Working with Databases and Java

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Introduction

- Introduction to relational databases
- Introduction to Structured Query Language (SQL)
- Entity Relationship modelling
- Working with databases and Java
- References
- Questions

What is a Database?

A database is an organised collection of data.

The computer program used to administrate and manage this data is called a database management system (DBMS), e.g. MySQL, Oracle DB, DB2, MS Access, Ingres, Sybase, etc.

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How the data is stored?

- Relational databases stores data in tables, where columns are called fields, and rows are called tuples.
- Columns are defined in conjunction with their "data type", e.g. char, varchar, integer, float, double, etc
- Also a column can be a "key" to access information in a table.

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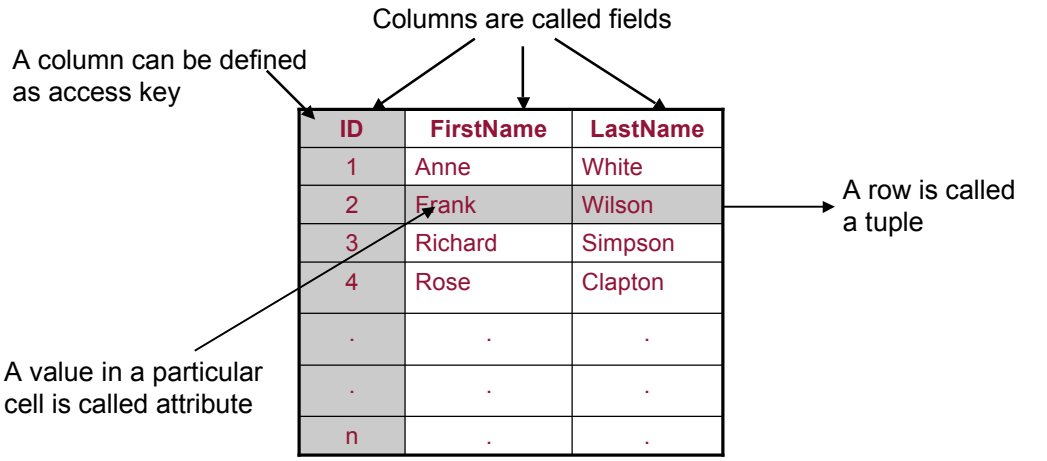
Database table example



ID	FirstName	LastName
1	Anne	White
2	Frank	Wilson
3	Richard	Simpson
4	Rose	Clapton
.	.	.
.	.	.
n	.	.

Table: authors

In turns data types here are: Integer, char, char

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Structured Query Language (SQL)

This is the most popular computer language used to **Create**, **Modify**, **Delete** and **Retrieve** data from a relational database management system

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SQL transactions

- Most frequent SQL data transaction are:
  - **Insert**, used to insert rows into a table
  - **Delete**, used to delete rows in a table
  - **Update**, used to modify values in a existing table
- Data retrieval
  - **Select**
    - **From**, used to indicate from which tables the data will be taken
    - **Where**, used to indicate rows to be retrieval
    - **Group by**, used to combine rows
    - **Order by**, used to indicate columns to sort result

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SQL Example

Following the table presented before:

- INSERT INTO **authors** (ID, FirstName, LastName) VALUES**(5, 'John, 'Sheen'**)
- UPDATE **authors** SET **FirstName = 'Martin'** WHERE **ID = 5**
- DELETE FROM **authors** WHERE **ID = 5**
- SELECT **FirstName, LastName** FROM **authors**

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Entity Relationship Modelling

- This is a set of rules used to interpret and specify the logic behind a problem when designing databases.
- E-R model is a *Conceptual Model* of the database, which is practice has many variations, but in general uses representation of mainly 4 constructs
- An E-R model can not be implement directly on a database, but from this a ***Physical*** model can be derived

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E-R Modelling Constructs

- **Entity**: a relevant object to be modelled, e.g. customers, products, employee
- **Attributes:** a characteristic of an entity, e.g. attributes from a ***customers*** could be: name, surname, and address
- **Identifiers:** a special attribute used to identify a specific instance of an entity, e.g.
  Identifier of a ***customer*** could be an ***customer ID***
  Identifier of a ***employee*** could be the ***employee code***
- **Relationship:** association between two entities, e.g.
  A ***customer*** places a ***customer order***
  A ***student*** enrols in a ***course***
  A ***course*** is taught by a ***faculty member***

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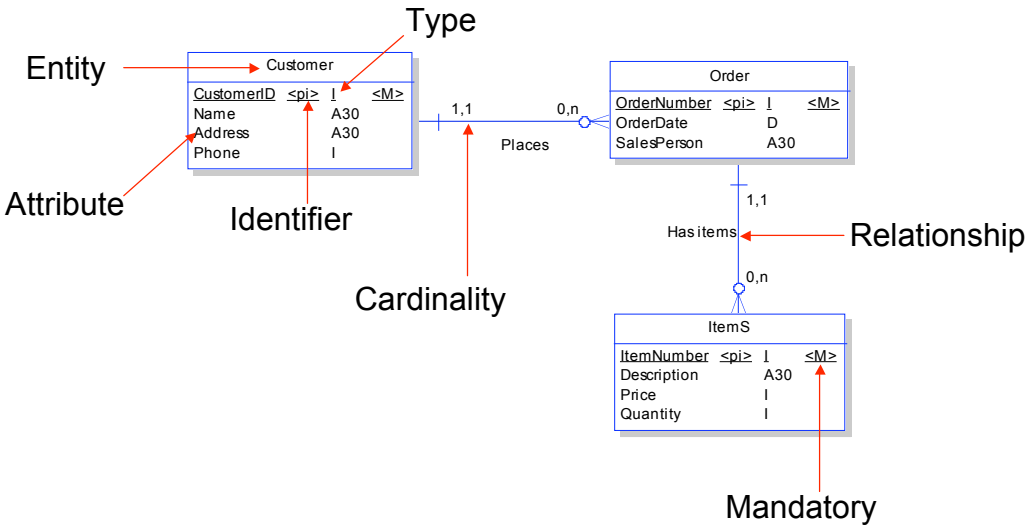
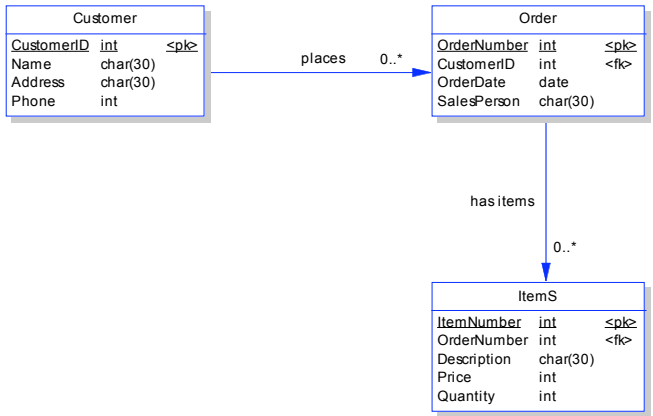
E-R Conceptual Diagram



E-R Physical Diagram

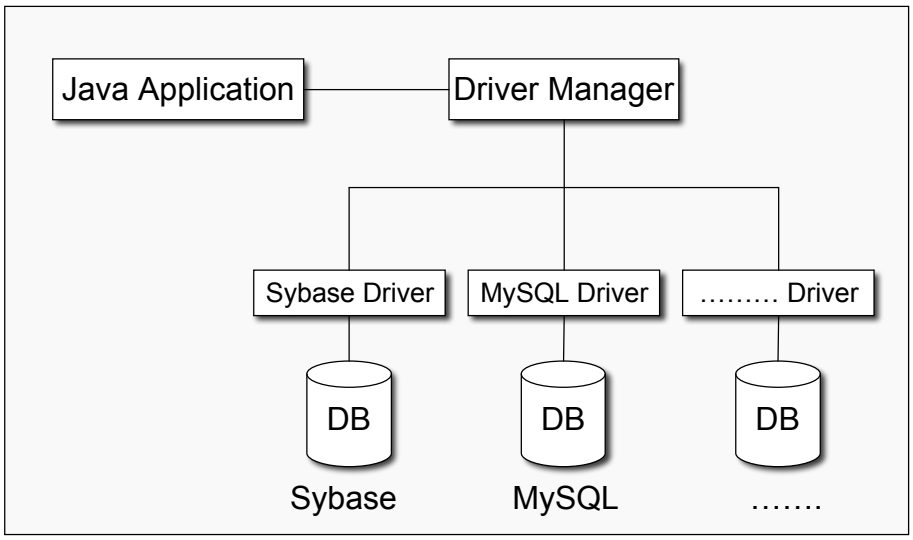


Java (JDBC) and Databases

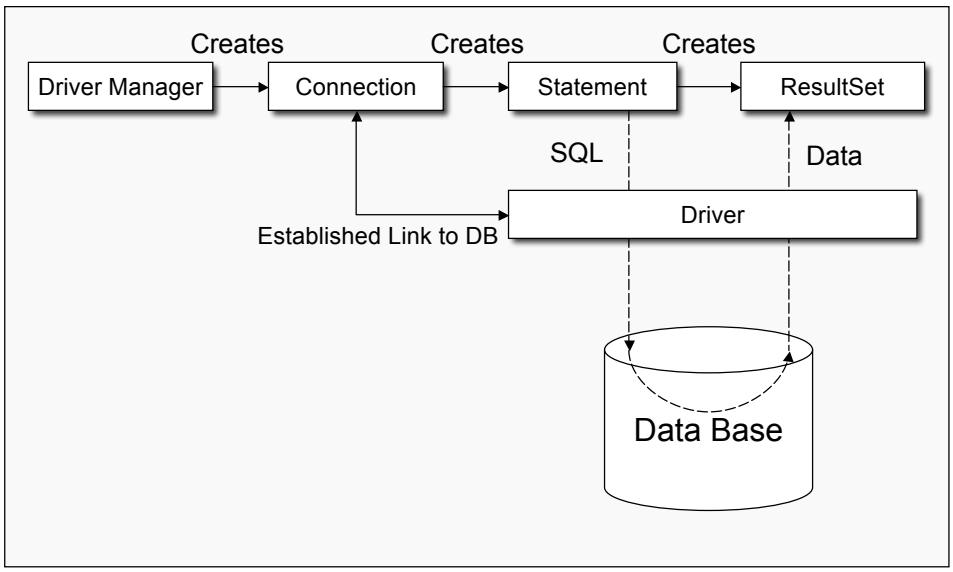
Java database technology relies on JDBC (Java Database Connectivity) libraries.

JDBC architecture is based on a collection of Java interfaces and classes that enables us to connect to data sources, to create, and to execute SQL statements.

Java and databases representation



Java and databases in detail



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Java steps for working with DB

- Import the necessary classes
- Load the `JDBC` driver
- Identify the data source
- Allocate a `Connection` object
- Allocate a `Statement` object
- Execute a query using the `Statement` object
- Retrieve data form from the returned `ResultSet` object
- Close the `ResultSet`
- Close the `Statement` object
- Close the `Connection` object

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DB transactions with Java

- Create table
- Insert data
- Update data
- Delete data
- Select data

Creating tables with Java

```
import java.sql.*;
public class Create {
public Create (String url, String user, String password) throws Exception {

try {
   Statement stmt;                                    // Register the JDBC driver for MySQL.
   Class.forName("com.mysql.jdbc.Driver");           // Get a connection to MySQL database
   Connection con = DriverManager.getConnection(url, user, password);
   stmt = con.createStatement();                      // Create statement

 try {
   stmt.executeUpdate("DROP table if exists " + table);
   } catch (Exception e) {
   System.out.print(e);
   // Create authors
   stmt.executeUpdate(   "CREATE TABLE authors (ID int NOT NULL, FirstName char(30) NOT NULL," +
                         "LatName char(30) NOT NULL)");
   stmt.close();          // Close statement
   con.close();           // Close connection
   }
 catch (Exception e) {
 System.out.print(e);
 }
}
}
```

Inserting data with Java

```
import java.sql.*;

public class Insert {
public Insert(String url, String user, String password) throws Exception {

try {

  Statement stmt;                                  // Register the JDBC driver for MySQL.
  Class.forName("com.mysql.jdbc.Driver");          // Get a connection to the database
  Connection con = DriverManager.getConnection(url, user, password);          //Get a Statement object
  stmt = con.createStatement();                    // Create statement

  // Insert data into a table
  stmt.executeUpdate( "INSERT INTO authors (ID, FirstName, LastName) VALUES(5, 'John, 'Sheen')" );
  stmt.close();          // Close statement
  con.close();           // Close connection
 }
 catch (Exception e) {
 System.out.print(e);
 }
}
}
```


Updating data with Java

```
import java.sql.*;

public class Update {
public Update(String url, String user, String password) throws Exception {

try {

  Statement stmt;                                  // Register the JDBC driver for MySQL.
  Class.forName("com.mysql.jdbc.Driver");          // Get a connection to the database
  Connection con = DriverManager.getConnection(url, user, password);          //Get a Statement object
  stmt = con.createStatement();                    // Create statement

  // Update data into a table
  stmt.executeUpdate( "UPDATE authors SET FirstName = 'Martin'  WHERE ID = 5" );
  stmt.close();          // Close statement
  con.close();           // Close connection
  }

catch (Exception e) {
 System.out.print(e);
 }
}
}
```

Deleting data with Java

```
import java.sql.*;

public class Delete {
public Delete(String url, String user, String password) throws Exception {

try {

   Statement stmt;                                    // Register the JDBC driver for MySQL.
   Class.forName("com.mysql.jdbc.Driver");            // Get a connection to the database
   Connection con = DriverManager.getConnection(url, user, password);          //Get a Statement
      object
   stmt = con.createStatement();                      // Create statement

   // Delete data into a table
   stmt.executeUpdate( "DELETE FROM authors WHERE ID = 5" );
   stmt.close();          // Close statement
   con.close();           // Close connection
   }

catch (Exception e) {
 System.out.print(e);
 }
}
}
```


Retrieving data with Java

```
import java.sql.*;

public class Select {
public Select(String url, String user, String password) throws Exception {

try {

   Statement stmt;                                    // Register the JDBC driver for MySQL.
   Class.forName("com.mysql.jdbc.Driver");            // Get a connection to the database
   Connection con = DriverManager.getConnection(url, user, password);

   // Create statement object
   Statement stmt = con.createStatement();

   // Select FirstName and LastName from the table authors
   ResultSet rs = stmt.executeQuery( "SELECT FirstName, LastName FROM authors" );   // "SELECT * FROM
      authors"

   ....
   // Print result set
  ....
   con.close();          // Close connection
   }

catch (Exception e) {
 System.out.print(e);
 }
}
}
```

Additional methods

The JDBC package also offers a series of additional methods that are very useful when working with databases

References

- Ivor Horton, “Beginning Java 2 – JDK 1.3.0 Edition”, Wrox Press, Chapter 19.
  http://java.sun.com/developer/Books/javaprogramming/begjava2/ch19.pdf
- George Reese, “Database Programming with JDBC and Java”, O’Reilly. pp 48-57

Questions?