

COP 4610L: Applications in the Enterprise Fall 2006

Introduction To MySQL – Part 1

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Database Access via JDBC

- The **Java Database Connectivity (JDBC)** interface enables any Java program to send SQL queries to any database, and receive back result tables with the desired data.
- Similar to the basic idea of Java in writing a program that will run on any hardware platform, JDBC enables the development of programs which function with nearly all commercially available DBMSs. Apart from the general popularity of Java, this is the fundamental reason for the widespread acceptance of JDBC.
- In order to guarantee the general database access, JDBC defines a certain core functionality supported by all DBMSs, This common denominator can be implemented by JDBC.
 - This implies that different product characteristics and manufacturer-specific optimizations are ignored by the JDBC standard.



Database Access via JDBC (cont.)

- One prerequisite for the use of JDBC is the availability of a **JDBC driver** for the database being utilized.
- The JDBC driver translates the JDBC queries of the Java database client into the respective supplier-specific calls.
- The simplest version on the Windows platform is the **Open Database Connectivity (ODBC)** interface. ODBC also enables different databases to function via a uniform interface.
- JDBC and ODBC are both based on the same idea. Using the JDBC-ODBC bridge, it is possible to access an ODBC data source via JDBC.

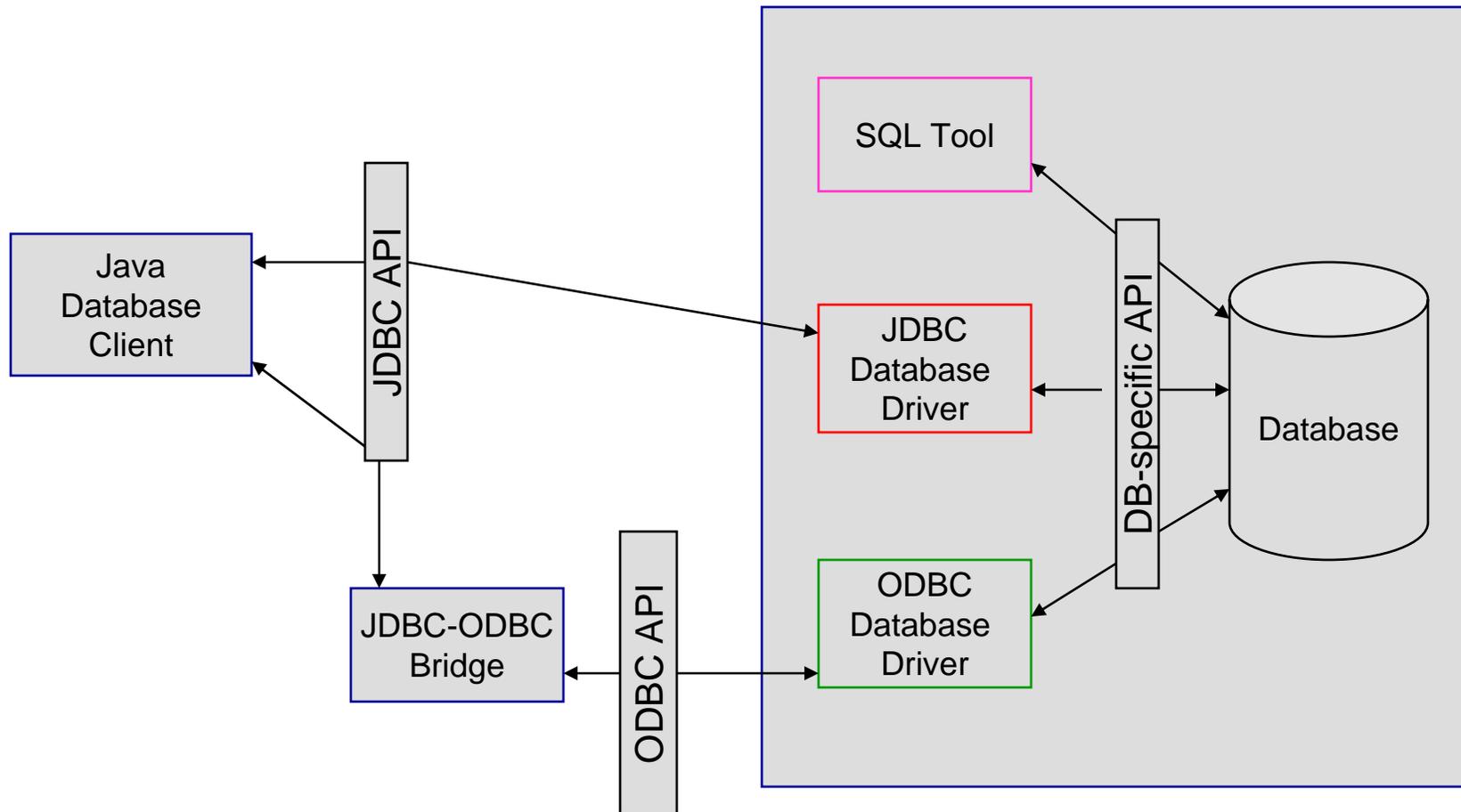


Different Methods for Database Access

- The figure on the next slide summarizes the various options available for accessing a database.
- The client software typically communicates with the server via a proprietary interface. The drivers translate JDBC or ODBC commands into the respective database specific calls.
- The user can also access the database using an SQL specific tool.
- One disadvantage of the ODBC solution is that every computer on which a Java database application is to run, the ODBC connection must be configured. This contradicts the Java principle “write once, run anywhere”. The way around this is through the use of servlets in which the only computer on which the ODBC must be configured is the one on which the servlet engine will run. If a database application is installed on several computers or distributed as an applet, the JDBC-ODBC bridge is not an option as the ODBC connection would have to be configured on every computer.



Summary of Database Access Methods



JDBC Database Access

- For the time being we will focus on the JDBC API for database access and not concern ourselves with ODBC (we'll look in more detail at ODBC later).
- JDBC is almost always used with a RDBMS. However, it can be used with any table-based data source. This means that it also works with applications like Excel.
- The separation of the JDBC API from the particular database drivers enables the application developer to change the underlying database without modifying the Java code that accesses the database.
- Most commercially available RDBMSs provide JDBC drivers and there are many third-party JDBC drivers available.
- We will focus on the JDBC and use it to manipulate a MySQL database. We'll discuss JDBC in more detail later.



MySQL RDBMS

- MySQL is a **database server** (although it does come with a set of simple client programs). The current stable version is 5.0.24 and can be downloaded from www.mysql.com. (Any of the versions of MySQL 5.0.15 or greater will be fine for our purposes.)
- It is typically used in **thin client** environments. In other words, it is used in client-server systems where the bulk of the processing and storage takes place on the server, and the client is little more than a dumb terminal.
- MySQL performs multithreaded processing, which means that multiple clients are allowed to connect to it and run queries simultaneously. This makes MySQL extremely fast and well suited to client-server environments such as Web sites and other environments that process numerous transactions for multiple users.



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MySQL Downloads

Overview Database Server Cluster MaxDB GUI Tools Connectors Mirrors

MySQL software is published under an open source license and is available in two ways:

1. **MySQL Community Edition** is the freely downloadable version of the world's most popular open source database. It is supported by a huge and active community of open source developers and enthusiasts. MySQL Community Edition uses the GPL License, is released early and often, and includes all features, including the latest features under development.
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[MySQL 5.0 -- Generally Available \(GA\) release for production use](#)

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MySQL Cluster

MySQL Cluster is included in version 5.0 of the MySQL database server, as part of the MySQL Max packages. Binaries and source are available from the [MySQL 5.0 download page](#).

Internet

This should be the next page you see.

Click here to download MySQL 5.0



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Address: <http://dev.mysql.com/downloads/mysql/5.0.html>

MySQL Community Edition

MySQL Community Edition is a freely downloadable version of the world's most popular open source database that is supported by an active community of open source developers and enthusiasts.

MySQL Network

To receive the MySQL Pro Certified Server that provides enterprise-grade reliability, security and performance, [purchase MySQL Network](#). MySQL Network also includes Technical Advisors, Production Support, and a comprehensive Knowledgebase to successfully develop, deploy, and manage business-critical applications using MySQL. [Learn more about the differences](#) between MySQL Community Edition and MySQL Network.

MySQL 5.0 Community Edition - Generally Available (GA) Release

- The Standard binaries are recommended for most users
- The Max version includes additional features that have not been exhaustively tested or are not required for general use. When these features have matured and proven to be stable, they will be incorporated into future releases of the binaries. The Max version also, for most platforms, contains [MySQL Cluster](#) storage node, management server, and enabling programs.
- The Debug binaries have been compiled with extra debug information, and are not intended for production use. Included debugging code may reduce performance.

Note: It is good practice to back up your data before installing any new version of software. Although MySQL has done its best to ensure a high level of quality, you should protect your data by making a backup. MySQL generally recommends that you dump and reload your tables from any previous version to upgrade to 5.0.

[View the MySQL 5.0 List of Changes](#)

We suggest that you [use the MD5 checksums and GnuPG signatures to verify the integrity of the packages you download.](#)

Windows downloads (platform notes)

Windows Essentials (x86)	5.0.24a	16.8M	Download Pick a mirror
	MD5: 4ea82aaa6551931450072d3b33a6c060		Signature
Windows (x86)	5.0.24a	40.0M	Download Pick a mirror
	MD5: a2c08d51b08b24d30a26341d12c278f5		Signature
Without installer (unzip in C:\)	5.0.24a	52.5M	Download Pick a mirror
	MD5: 572b809454020939dc4433e67913c258		Signature

Windows x64 downloads (platform notes)

Select version and a site to begin download. There will be a registration type form at the top of the page...you can ignore this if you wish and go straight to the download site.

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MySQL Cluster

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MySQL Tools

MySQL also develops Graphical User Interface applications for administering MySQL Server and working with data.

- [MySQL GUI Tools](#) -- single bundle including all GUI tools (MySQL Administrator, MySQL QueryBrowser, MySQL MigrationToolkit and MySQL Workbench)

Drivers and Connectors

While many programming languages have included support for connecting to MySQL server, additional drivers are available:

- MySQL Connector/J -- for connecting to MySQL from Java
 - [MySQL Connector/J 5.0](#) -- Generally Available (GA) release (recommended)
 - [MySQL Connector/J 3.1](#) -- Previous Generally Available (GA) release
 - [MySQL Connector/J 3.0](#) -- Previous Generally Available (GA) release
 - [Older releases](#) -- older releases (only recommended for special needs)
 - [Snapshots](#) -- source code snapshots of the development trees
- MySQL Connector/Net -- for connecting to MySQL from .NET
 - [MySQL Connector/Net 5.0](#) -- Beta release
 - [MySQL Connector/Net 1.0](#) -- Generally Available (GA) release
- MySQL Visual Studio Plugin
 - [MySQL Visual Studio Plugin 1.0](#) -- Beta release

Go back to the main download page and also download MySQL Administrator and MySQL Query Browser

Also download the MySQL Connector/J 3.1

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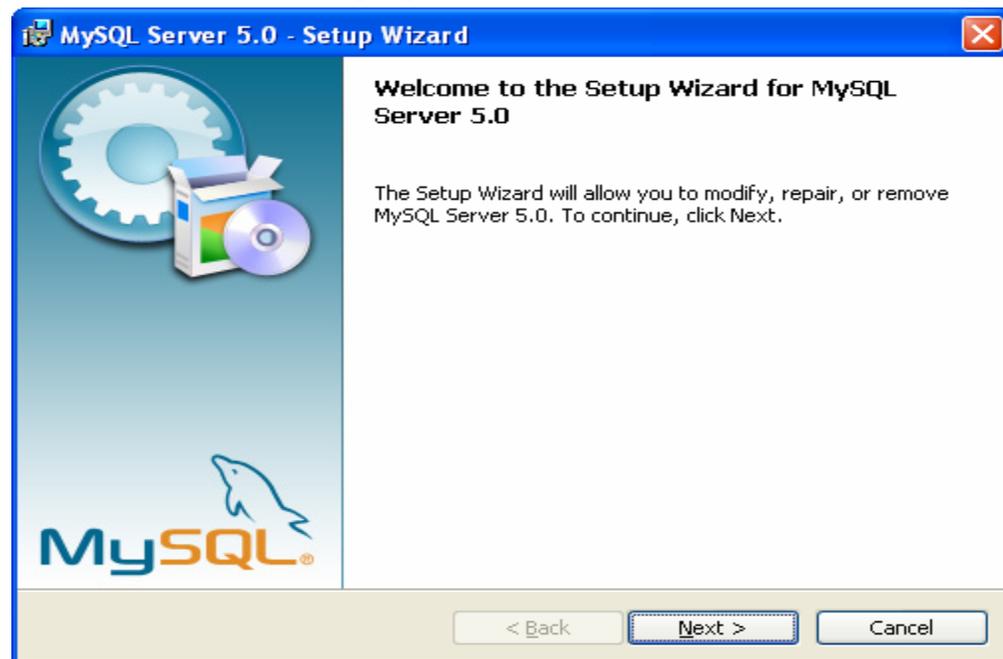
Installing MySQL 5.0

- Once you've got MySQL downloaded, go through the installation process. It may vary somewhat depending on platform.
- I've illustrated the basic install on Windows XP over the next few pages, just to give you an idea of what you should be seeing.



Installing MySQL 5.0

- Once you've got MySQL downloaded, go through the installation process. It may vary somewhat depending on platform.
- I've illustrated the basic install on Windows XP over the next few pages, just to give you an idea of what you should be seeing.
- Once the Windows installer is running you should see the following window appear:

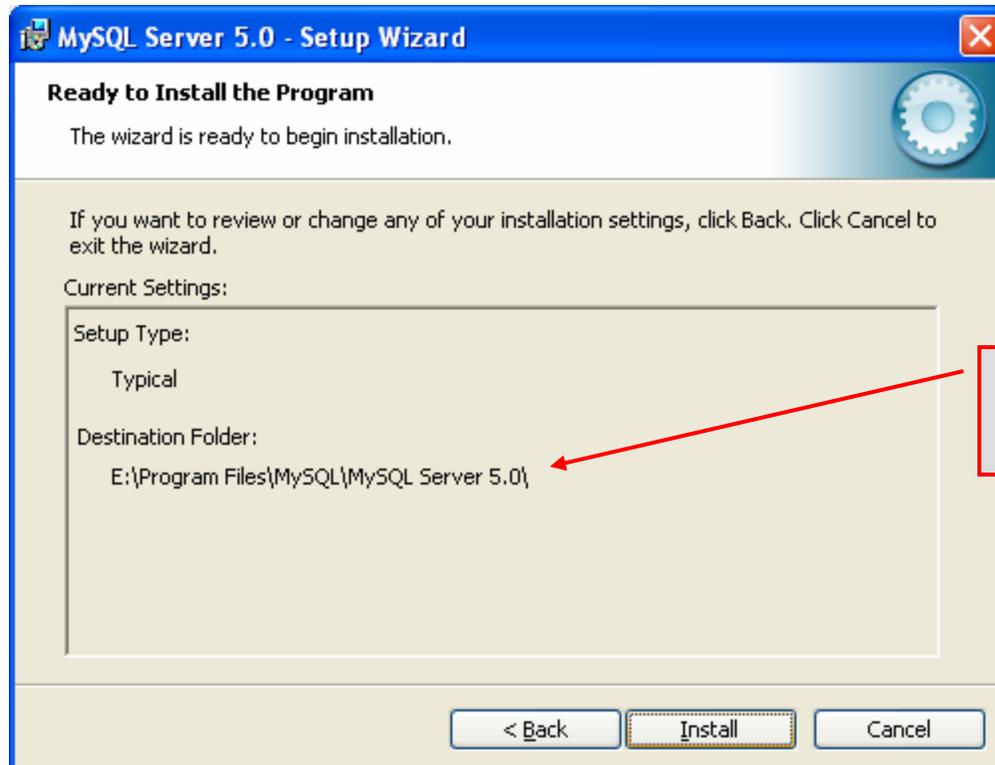


Installing MySQL 5.0 (cont.)

Your choice here.
For this course, a
typical set-up will be
fine.



Installing MySQL 5.0 (cont.)



Select the destination folder for the install.



Installing MySQL 5.0 (cont.)

Again, your choice here. If you want to skip the sign-up that's fine.

MySQL.com Sign Up - Setup Wizard

MySQL.com Sign-Up
Login or create a new MySQL.com account.

Please log in or select the option to create a new account.

Create a new free MySQL.com account
If you do not yet have a MySQL.com account, select this option and complete the following three steps.

Login to MySQL.com
Select this option if you already have a MySQL.com account. Please specify your login information below.

Email address:

Password:

Skip Sign-Up

Next > Cancel



Installing MySQL 5.0 (cont.)



If everything has good well up to this point, you should see a window similar to this one. Click the Finish button, cross your fingers, and hang-on while the installer configures your system and gets MySQL up and running as a service.



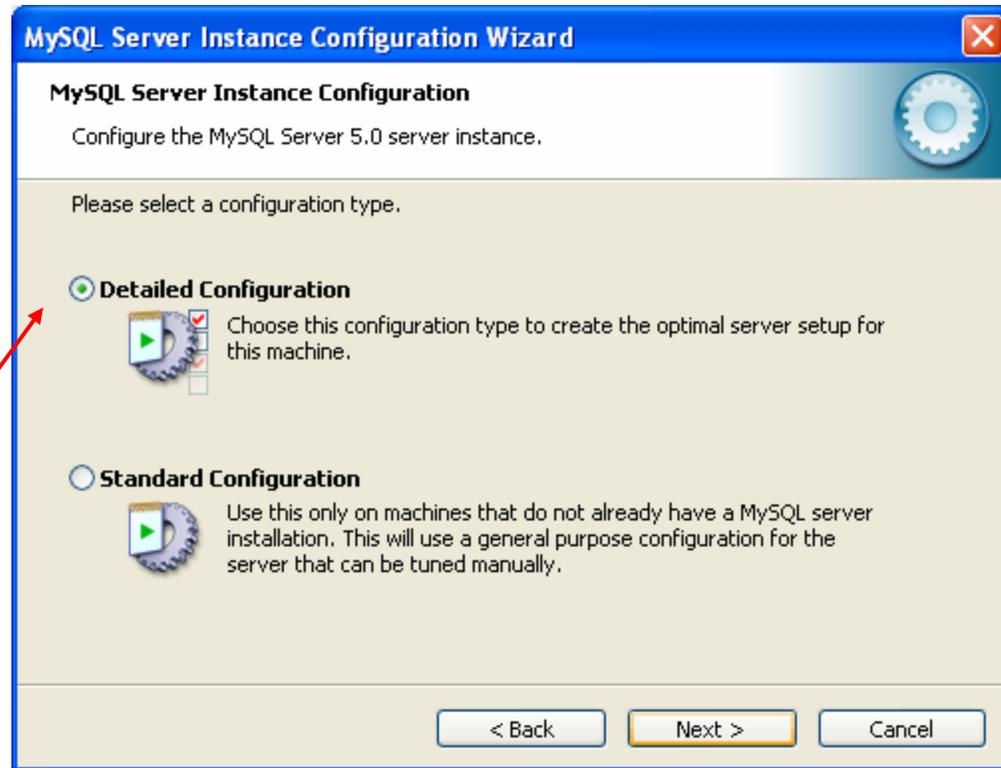
Installing MySQL 5.0 (cont.)



Initial server
configuration window



Installing MySQL 5.0 (cont.)

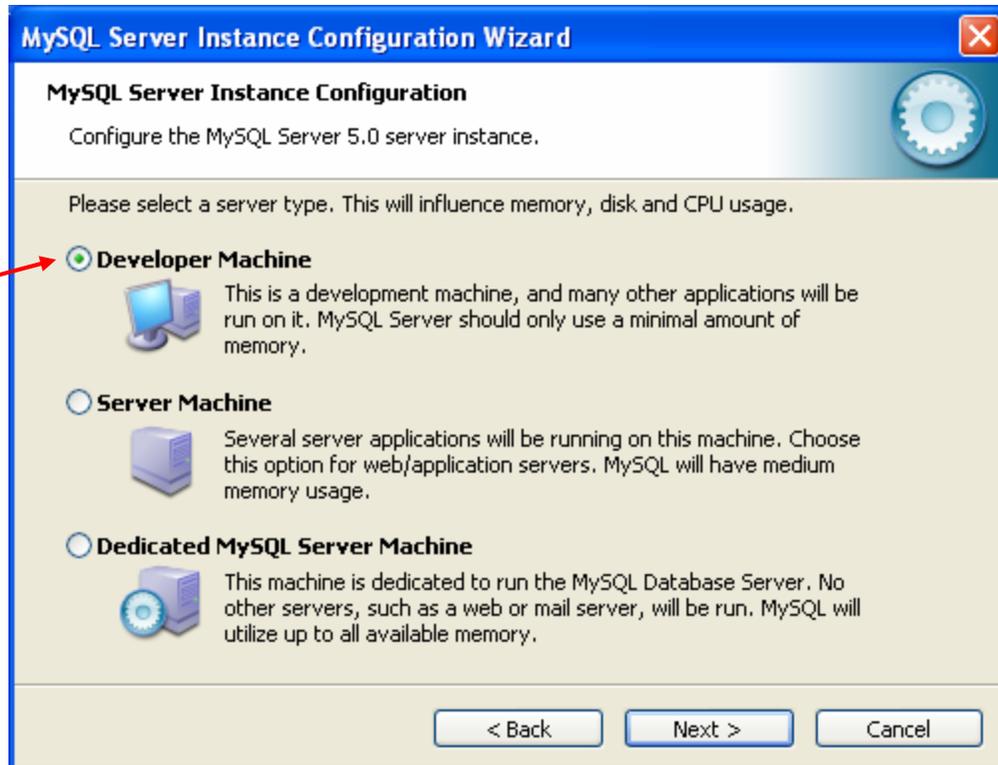


Your choice here. If you are not sure if there is already a MySQL server on your machine, choose the detailed configuration setting.



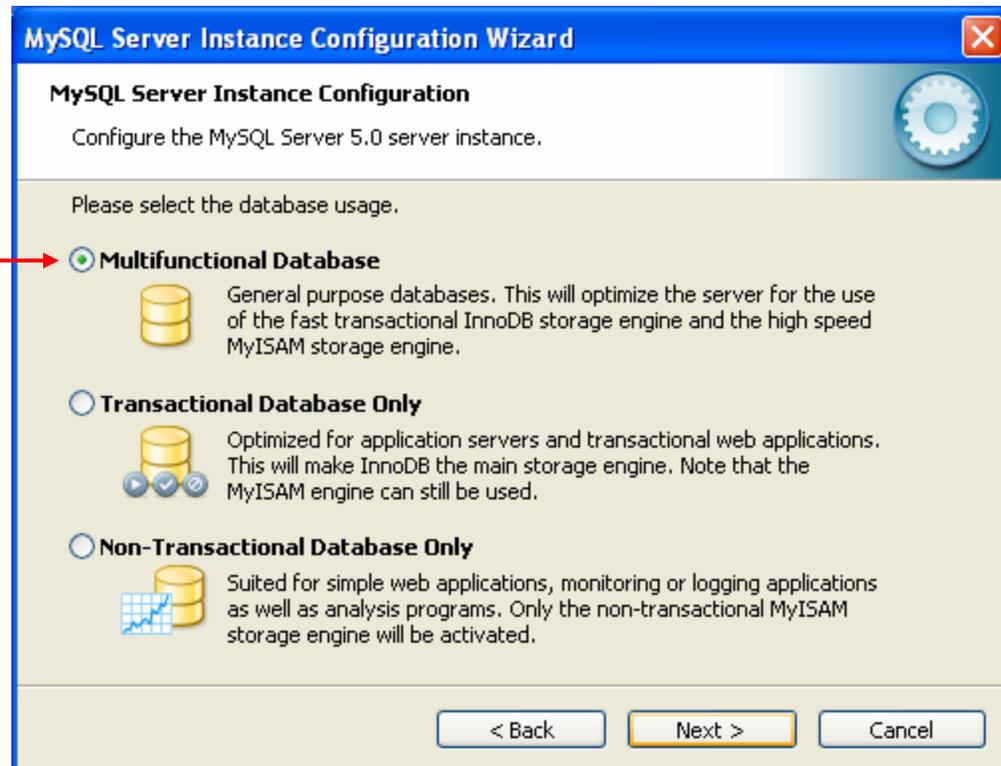
Installing MySQL 5.0 (cont.)

Choose the
developer machine
option



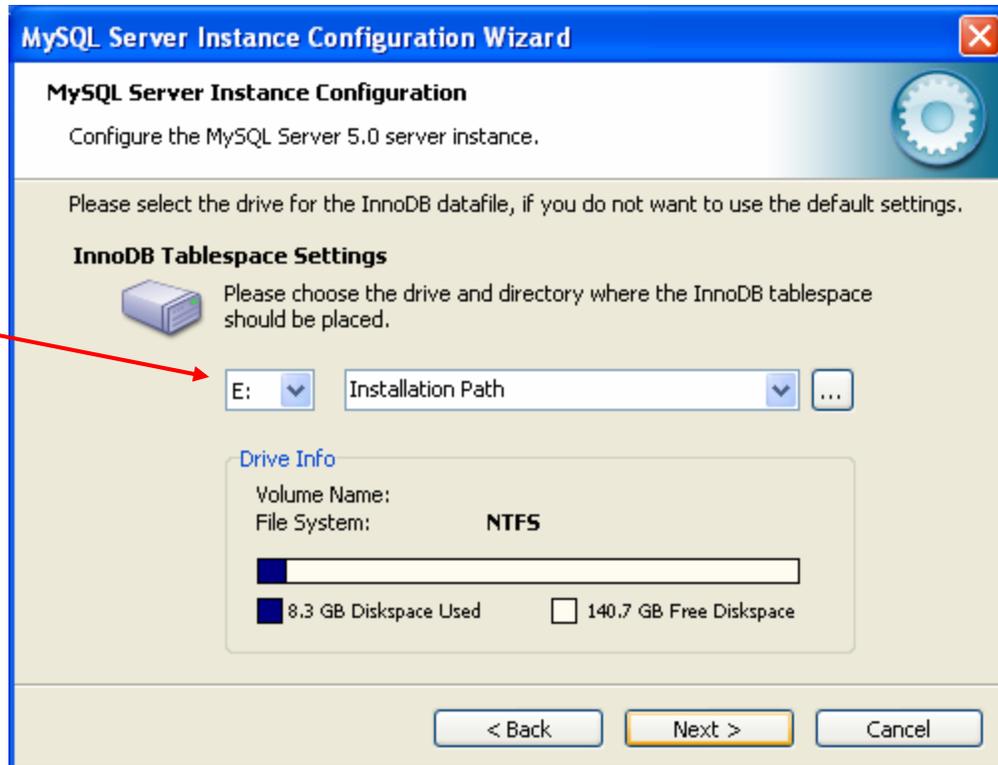
Installing MySQL 5.0 (cont.)

Choose the
multifunctional
database option



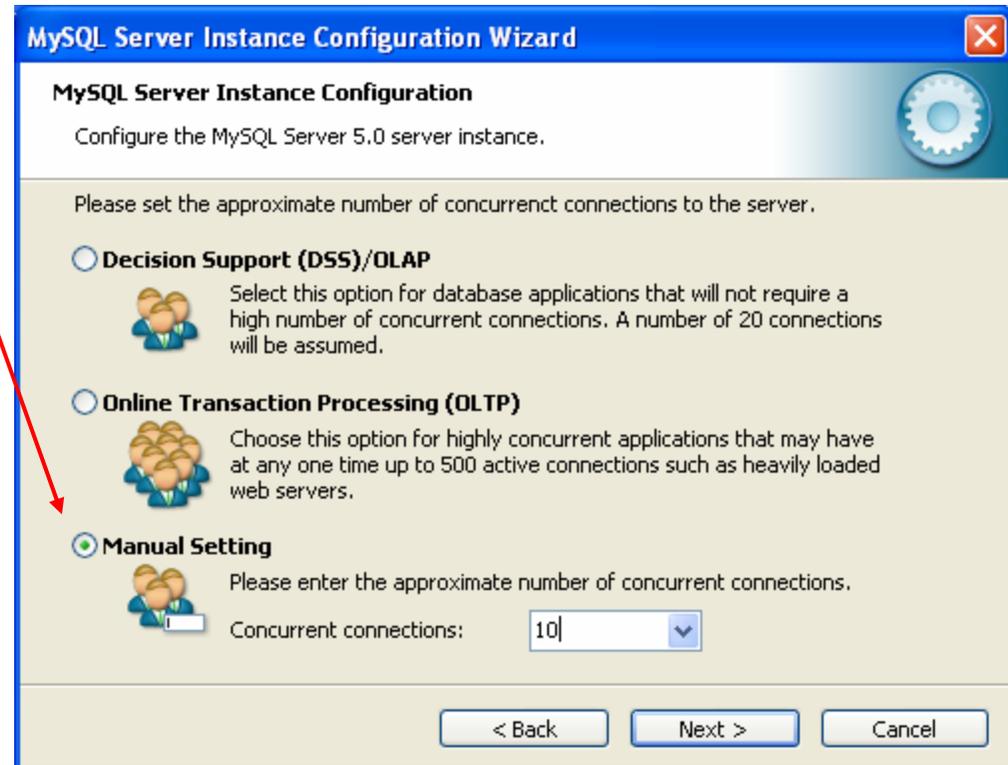
Installing MySQL 5.0 (cont.)

Choose the installation path to keep InnoDB tables in same area as other MySQL files



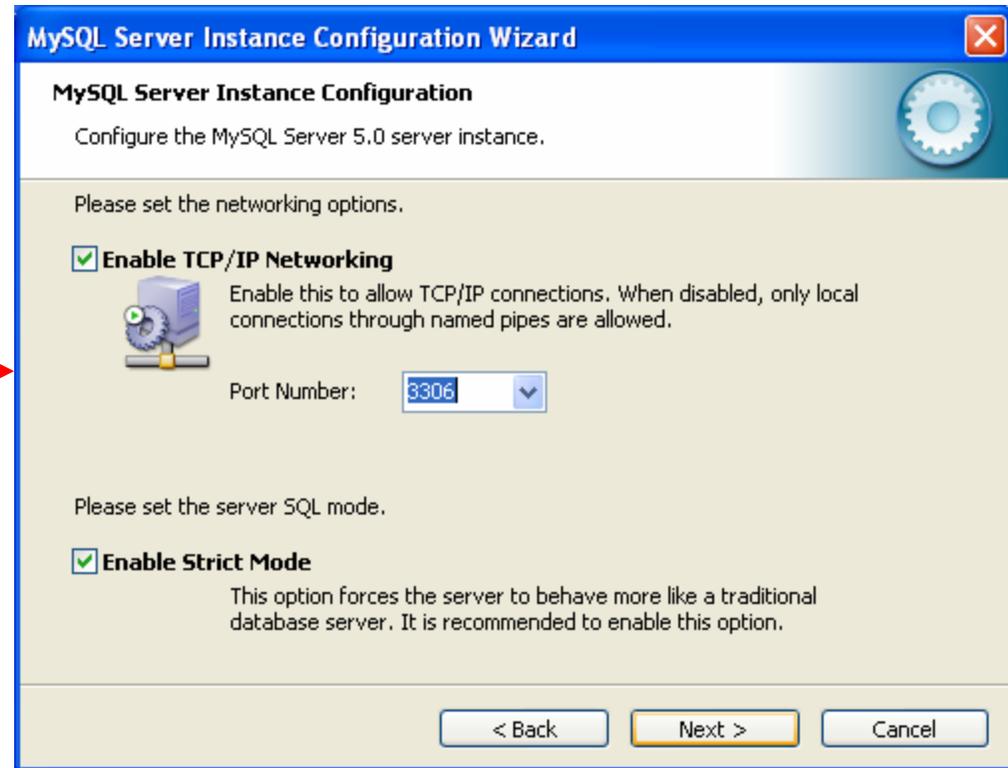
Installing MySQL 5.0 (cont.)

Select manual setting for this option. The default is 15, I set mine to 10, but you can use any number you would like, but pick something greater than 2 or 3.

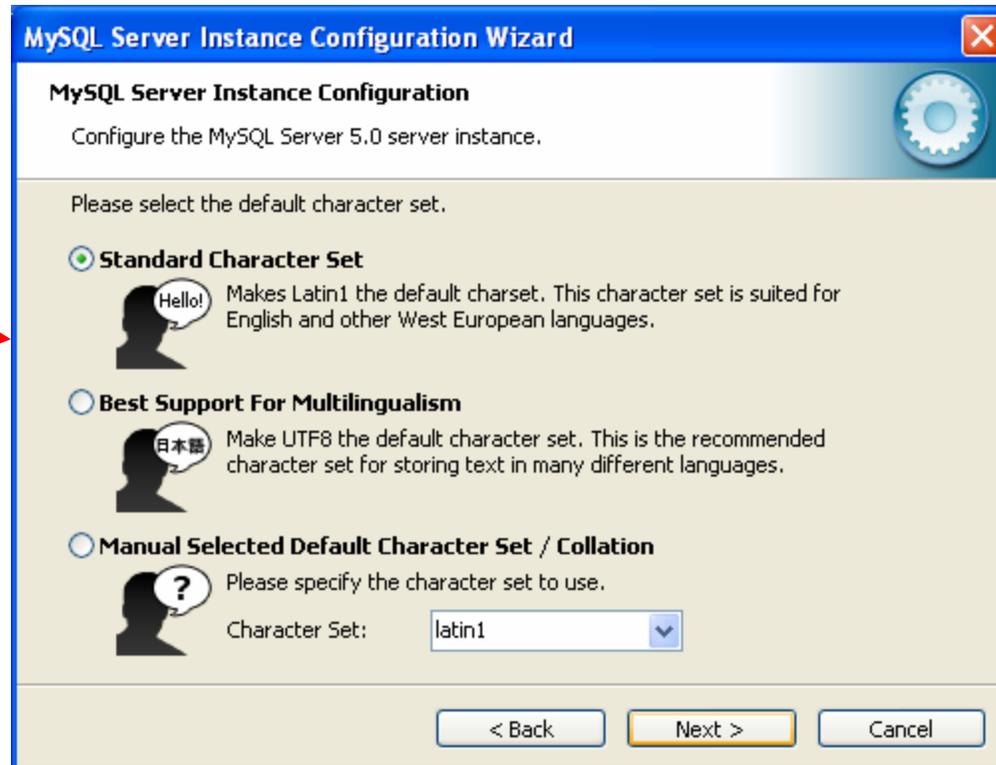


Installing MySQL 5.0 (cont.)

Accept all defaults in this window



Installing MySQL 5.0 (cont.)



Your choice again



Installing MySQL 5.0 (cont.)

Accept default options

This option is not marked by default, but you can mark and accept it if you want to include MySQL file locations in your PATH statement.



Installing MySQL 5.0 (cont.)

Accept default setting and enter a password for the root (superuser with all privileges by default). Enabling root access from remote machines is only necessary if you will be accessing the DB as the root user from a remote machine – we will not be doing this in this course.

Do not enable this option

MySQL Server Instance Configuration Wizard

MySQL Server Instance Configuration
Configure the MySQL Server 5.0 server instance.

Please set the security options.

Modify Security Settings

 New root password: Enter the root password.
Confirm: Retype the password.

Enable root access from remote machines

Create An Anonymous Account

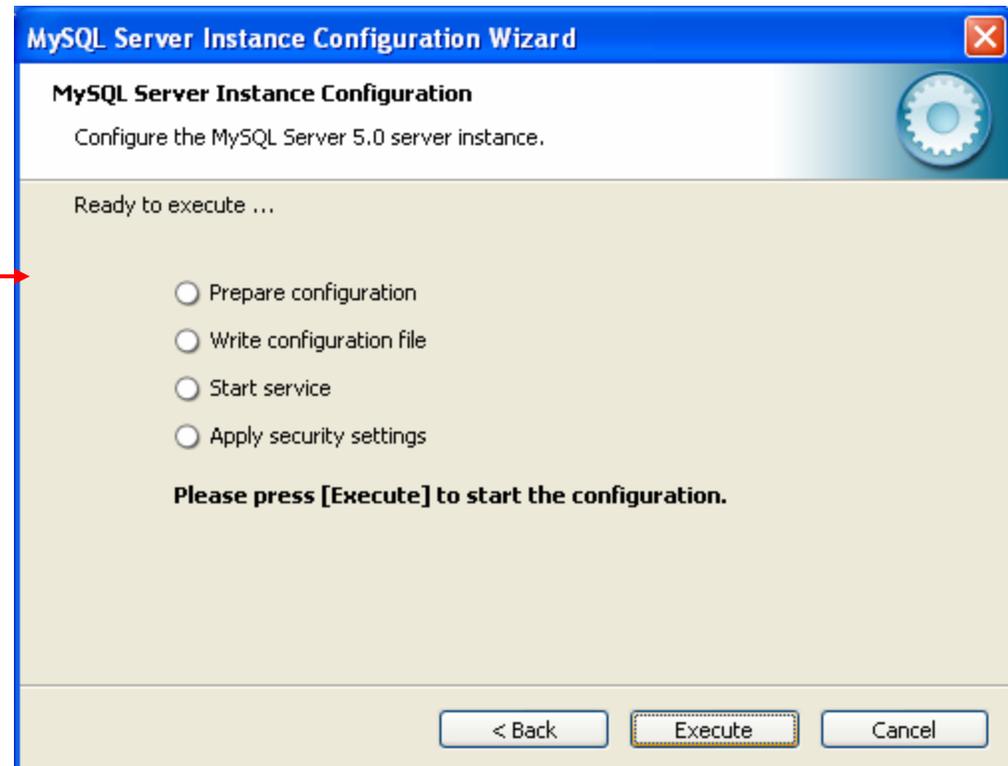
 This option will create an anonymous account on this server. Please note that this can lead to an insecure system.

< Back Next > Cancel

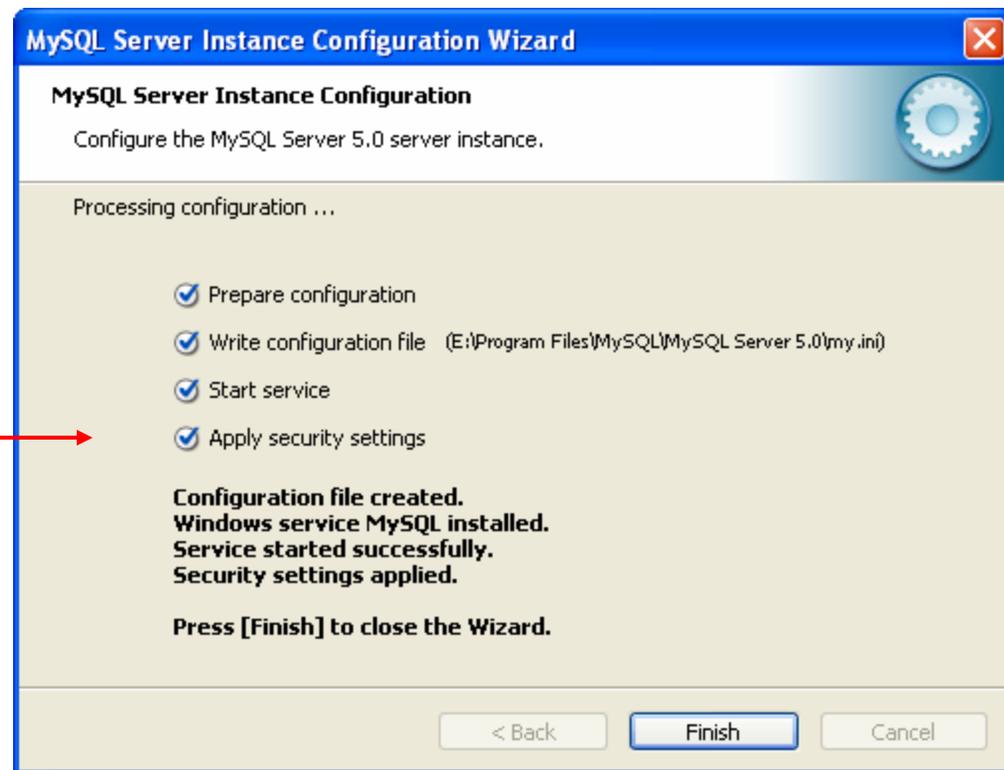


Installing MySQL 5.0 (cont.)

Configuration is about to begin. Now cross your fingers, toes, and anything else you have, take a deep breath, click the Execute button and close your eyes for a few seconds.



Installing MySQL 5.0 (cont.)



You've successfully installed MySQL!!



Running MySQL 5.0

- If you've successfully installed MySQL, it should now be running as a service on your machine. It will start automatically when your machine boots.
- Go into your listing of programs (from the start menu at the bottom: All Programs) and you should see MySQL appear. Since you will be running MySQL clients a lot, it will be easier if you pin the MySQL Client to the start menu.
- To verify that MySQL is running properly as a service you can either check the process window or run a MySQL client.



Running MySQL 5.0 (cont.)

```
MySQL Command Line Client
Enter password: ****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 5 to server version: 5.0.24a-community-nt

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> status;
-----
E:\Program Files\MySQL\MySQL Server 5.0\bin\mysql.exe  Ver 14.12 Distrib 5.0.24a, for Win32 (ia32)

Connection id:          5
Current database:
Current user:           root@localhost
SSL:                    Not in use
Using delimiter:       ;
Server version:        5.0.24a-community-nt
Protocol version:      10
Connection:            localhost via TCP/IP
Server characterset:   latin1
Db characterset:       latin1
Client characterset:   latin1
Conn. characterset:    latin1
TCP port:              3306
Uptime:                36 min 0 sec

Threads: 1  Questions: 60  Slow queries: 0  Opens: 29  Flush tables: 1  Open tables: 0  Queries per second avg: 0.028
-----

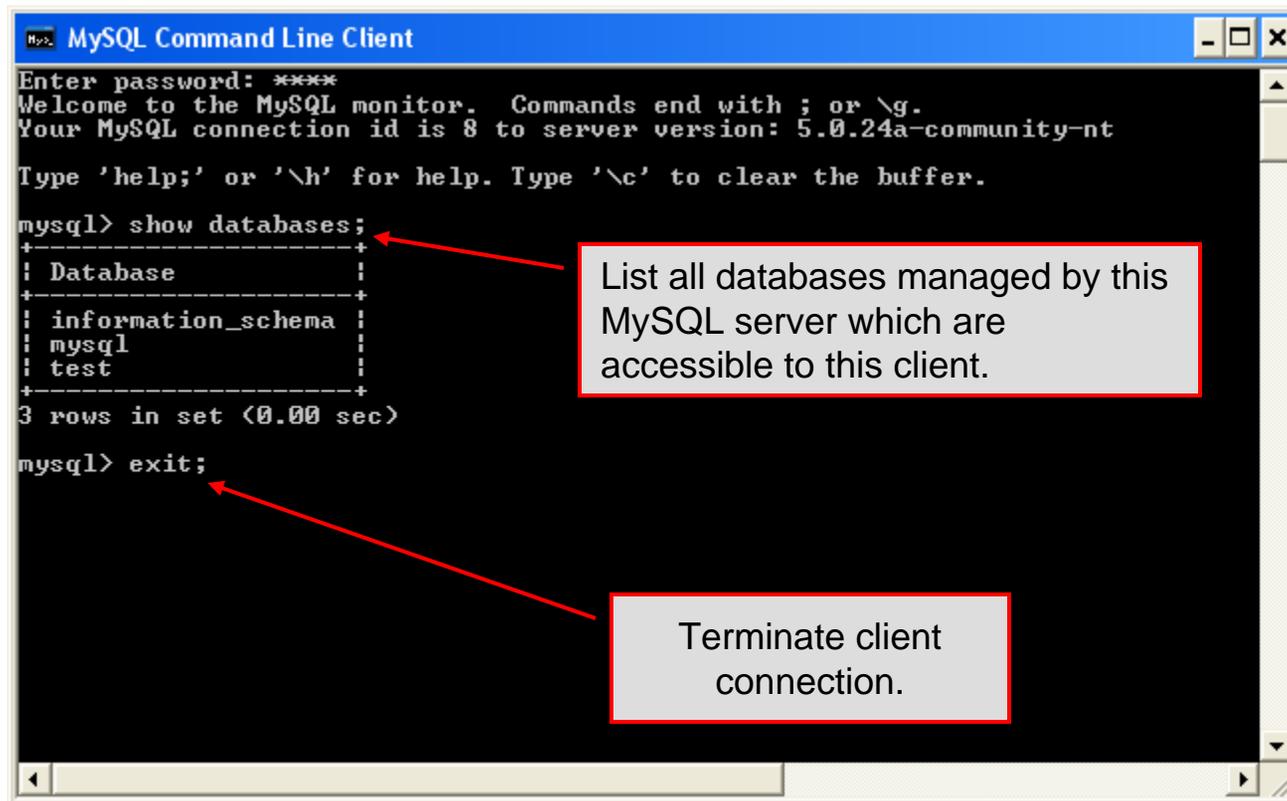
mysql> _
```

Enter the password you provided during the MySQL installation procedure as the root user.

Hopefully, you see this output from MySQL. The MySQL server is now awaiting a command from this client.



Running MySQL 5.0 (cont.)



```
MySQL Command Line Client
Enter password: ****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 8 to server version: 5.0.24a-community-nt

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| mysql      |
| test      |
+-----+
3 rows in set (0.00 sec)

mysql> exit;
```

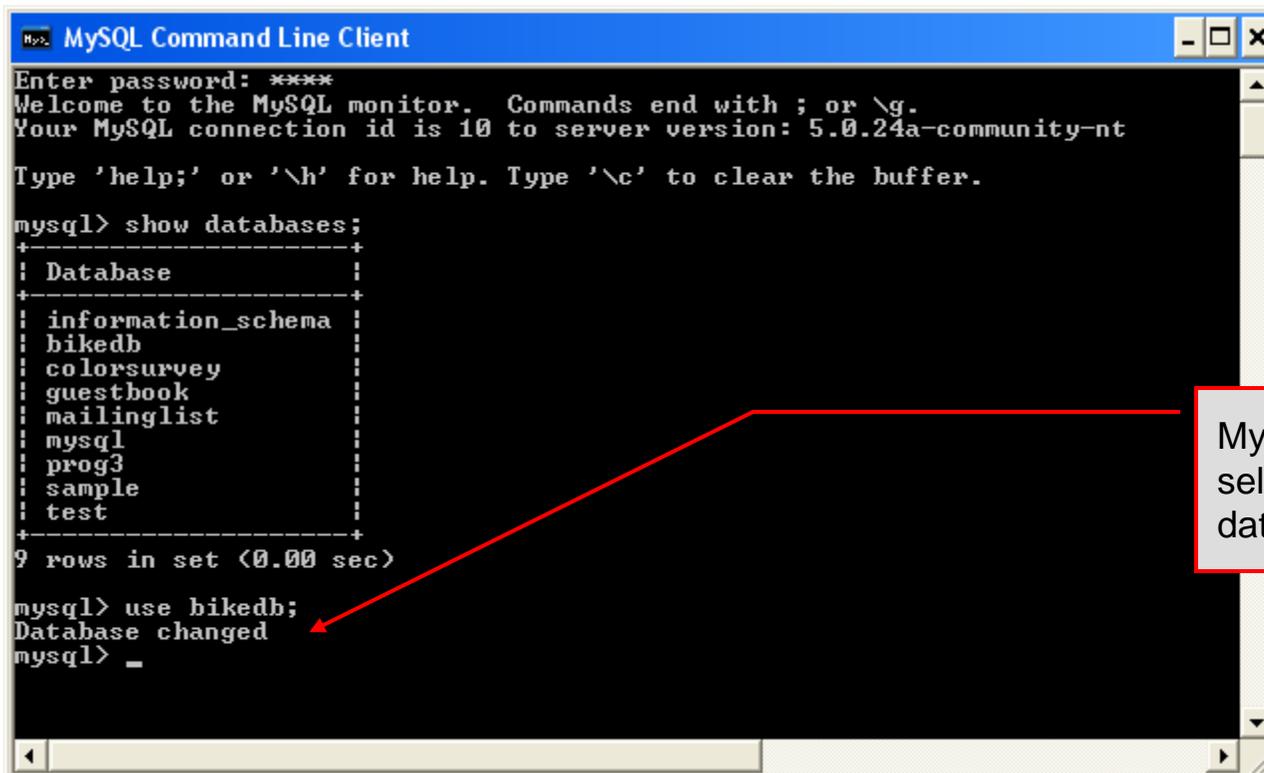
List all databases managed by this MySQL server which are accessible to this client.

Terminate client connection.



Specifying A Database Within MySQL

- Unless, it is specifically stated, in the following slides we'll assume that the user has root-level privileges.
- To select a database for use in MySQL the use command must be issued. In the example below, we'll select the `bikedb` database.



```
MySQL Command Line Client
Enter password: ****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 10 to server version: 5.0.24a-community-nt
Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| bikedb      |
| colorsurvey |
| guestbook   |
| mailinglist |
| mysql       |
| prog3       |
| sample      |
| test        |
+-----+
9 rows in set (0.00 sec)

mysql> use bikedb;
Database changed
mysql> _
```

MySQL acknowledges selection of bikedb database.



Viewing the Schema of a Relation

- To see the schema of a relation within a database, use the `describe <tablename>` command as illustrated below.

```
Command Prompt (2) - mysql -u root -p
mysql> create table bikes (
-> bikeName varchar(30) NOT NULL,
-> size int(2),
-> color varchar(15),
-> cost int(5),
-> purchased date,
-> mileage int(6),
-> primary key (bikeName)
-> );
Query OK, 0 rows affected (0.05 sec)

mysql> describe bikes;
+-----+-----+-----+-----+-----+-----+
| Field | Type          | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| bikeName | varchar(30) | YES  | PRI |          |       |
| size     | int(2)       | YES  |     |          |       |
| color    | varchar(15)  | YES  |     |          |       |
| cost     | int(5)       | YES  |     |          |       |
| purchased | date         | YES  |     |          |       |
| mileage  | int(6)       | YES  |     |          |       |
+-----+-----+-----+-----+-----+-----+
6 rows in set (0.00 sec)

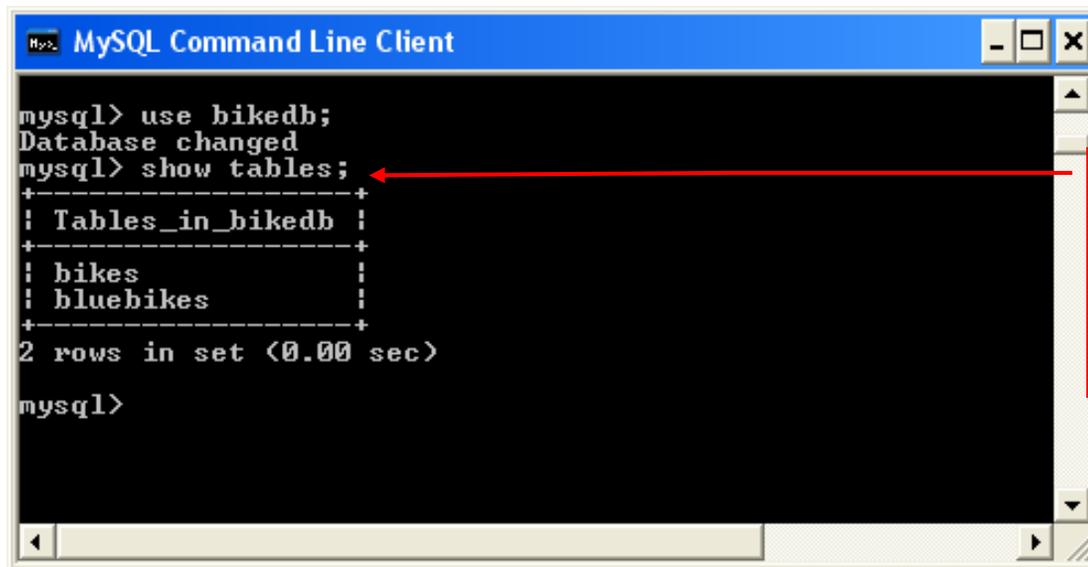
mysql>
```

Specify which table's schema to describe. All information regarding the schema visible to the user is displayed.



Viewing the Relations of a Database

- Once a database has been selected you can see the relations (tables) within that database with the `show tables` command as illustrated below.



```
mysql> use bikedb;
Database changed
mysql> show tables;
+-----+
| Tables_in_bikedb |
+-----+
| bikes             |
| bluebikes         |
+-----+
2 rows in set (0.00 sec)

mysql>
```

Show tables command lists all the relations within a database visible to the user. There are two tables in this database.



Running a Simple Select Query in MySQL

- Within the MySQL monitor, running an SQL query is straight forward. The example below illustrates a simple selection query on the bikes table of the bikedb database.

```
MySQL Command Line Client
mysql>
mysql>
mysql> select *
-> from bikes;
+-----+-----+-----+-----+-----+-----+
| bikename      | size | color      | cost  | purchased | mileage |
+-----+-----+-----+-----+-----+-----+
| Battaglin Carrera | 60   | red/white  | 4000  | 2001-03-14 | 11200  |
| Bianchi Corse Evo 4 | 58   | celeste    | 5700  | 2004-12-22 | 300    |
| Bianchi Evolution 3 | 58   | celeste    | 4800  | 2003-11-16 | 2000   |
| Bianchi/Liquigas FG | 58   | celeste/blue | 5600  | 2005-12-02 | 0      |
| Colnago Dream Rabobank | 60   | blue/orange | 5500  | 2002-07-27 | 4300   |
| Colnago Superissimo | 59   | red        | 3800  | 1996-03-01 | 13000  |
| Eddy Merckx Domo    | 58   | blue/black | 5300  | 2005-02-02 | 0      |
| Eddy Merckx Molteni | 58   | orange     | 5100  | 2004-08-12 | 0      |
| Gianni Motta Personal | 59   | red/green  | 4400  | 2000-05-01 | 8700   |
| Gios Torino Super  | 60   | blue       | 2000  | 1998-11-08 | 9000   |
| Schwinn Paramount P14 | 60   | blue       | 1800  | 1992-03-01 | 200    |
+-----+-----+-----+-----+-----+-----+
11 rows in set (0.00 sec)
mysql>
```

The tuples within the bikes table are displayed as the result of the query.



Creating a Database in MySQL

- From the MySQL monitor enter create database *<db name>*

```
MySQL Command Line Client
Enter password: ****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 1 to server version: 5.0.18-nt
Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| bikedb     |
| mysql     |
| test      |
+-----+
4 rows in set (0.03 sec)

mysql> create database sample;
Query OK, 1 row affected (0.01 sec)

mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| bikedb     |
| mysql     |
| sample    |
| test      |
+-----+
5 rows in set (0.00 sec)

mysql> _
```

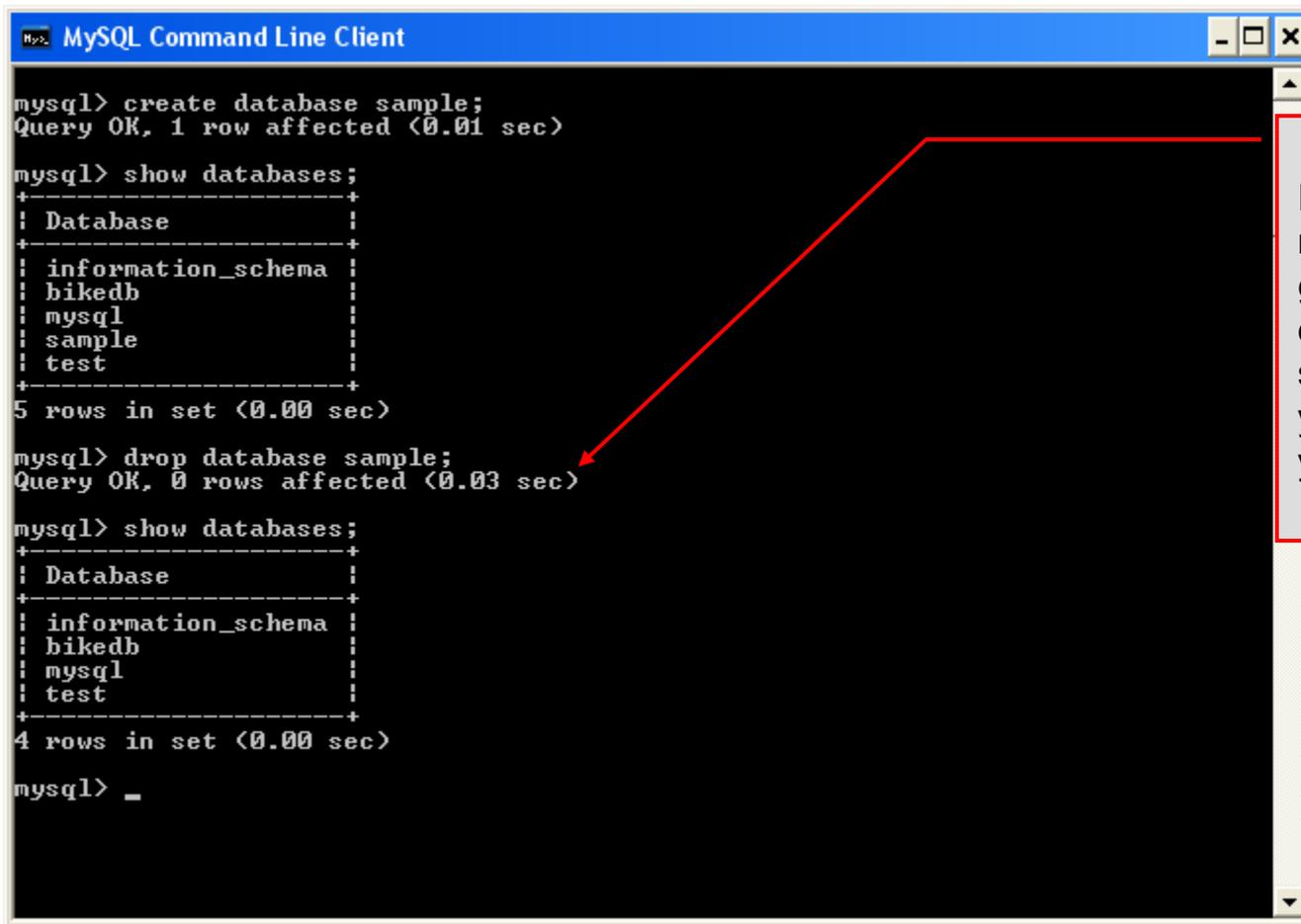
Create new database from within MySQL monitor.

Subsequent listing shows newly created database



Dropping a Database in MySQL

- From the MySQL monitor execute the `drop database <db name>` command.



```
mysql> create database sample;
Query OK, 1 row affected (0.01 sec)

mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| bikedb      |
| mysql      |
| sample     |
| test       |
+-----+
5 rows in set (0.00 sec)

mysql> drop database sample;
Query OK, 0 rows affected (0.03 sec)

mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| bikedb      |
| mysql      |
| test       |
+-----+
4 rows in set (0.00 sec)

mysql> _
```

From within the MySQL monitor, no warning is given when dropping a database. Be very sure that this is what you want to do before you do it.



Manipulating Tables in MySQL

- The creation of a database does not place any relations into the database. Relations must be separately created.
- To create a table within a database, first select the database (or create one if you haven't already done so), then execute the create table command.

```
MySQL Command Line Client
mysql> create database sample;
Query OK, 1 row affected (0.00 sec)

mysql> use sample;
Database changed
mysql> create table articles (
-> article_id int(9) not null auto_increment,
-> headline text not null,
-> data_post datetime not null default '0000-00-00 00:00:00',
-> text_body text,
-> who_created int(9) default null,
-> email_sent int(1) not null default '0',
-> date_email datetime default null,
-> who_approved int(9) default null,
-> pic varchar(255) default null,
-> primary key (article_id)
-> );
Query OK, 0 rows affected (0.08 sec)

mysql> _
```



Manipulating Tables in MySQL (cont.)

Screen shot showing newly created table.

```
MySQL Command Line Client
-> >;
Query OK, 0 rows affected (0.08 sec)
mysql> describe articles;
+-----+-----+-----+-----+-----+-----+
| Field          | Type          | Null | Key | Default          | Extra          |
+-----+-----+-----+-----+-----+-----+
| article_id     | int(9)        | NO   | PRI | NULL             | auto_incremen |
| headline       | text          | NO   |     |                  |                |
| data_post      | datetime      | NO   |     | 0000-00-00 00:00:00 |                |
| text_body      | text          | YES  |     | NULL             |                |
| who_created    | int(9)        | YES  |     | NULL             |                |
| email_sent     | int(1)        | NO   |     | 0                |                |
| date_email     | datetime      | YES  |     | NULL             |                |
| who_approved   | int(9)        | YES  |     | NULL             |                |
| pic            | varchar(255) | YES  |     | NULL             |                |
+-----+-----+-----+-----+-----+-----+
9 rows in set (0.01 sec)
mysql>
```



Manipulating Tables in MySQL (cont.)

- The `create table` command has the following general format:

```
create [temporary] table
[if not exists] tablename
[(create_definition, ...)]
[table_options] [select_statement];
```

- If the `[if not exists]` clause is present, MySQL will produce an error message if a table with the specified name already exists in the database, otherwise the table is created.



Manipulating Tables in MySQL (cont.)

- A temporary table exists only for the life of the current database connection. It is automatically destroyed when the connection is closed or dies.
- Two different connections can use the same name for a temporary table without conflicting with one another.
- Temporary tables are most useful when queries get complex and intermediate results become useful. Also, versions of MySQL earlier than version 4.1 do not have subselect capability and temporary tables are a convenient way to simulate subselect query results.

Note: Non-root users require special permission to be able to create temporary tables. These users must have the `Create_tmp_tables` privilege set in the user grant table. We'll see more on this later.



Creating A Temporary Table From A Select Query

```
MySQL Command Line Client
mysql> select * from bikes;
+-----+-----+-----+-----+-----+-----+
| bikename      | size | color      | cost  | purchased | mileage |
+-----+-----+-----+-----+-----+-----+
| Battaglin Carrera      | 60   | red/white  | 4000  | 2001-03-14 | 11200  |
| Bianchi Corse Evo 4    | 58   | celeste    | 5700  | 2004-12-22 | 300    |
| Bianchi Evolution 3    | 58   | celeste    | 4800  | 2003-11-16 | 2000   |
| Bianchi/Liquigas FG    | 58   | celeste/blue | 5600  | 2005-12-02 | 0      |
| Colnago Dream Rabobank | 60   | blue/orange | 5500  | 2002-07-27 | 4300   |
| Colnago Superissimo    | 59   | red        | 3800  | 1996-03-01 | 13000  |
| Eddy Merckx Domo       | 58   | blue/black | 5300  | 2005-02-02 | 0      |
| Eddy Merckx Molteni    | 58   | orange     | 5100  | 2004-08-12 | 0      |
| Gianni Motta Personal  | 59   | red/green  | 4400  | 2000-05-01 | 8700   |
| Gios Torino Super      | 60   | blue       | 2000  | 1998-11-08 | 9000   |
| Schwinn Paramount P14  | 60   | blue       | 1800  | 1992-03-01 | 200    |
+-----+-----+-----+-----+-----+-----+
11 rows in set (0.00 sec)

mysql> create temporary table celestebikes
-> select *
-> from bikes
-> where color = 'celeste';
Query OK, 2 rows affected (0.09 sec)
Records: 2  Duplicates: 0  Warnings: 0

mysql> show tables;
+-----+
| Tables_in_bikedb |
+-----+
| bikes             |
| bluebikes         |
+-----+
2 rows in set (0.00 sec)

mysql> select * from celestebikes;
+-----+-----+-----+-----+-----+-----+
| bikename      | size | color      | cost  | purchased | mileage |
+-----+-----+-----+-----+-----+-----+
| Bianchi Corse Evo 4    | 58   | celeste    | 5700  | 2004-12-22 | 300    |
| Bianchi Evolution 3    | 58   | celeste    | 4800  | 2003-11-16 | 2000   |
+-----+-----+-----+-----+-----+-----+
2 rows in set (0.00 sec)

mysql>
```

A SELECT query produces a result set which has been extracted from one or more tables. A table can be created with the results of this data using the create table command.

Notice that temporary tables do not appear in a table listing.



A First Look At The MySQL Query Browser

The screenshot shows the MySQL Query Browser interface. At the top, the title bar reads "MySQL Query Browser - root@localhost:3306 / bikedb". The menu bar includes File, Edit, View, Query, Script, Tools, Window, and Help. Below the menu bar, there are navigation buttons: Go back, Next, and Refresh. The main query input area contains the text "SELECT * FROM bikes b;". To the right of the query input are buttons for Execute and Stop. Below the query input is a "Resultset 1" section containing a table with 12 rows and 8 columns. The columns are: bikename, lastove..., size, color, cost, purchased, mileage, and races_ridden. The first row is "Battaglin Carrera" with values: NULL, 60, red/white, 4000, 2001-03-14, 11200, NULL. The last row is "Schwinn Paramount P14" with values: NULL, 60, blue, 1800, 1992-03-01, 200, NULL. To the right of the table is a "Schemata" panel showing a tree view of the database structure, including "bikedb" and its sub-databases like "bikes", "bluebikes", etc. Below the schemata panel is a "Syntax" panel with categories like "Data Manipulation", "Data Definition", etc. At the bottom of the interface, there is a status bar showing "12 rows fetched in 0.0262s (0.0291s)" and buttons for Edit, Apply Changes, Discard Changes, First, Last, and Search.

Annotations with red boxes and arrows point to the following components:

- Query input window**: Points to the text area containing the SQL query.
- Database selection window**: Points to the Schemata panel on the right side of the interface.
- Result set window**: Points to the table displaying the query results.

