Accessing a relational database with JDBC

Object-Oriented programming

Antonius Camara

“Object persistence” is the goal

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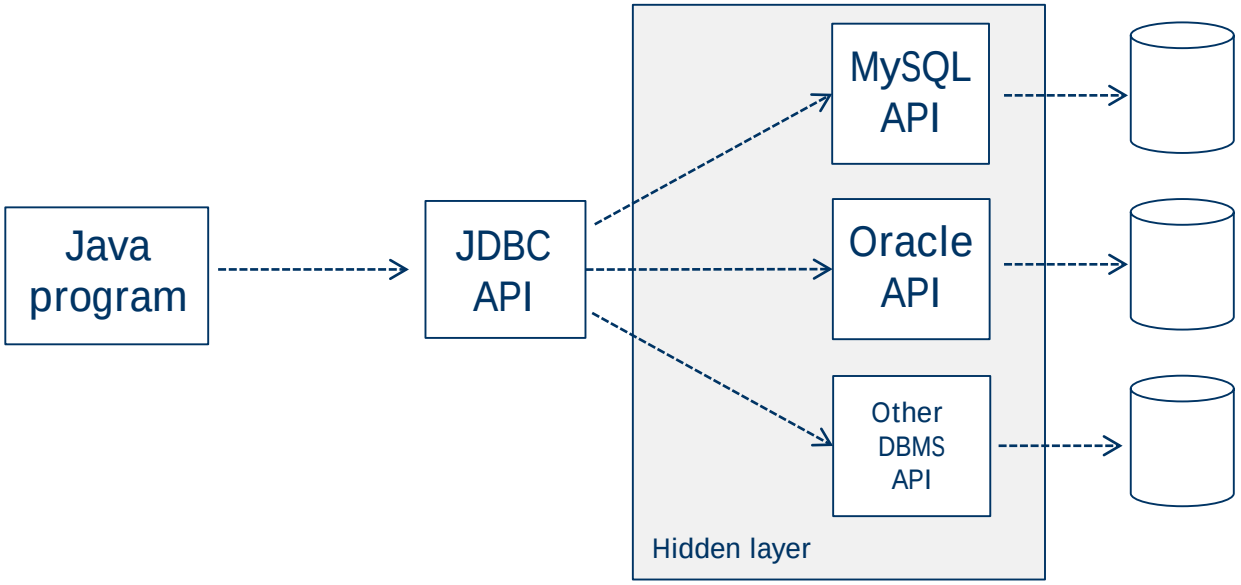
- Until now, the objects processed in your programs were transient/temporary: i.e, when the program stops executing, the objects and their associated data are destroyed from the computer’s run-time memory
- In normal applications you would like to store objects’ data after the program stops executing. This is called Object Persistence
- Persistence is achieved by storing object data in files or databases
- JDBC allows programs to store object data in Relational Databases

JDBC (Java Database Connectivity)

- Standardized API to access data sources with tabular data (ex: Relational Databases)
- Supported in different database vendors/providers
  - MySQL, MariaDB, Oracle
- By using JDBC, a developer does not need to learn the database vendor's specific API
- It is also possible to change the DBMS used in an application without needing to change the application's code



Some JDBC Classes you will need to use

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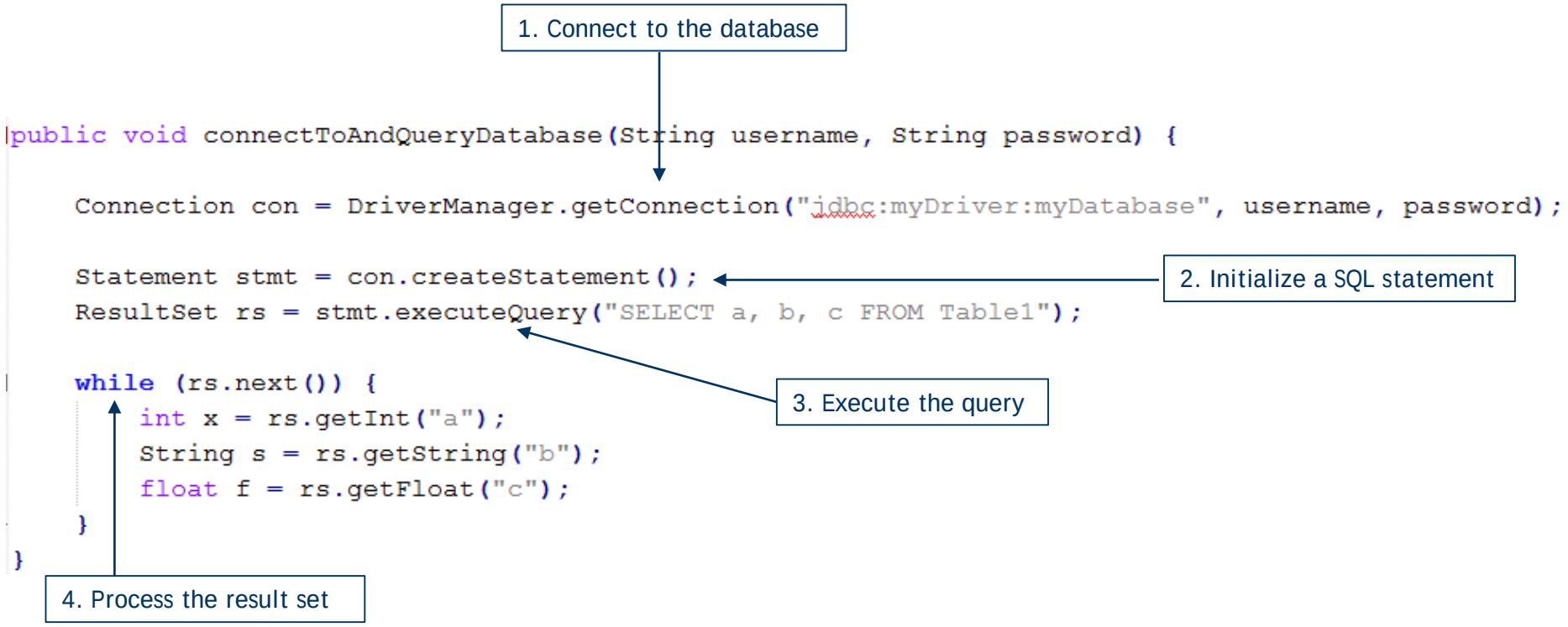
JDBC Class	Purpose	Import Package
DriverManager	Connects to the JDBC driver	`java.sql.DriverManager`
Connection	Setup a database connection	`java.sql.Connection`
Statement	Define SQL statements	`java.sql.Statement`
ResultSet	Contains the results of a query	`java.sql.ResultSet`

A simple example

Example from: https://docs.oracle.com/javase/tutorial/jdbc/overview/



Check also another instructive example at:
https://www.tutorialspoint.com/jdbc/jdbc-sample-code.htm

Coding object persistence is challenging

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- The basic idea in using the JDBC API is simple and straightforward
- However, integrating a database in your application is not a straightforward task
- Implementing “object persistence” in your application requires careful and good design
- In the implementation of large applications you would probably use some ready made framework (Classes, methods) that provides a higher layer to interact with a database. Using such frameworks are not in the scope of this course

Proposed “object persistence” technique for this course’s projects

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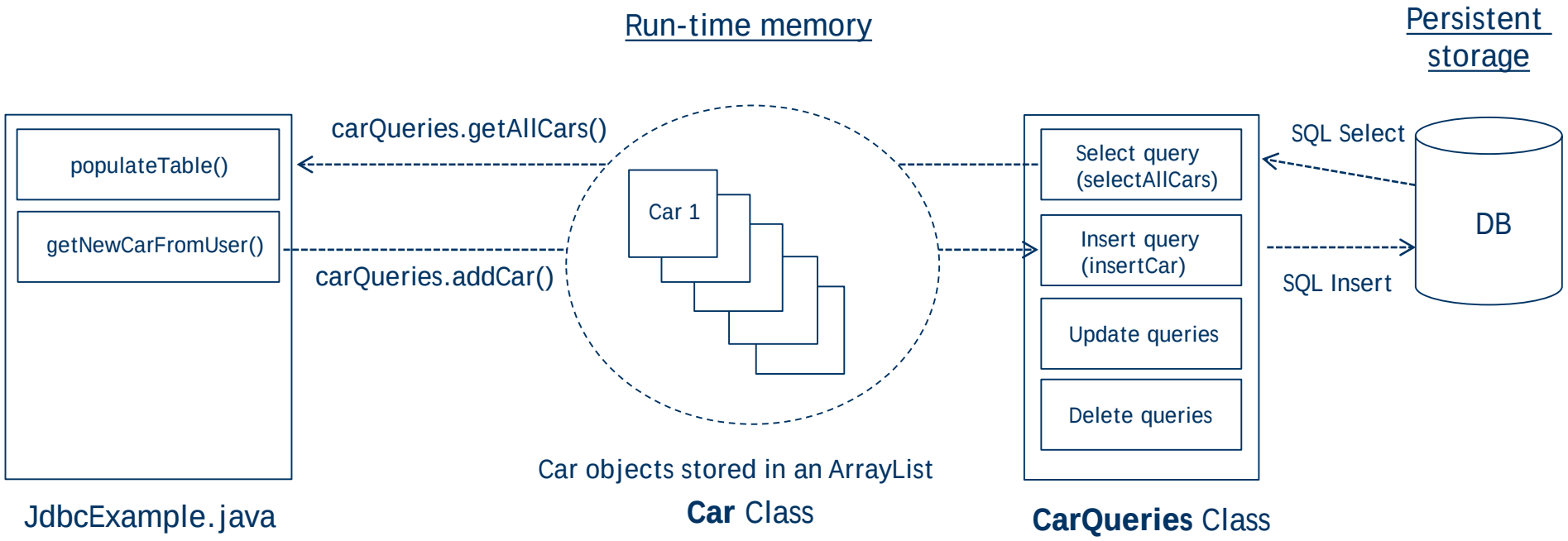
- Run-time object data should be kept in the application’s object instances (ex: Car objects)
- “Array Lists” should be used store collections of objects in run-time memory (ex: Array List of Car objects)
- For each object Class you have in your application, you should have an associated Class that handles the operations towards the database (ex: CarQueries)
- Use “Prepared Statements” to implement the SQL queries
- This technique is described in the book “Java – How to Program, Paul Deitel” pages 1223-1237

Proposed approach - diagram



The rest of the application only knows about Car objects. All operations related to manipulating Cars and Car data are done by using the public methods provided by the Car Class and CarQueries Class. The Car data model used in these interactions is the one used in the Car Class (Car objects). The rest of the application don't need to deal with relational database specific details (tables&fields) neither need to use SQL

This class "hides" database specific details from the rest of the application. It also has the task to provide the interface that transforms the tabular Car data from the relational tables into the run-time data model of Car objects

Database options you can use in your computer

- XAMPP
  - Download from: https://www.apachefriends.org/index.html
  - Most of you already using it
  - Apache (web server), DB server (originally with MySQL but later with MariaDB), PHP
  - phpMyAdmin for database administration
- MySQL (by Oracle)
  - Download from: https://www.mysql.com/products/community/
  - Just the database server. Enough for this course as we don't need Apache
  - The free version is called "MySQL Community Edition"
  - MySQL Workbench is the tool for database administration
- MariaDB
  - Download from: https://mariadb.org/download/
  - Made by the original developers of MySQL and guaranteed to stay open source
  - The download package contains only a command line client for db administration. Most MySQL tools work also with MariaDB (ex: phpMyAdmin)
  - If you need a GUI tool you will need to install one separately. Here's a list of options: https://mariadb.com/kb/en/mariadb/graphical-and-enhanced-clients/

Configuring Eclipse to access MySQL with JDBC

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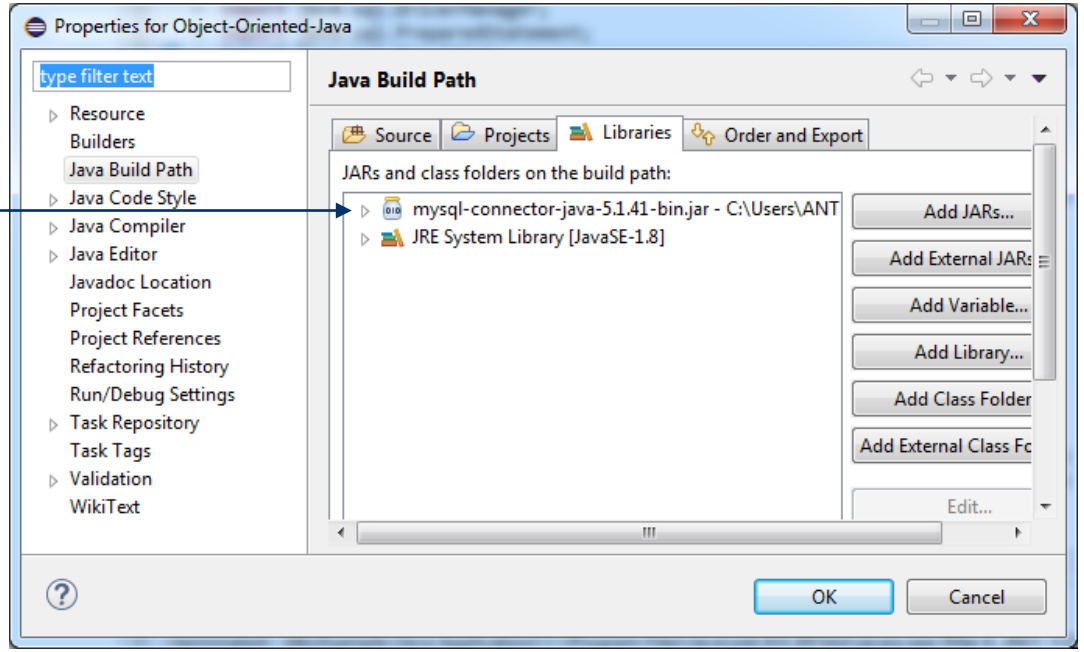
- Download the MySQL JDBC Driver (https://dev.mysql.com/downloads/connector/j/)
- Extract the zip file mysql-connector-java-5.1.41.zip to a safe location in your computer
- In Eclipse, Package Explorer: right click on your project -> Properties -> Libraries -> Add external JARs
- Select the file "mysql-connector-java-5.1.41-bin.jar" from the location where you extracted the downloaded driver. MAKE SURE YOU ARE SELECTING THE .JAR FILE, NOT THE .ZIP FILE

After you successfully add the JAR your Java Build Path / Libraries list should contain the mysql-connector-java-xxxx-bin.jar file



Hands on... (jdbcExample)

Step	Notes
Check how ArrayLists work	https://www.tutorialspoint.com/java/java_arraylist_class.htm
Check how JDBC SQL prepared statements work	http://tutorials.jenkov.com/jdbc/preparedstatement.html
Make sure you have a database server installed in your computer	In the classroom computers, XAMPP should be installed
Download the JDBC driver for your database server	See instructions in a previous slide
Download the project/package jdbcExample from github	Create the project in your Eclipse IDE. Configure the properties of the project, adding the JDBC driver for your database server
In your database server, create a database with name "jdbcexample"	Import the SQL script "jdbcexample.sql" to create the cars table and some test data
Run the project (file JdbcExample.java) in Eclipse and see how the application works	Read the comments at the source code to understand how the program works. Refer also to the diagram in this presentation to visualize the program structure
Add some missing code in the program to get the "Add Car" functionality working	