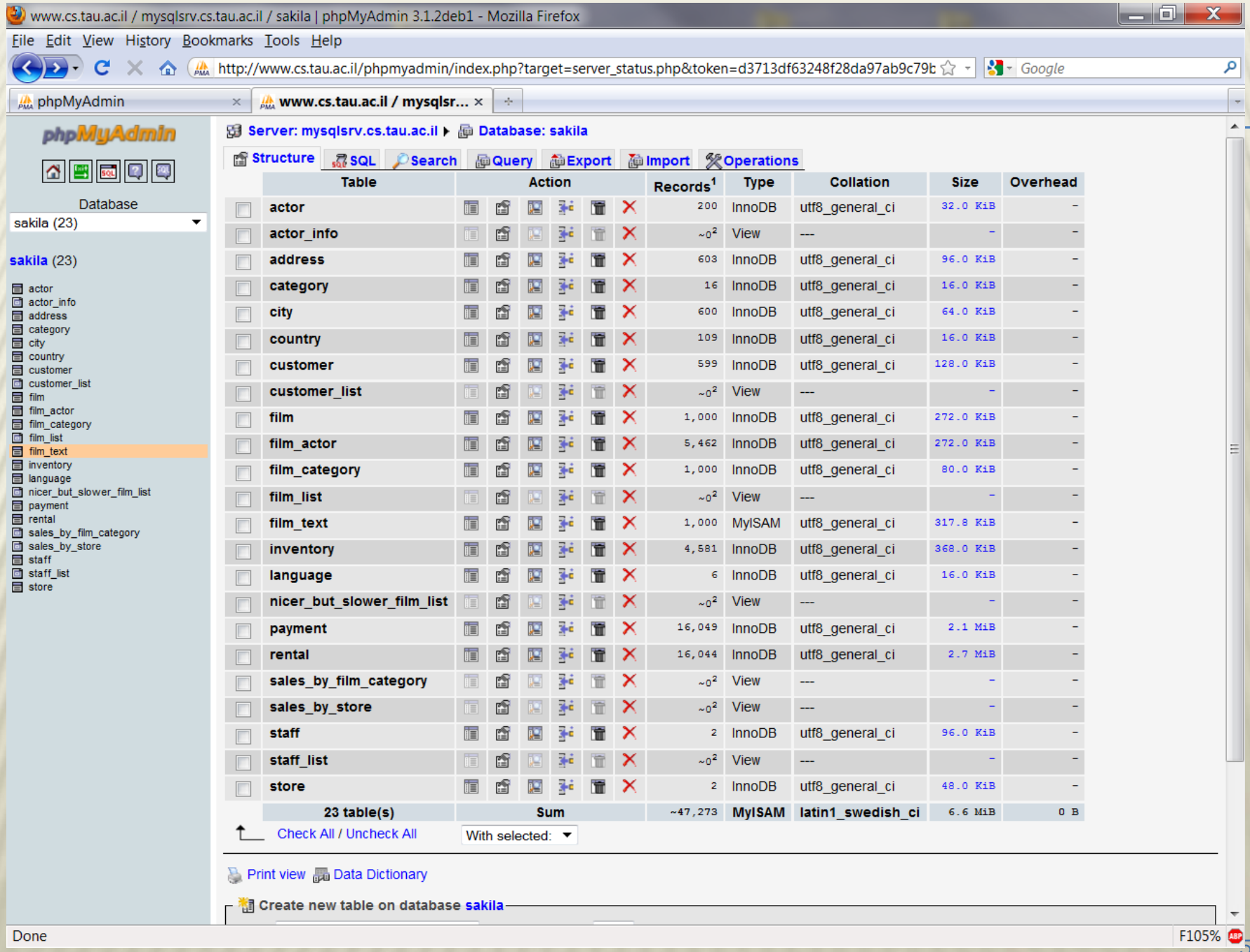
phpMyAdmin

- Another tool for managing MySQL
- Installed on tau, and reachable from home without a tunnel!

  https://www.cs.tau.ac.il/phpmyadmin/index.php
  (note the *https*)

- To install at home, download from:

  http://www.phpmyadmin.net/
  (requires php server so its not recommended unless you are familiar with these stuff…)


www.cs.tau.ac.il / mysqlsrv.cs.tau.ac.il / sakila | phpMyAdmin 3.1.2deb1 - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://www.cs.tau.ac.il/phpmyadmin/index.php?target=server_status.php&token=d3713df63248f28da97ab9c79b
phpMyAdmin
www.cs.tau.ac.il / mysqlsr...
Server: mysqlsrv.cs.tau.ac.il ▸ Database: sakila
Structure SQL Search Query Export Import Operations
Database
sakila (23)
sakila (23)
actor
actor_info
address
category
city
country
customer
customer_list
film
film_actor
film_category
film_list
film_text
inventory
language
nicer_but_slower_film_list
payment
rental
sales_by_film_category
sales_by_store
staff
staff_list
store
Table | Action | Records[1] | Type | Collation | Size | Overhead
actor | 200 | InnoDB | utf8_general_ci | 32.0 KiB | -
actor_info | ~0[2] | View | --- | - | -
address | 603 | InnoDB | utf8_general_ci | 96.0 KiB | -
category | 16 | InnoDB | utf8_general_ci | 16.0 KiB | -
city | 600 | InnoDB | utf8_general_ci | 64.0 KiB | -
country | 109 | InnoDB | utf8_general_ci | 16.0 KiB | -
customer | 599 | InnoDB | utf8_general_ci | 128.0 KiB | -
customer_list | ~0[2] | View | --- | - | -
film | 1,000 | InnoDB | utf8_general_ci | 272.0 KiB | -
film_actor | 5,462 | InnoDB | utf8_general_ci | 272.0 KiB | -
film_category | 1,000 | InnoDB | utf8_general_ci | 80.0 KiB | -
film_list | ~0[2] | View | --- | - | -
film_text | 1,000 | MyISAM | utf8_general_ci | 317.8 KiB | -
inventory | 4,581 | InnoDB | utf8_general_ci | 368.0 KiB | -
language | 6 | InnoDB | utf8_general_ci | 16.0 KiB | -
nicer_but_slower_film_list | ~0[2] | View | --- | - | -
payment | 16,049 | InnoDB | utf8_general_ci | 2.1 MiB | -
rental | 16,044 | InnoDB | utf8_general_ci | 2.7 MiB | -
sales_by_film_category | ~0[2] | View | --- | - | -
sales_by_store | ~0[2] | View | --- | - | -
staff | 2 | InnoDB | utf8_general_ci | 96.0 KiB | -
staff_list | ~0[2] | View | --- | - | -
store | 2 | InnoDB | utf8_general_ci | 48.0 KiB | -
23 table(s) | Sum | ~47,273 | MyISAM | latin1_swedish_ci | 6.6 MiB | 0 B
Check All / Uncheck All
With selected:
Print view Data Dictionary
Create new table on database sakila
Done
F105%

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- Already installed on TAU’s server:
  username: *sakila*
  password: *sakila*
  schema:*sakila*

Homework Notes

- SQL functions and arithmetic conditions.
- ‘strings‘
- LIKE (%), LOWER
- Use the Syntax help in Query browser
- MAX, MIN
- IN

MySQL Queries

- For now, only general SQL queries
- Not everything we discussed is enabled in MySQL!
- Manual
  - http://dev.mysql.com/doc/refman/5.6/en/index.html

Thank you ☺