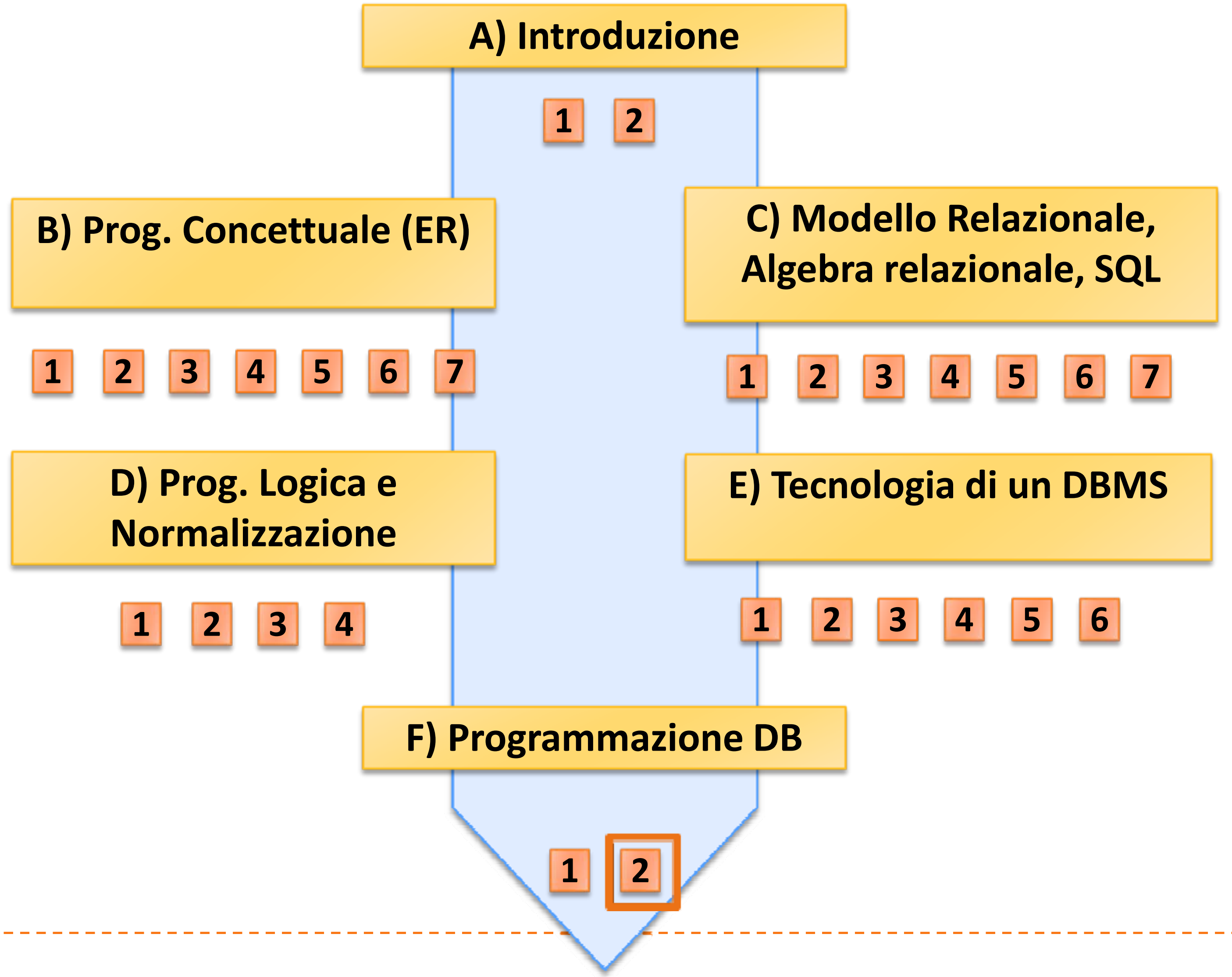
Basi di Dati

jdbc

Basi di Dati – Dove ci troviamo?


A) Introduzione
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B) Prog. Concettuale (ER)
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C) Modello Relazionale, Algebra relazionale, SQL
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D) Prog. Logica e Normalizzazione
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E) Tecnologia di un DBMS
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F) Programmazione DB
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Download

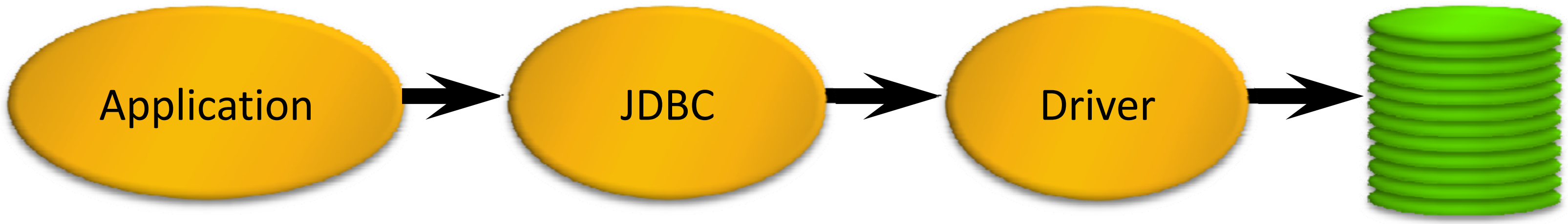
- Download PostgresSQL
  - http://www.postgresql.org/download/
- Download jdbc driver for PostgresSQL
  - http://jdbc.postgresql.org/download.html
- Create database
  - Esami
- Create
  - User ‘user’, Password ‘pw’

JDBC Goals

- SQL-Level
- 100% Pure Java
- Keep it simple
- High-performance
- Leverage existing database technology
  - why reinvent the wheel?
- Use strong, static typing wherever possible
- Use multiple methods to express multiple functionality

JDBC Architecture

- Java code calls JDBC library
- JDBC loads a *driver*
- Driver talks to a particular database
- Can have more than one driver -> more than one database
- Ideal: can change database engines <u>without changing any application code</u>



java.sql

- JDBC is implemented via classes in the java.sql package

DriverManager

- DriverManager tries all the drivers
- Uses the first one that works
- When a driver class is first loaded, it registers itself with the DriverManager
- Therefore, to register a driver, just load it!

Registering a Driver

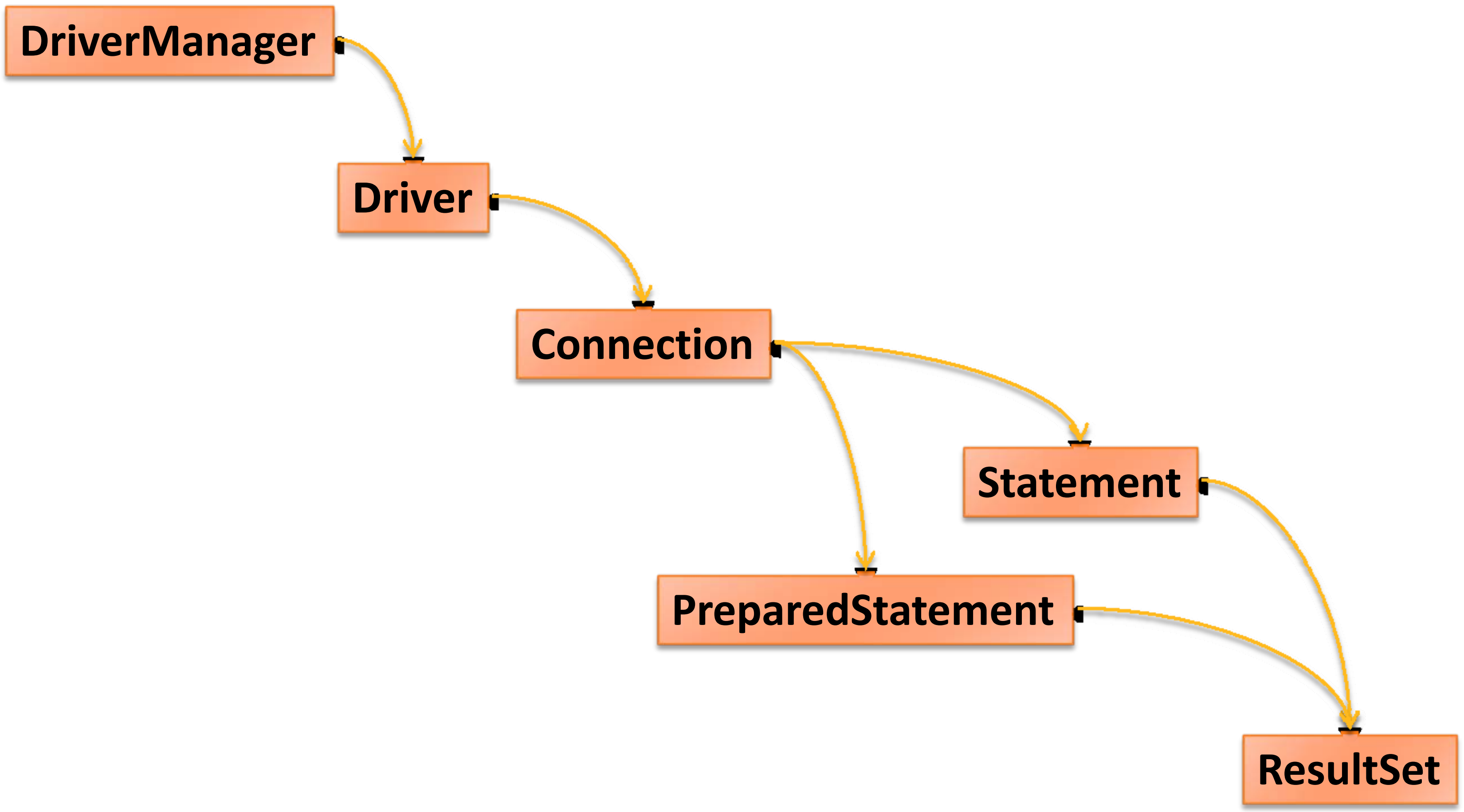
- Statically load driver

```
Class.forName(“org.postgresql.Driver”);
Connection c =
  DriverManager.getConnection(...);
```

JDBC Object Classes

- DriverManager
  - Loads, chooses drivers
- Driver
  - connects to actual database
- Connection
  - a series of SQL statements to and from the DB
- Statement/PreparedStatement
  - a single SQL statement
- ResultSet
  - the records returned from a Statement/PreparedStatement

JDBC Class Usage



JDBC URLs

`jdbc:`*`subprotocol`*`:`*`source`*

- each driver has its own subprotocol
- each subprotocol has its own syntax for the source

`jdbc:odbc:`*`DataSource`*
- e.g. `jdbc:odbc:Northwind`

`jdbc:mysql:`*`//host[:port]/database`*
- e.g. `jdbc:msql://foo.nowhere.com:4333/accounting`

`jdbc:postgresql:`*`//host:port/database`*
- e.g. `jdbc:postgresql://localhost:5432/esami`

DriverManager

```
Connection getConnection
  (String url, String user, String password)
```

- Connects to given JDBC URL with given user name and password
- Throws java.sql.SQLException
- Returns a Connection object

Connection

- A Connection represents a session with a specific database.
- Within the context of a Connection, SQL statements are executed and results are returned.
- Can have multiple connections to a database
  - NB: Some drivers don’t support serialized connections
  - Fortunately, most do (now)
- Also provides “metadata” - information about the database, tables, and fields
- Also methods to deal with transactions

Obtaining a Connection

```
try{
   Class.forName ("org.postgresql.Driver");  // Load the Driver
   Connection conn = DriverManager.getConnection
          ("jdbc:postgresql://localhost:5432/esami", "user", "pw" );
   Statement stmt = conn.createStatement();
   //...
   stmt.close();
   conn.close();
}
catch (ClassNotFoundException e) {
   e.printStackTrace();
}
catch (SQLException e) {
   e.printStackTrace();
}
```

Connection Methods

`Statement createStatement()`

- returns a new Statement object

`PreparedStatement prepareStatement(String sql)`

- returns a new PreparedStatement object

Statement

- A Statement object is used for executing a static SQL statement and obtaining the results produced by it.

Statement Methods

`ResultSet executeQuery(String)`

- Execute a SQL statement that returns a single ResultSet.

`int executeUpdate(String)`

- Execute a SQL INSERT, UPDATE or DELETE statement. Returns the number of rows changed.

`boolean execute(String)`

- Execute a SQL statement that may return multiple results.

Statement Methods

```
...
String sql =
  "CREATE TABLE STUDENTI
  (matr integer primary key, cognome varchar, nome varchar)";
stmt.executeUpdate(sql);

sql =
  "INSERT INTO STUDENTI VALUES(1, 'rossi', 'mario'),
        (2, 'bianchi', 'sergio')";
stmt.executeUpdate(sql);

sql =
  "SELECT * FROM STUDENTI";
ResultSet rs = stmt.executeQuery(sql);
...
```

ResultSet

- A ResultSet provides access to a table of data generated by executing a Statement.
- Only one ResultSet per Statement can be open at once.
- The table rows are retrieved in sequence.
- A ResultSet maintains a cursor pointing to its current row of data.
- The 'next' method moves the cursor to the next row.
  - you can’t rewind

ResultSet Methods

- boolean next()
  - activates the next row
  - the first call to next() activates the first row
  - returns false if there are no more rows
- void close()
  - disposes of the ResultSet
  - allows you to re-use the Statement that created it
  - automatically called by most Statement methods

ResultSet Methods

- *Type* get*Type*(int columnIndex)
  - returns the given field as the given type
  - fields indexed starting at 1 (not 0)
- *Type* get*Type*(String columnName)
  - same, but uses name of field
  - less efficient
- int findColumn(String columnName)
  - looks up column index given column name

ResultSet Methods

- String getString(int columnIndex)
- boolean getBoolean(int columnIndex)
- byte getByte(int columnIndex)
- short getShort(int columnIndex)
- int getInt(int columnIndex)
- long getLong(int columnIndex)
- float getFloat(int columnIndex)
- double getDouble(int columnIndex)
- Date getDate(int columnIndex)
- Time getTime(int columnIndex)
- Timestamp getTimestamp(int columnIndex)

ResultSet Methods

- String getString(String columnName)
- boolean getBoolean(String columnName)
- byte getByte(String columnName)
- short getShort(String columnName)
- int getInt(String columnName)
- long getLong(String columnName)
- float getFloat(String columnName)
- double getDouble(String columnName)
- Date getDate(String columnName)
- Time getTime(String columnName)
- Timestamp getTimestamp(String columnName)

ResultSet Methods

```
...
sql = "SELECT * FROM STUDENTI";
ResultSet rs = stmt.executeQuery(sql);

while (rs.next()) {
   int matr = rs.getInt("matr");
   String cognome = rs.getString("cognome");
   String nome = rs.getString("nome");
   System.out.println(matr+" "+cognome+" "+nome);
}
rs.close();
stmt.close();
...
```

Mapping Java Types to SQL Types

SQL type	**Java Type**
CHAR, VARCHAR, LONGVARCHAR	String
NUMERIC, DECIMAL	java.math.BigDecimal
BIT	boolean
TINYINT	byte
SMALLINT	short
INTEGER	int
BIGINT	long
REAL	float
FLOAT, DOUBLE	double
BINARY, VARBINARY, LONGVARBINARY	byte[]
DATE	java.sql.Date
TIME	java.sql.Time
TIMESTAMP	java.sql.Timestamp

PreparedStatement motivation

- Suppose we would like to run the query

```
SELECT * FROM STUDENTI
WHERE name=‘sergio’;
```

- But we would like to run this for all students (separately), not only ‘sergio’…
- Could we create a variable instead of ‘sergio’ which would get a different name every time??..

PreparedStatement

- PreparedStatement prepareStatement(String)
  - returns a new PreparedStatement object

- Prepared Statements are used for queries that are executed many times with possibly different contents.
- A PreparedStatement object includes the query and is prepared for execution (precompiled).
- Question marks can be inserted as variables.
  - setString(i, value)
  - setInt(i, value)

  } The i-th question mark is set to the given value.

PreparedStatement

```
...
sql = "SELECT * FROM STUDENTI WHERE nome = ? and matr > ?";
PreparedStatement preparedStatement = conn.prepareStatement(sql);
preparedStatement.setString(1, "sergio");
preparedStatement.setInt(2, 0);
rs = preparedStatement.executeQuery();
while (rs.next()) {
   int matr = rs.getInt(1);
   String cognome = rs.getString(2);
   String nome = rs.getString(3);
   System.out.println(matr+" "+cognome+" "+nome);
}
rs.close();
preparedStatement.close();
conn.close();
}
...
```

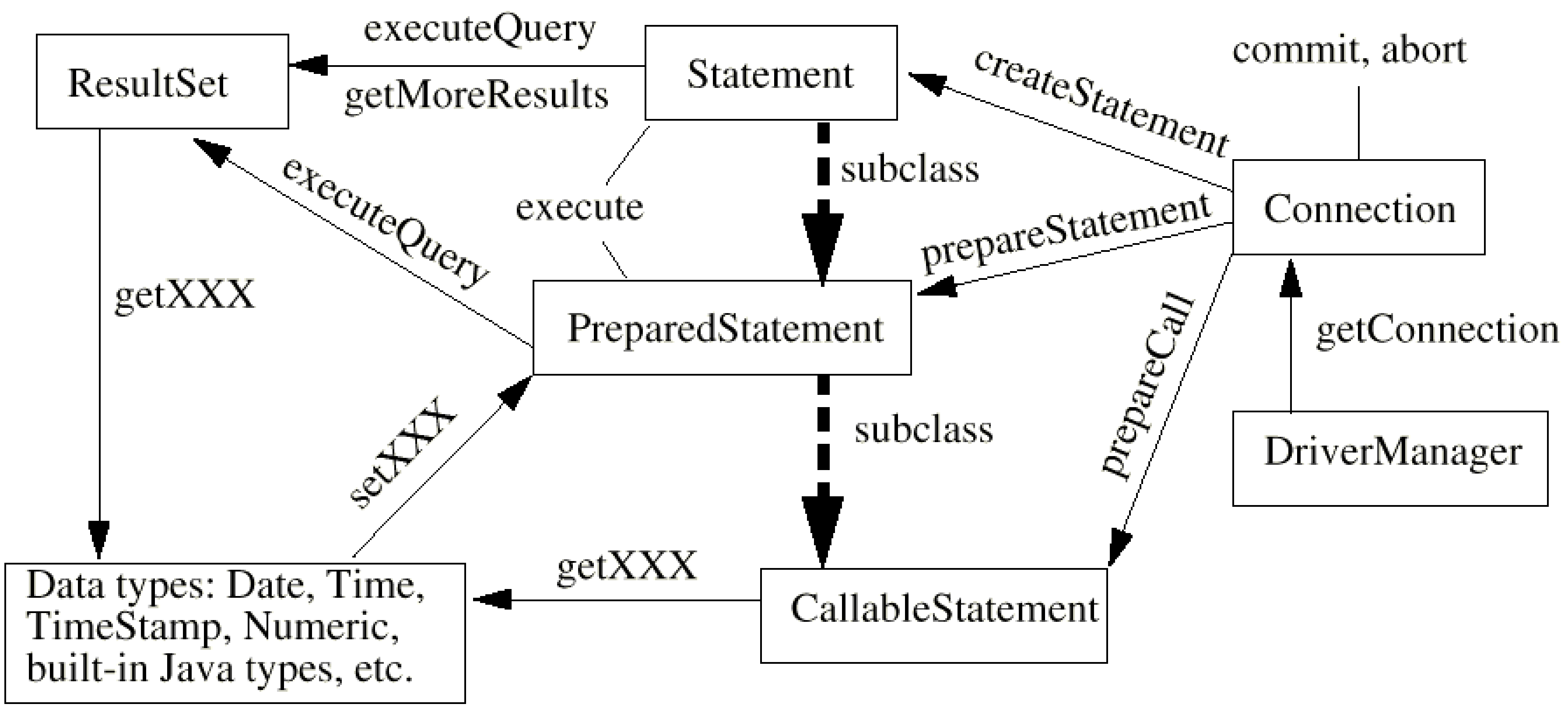
PreparedStatement

- Will this work?

```
PreparedStatement pstmt =
   con.prepareStatement(“select * from ?”);
pstmt.setString(1, "Sailors");
```

- No! We may put ? only instead of values

JDBC Class Diagram


ResultSet
executeQuery
getMoreResults
Statement
createStatement
commit, abort
Connection
execute
subclass
executeQuery
prepareStatement
getXXX
PreparedStatement
getConnection
prepareCall
DriverManager
setXXX
subclass
getXXX
Data types: Date, Time, TimeStamp, Numeric, built-in Java types, etc.
CallableStatement