JEE :: Introduction to JDBC

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Introduction to JDBC

The content in this presentation is aimed at teaching learners to:

- Identify the types of Drivers
- List the Pros and Cons of JDBC Drivers
- Establish connection using Type-4 Driver
- Retrive/Insert/Update the data in/form Database

Introduction to JDBC

The content in this presentation is aimed at teaching learners to:

- Use different type of Statements
- Use different type of ResultSet
- Perform Batch Operations
- Get the Meta data of the Database and ResultSet

Introduction to JDBC

The content in this presentation is aimed at teaching learners to:

- Understanding PreparedStatement
- Flow of PreparedStatement working
- Programming Interaction

Introduction to JDBC

JDBC (Java DataBase Connectivity)

- A sub set of CLI (Call Level Interface) specification.
- Can Create a platform-neutral interface between Java applications and Databases.
- Contains standard functions required to connect and perform SQL operation on the DB
- Communicates with ODBC , DB native libraries , java socket connection to DB

Introduction to JDBC

Why JDBC?

- To enable a java application to interact with aÂădatabase
- To provides a common base on which alternate interfaces and tools can be built

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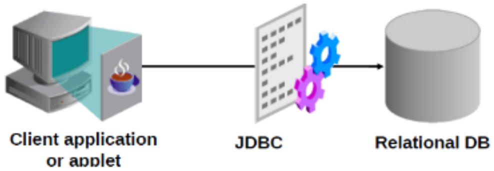
Why JDBC?



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Driver Types

There are four types of JDBC drivers available in java for connecting to Database

Type 1	JDBC-ODBC Bridge plus ODBC Driver
Type 2	Native API Partly Java Driver
Type 3	JDBC -Net pure Java Driver
Type 4	Native-Protocol Pure Java Driver

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Type 1 - JDBC-ODBC Bridge plus ODBC Driver

- Translates the JDBC method calls into ODBC function calls.
- Included with the JDK in the sun.jdbc.odbc.JdbcOdbcDriver class.
- Not recommended for production use.

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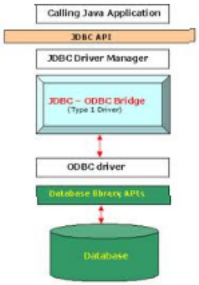

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Type 2 - Native API Partly Java Driver

- Partly written in Java and partly in the native code. So, called Native API Partly Java Driver.
- Consists of drivers that communicate with databases servers in the serverâĂŹs native protocol.
- Implemented in a combination of binary code and Java.

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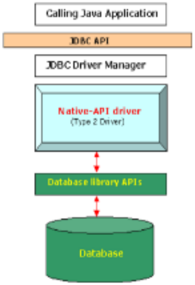
- Installation is easier than installing both the JDBC-ODBC bridge and an ODBC driver.



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Type 3 - JDBC -Net pure Java Driver

- Communicate with a database access server using HTTP or SHTTP protocol and works for both the Internet and the Intranet.
- Translates the network protocol into a vendor specific database protocol
- Served from the web server are the best solution for the applets.

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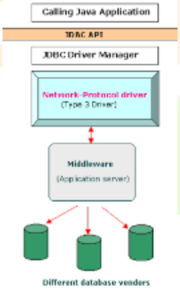
- Automatically installed on the userâĂŹs machine in a transparent manner.



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Type 4 - Native-Protocol Pure Java Driver

- A pure Java library that translates JDBC calls directly to a database-specific protocol.
- Written completely in Java and is hence platform independent.
- Installed inside the Java VirtualÂăMachine of the client.

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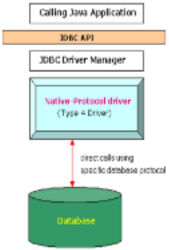
- Does not have the overhead ofÂăconversion of calls into ODBC or database API calls.
- Efficient for Intranet applications.



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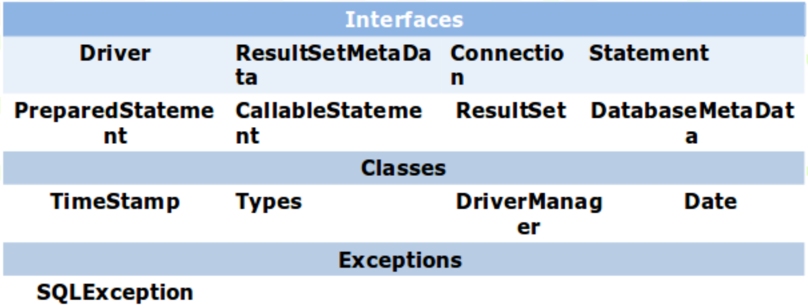
JDBC Specifications

Consists of the following interfaces and classes:



Interfaces			
Driver	ResultSetMetaData	Connection	Statement
PreparedStatement	CallableStatement	ResultSet	DatabaseMetaData
Classes			
TimeStamp	Types	DriverManager	Date
Exceptions			
SQLException			

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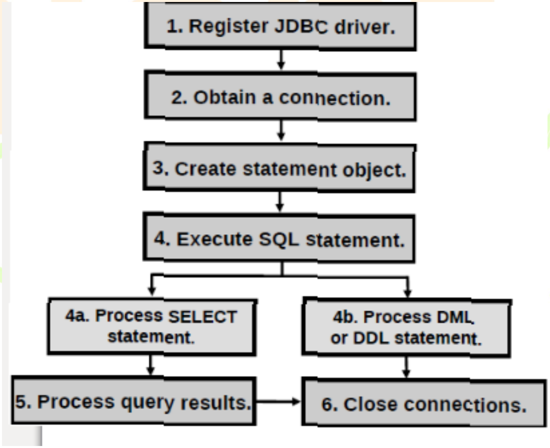
Steps to establish a connection



1. Register JDBC driver.
2. Obtain a connection.
3. Create statement object.
4. Execute SQL statement.
4a. Process SELECT statement.
4b. Process DML or DDL statement.
5. Process query results.
6. Close connections.

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Steps to establish a connection

Step 1 - Load/Register JDBC Drivers

Before the driver manager can activate a driver, the driver must be registered manually by loading its class using the "Class" class **Example**

- JDBC-ODBC Bridge driver

  Class.forName("sun.jdbc.odbc.JdbcOdbcDriver");

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- Native-Protocol Pure Java Driver

  Class.forName("sun.jdbc.odbc.JdbcOdbcDriver");

- Oracle

  Class.forName("oracle.jdbc.driver.OracleDriver");

- MySql

  Class.forName("com.mysql.jdbc.Driver");

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Steps to establish a connection

Step 2 - Establish Connection using Driver Manager

- Select the database drivers
- Create a new database connection by calling the static method getConnection() of the DriverManager class

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- This method takes
  - the database URL
  - a user name // Optional
  - password // Optional

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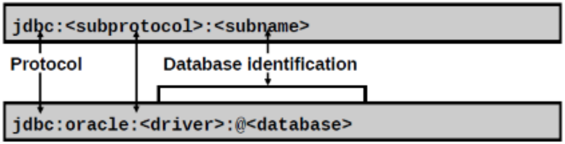
JDBC URLs

- JDBC uses a URl-like string. The URL identifies.
- Database connection details, vary depending on the driver used.


jdbc:<subprotocol>:<subname>
Protocol
Database identification
jdbc:oracle:<driver>:@<database>

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- jdbc:oracle:thin:@localhost:1521:orcl
  –For Oracle SE
- jdbc:oracle:thin:@localhost:1521:XE
  –For Oracle XE
- jdbc:mysql://localhost:3306/dbname
  –For MySql

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Steps to establish a connection

Step 3 - Create the Statement

Create one of the following Statement object to send SQL statement to the database using Connection Object (con).

Statement executes a static SQL statement

```
Statement stmt= con.createStatement();
```

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- PreparedStatement represents a precompiled SQL statement

  PreparedStatement ps=con.prepareStatement(
  query);

- CallableStatement executes SQL stored procedures

  CallableStatement cs=con.prepareCall(query);

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Steps to establish a connection

Step 4 - Execute the Statement

The Statement interface provides three methods to execute SQL statements:

- Use executeQuery(String sql)for SELECT statements
  - Returns a ResultSet object for processing rows
- Use executeUpdate(String sql) for DML or DDL
  - Returns an int represents the row count for SQL Data Manipulation Language

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- Use execute(String) for any SQL statement.
    - Returns a boolean value, such that
        - if the first result is aÂăResultSetÂăobject returns true
        - if it is an update count or there are no results returns false

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Steps to establish a connection

Step 4a - Process SELECT Statement

Statement will returns the results of a query in a ResultSet object.

- Maintains a cursor pointing to its current row of data
- Provides following methods to retrieve column values
  - Use the next() method in loop to iterate through rows

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- Use getXXX() methods to obtain column values by column position in query, or column name.

```
ResultSet rs=stmt.executeQuery("SELECT"+ "ename, empno
    FROM emp");
while(rs.next())
{
String s= rs.getString("ename");
int n = rs.getInt (" empno");
System.out.println(s+ "–" + n);
}
```

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Steps to establish a connection

Step 4b - Submitting DDL / DML Statement

DDL Statement Create a table in a database from a JDBC program using the following lines of code:

```
String creatTable = “CREATE TABLE emp”+“(
    ename VARCHAR2(32),empno NUMBER)”;
stmt.executeUpdate(createTable);
```

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DML Statement Insert values into a table in from a JDBC program using the following lines of code:

```
stmt.executeUpdate(“INSERT INTO emp”+ “
    VALUES(‘Ram’, ‘101’)”);
```

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Steps to establish a connection

Step 5 - Closing Connection

- Explicitly close a Connection, Statement, and ResultSet object to release resources that are no longer needed.
- Protect the database from accidental changes.

```
rs.close() ;
stmt.close();
con.close();
```

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Example 1 - An Example to create a Table in Database (DDL Statement)

```
void createDB() {
    try{
        String driver="oracle.jdbc.driver.OracleDriver";
        String url="jdbc:oracle:thin:@localhost:1521:orcl";
        Class.forName(driver);
        Connection con = DriverManager.getConnection(url,"
    scott","tiger");
```

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```
        Statement stmt = con.createStatement();
        // Create the table Account Holder
        String query="CREATE TABLE AccountHolder(AcctNo
    INTEGER, Name VARCHAR(50), Address INTEGER
    VARCHAR(50), Balance FLOAT)";
        stmt.executeUpdate(query);
        // close the connection
        con.close();
    }
    catch(Exception ex) {
        System.out.println(ex.toString());
    }
}
```

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Example 2 - An Example to insert data into a Table in Database (DML Statement)

```
void createDB() {
    try {
        String driver="oracle.jdbc.driver.OracleDriver";
        String url="jdbc:oracle:thin:@localhost:1521:orcl";
        Class.forName(driver);
        Connection con = DriverManager.getConnection(url,"
    scott","tiger");
        Statement stmt = con.createStatement();
```

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```
        // Create the table Account Holder
        String query= "INSERT INTO AccountHolder VALUES
     (10015,'Asish','Commercial Street,Bangalore',1500000)";
        stmt.executeUpdate(query);
        // close the connection
        con.close();
     }
     catch(Exception ex) {
        System.out.println(ex.toString());
     }
  }
```

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Example 3 - An Example to retirve data from Table in Database (SELECT Statement)

```
void createDB() {
    try {
        String driver="oracle.jdbc.driver.OracleDriver";
        String url="jdbc:oracle:thin:@localhost:1521:orcl";
        Class.forName(driver);
        Connection con = DriverManager.getConnection(url,"
    scott","tiger");
        Statement stmt = con.createStatement();
        // Select values into the Account Holder table
        ResultSet rs = stmt.executeQuery("SELECT * FROM
    ACCOUNTHOLDER");
```

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```
        while(rs.next()) {
            System.out.println(" Acc No = "+rs.getString("
    AcctNo"));
            System.out.println(" Name = "+rs.getString("Name"))
    ;
            System.out.println(" Address = "+rs.getString("
    Address"));
            System.out.println(" Balance = "+rs.getString("
    Balance"));
        }
        rs.close() ;  // close the Result Set
        stmt.close();  // close the Statement
        con.close();  // close the connection
    }
    catch(Exception ex) {
        System.out.println(ex.toString());
    }
}
```

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Executing SQL Statements

- To populate the database, update or delete the existing database information.
- Uses java.sql package
  - Statement Interface
  - PreparedStatement Interface
  - CallableStatement Interface

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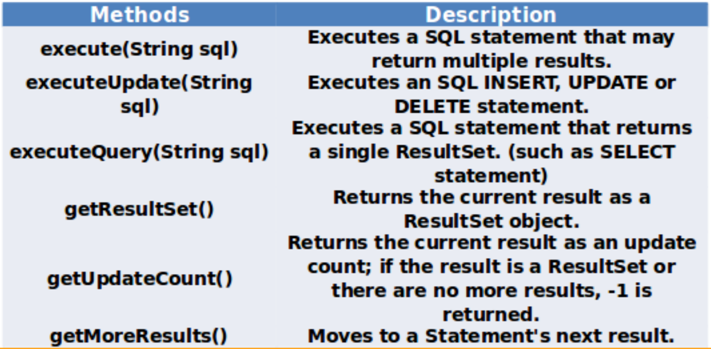
Statement Interface

Call createStatement() method of the Connection interface to create Statement Object



Methods	Description
execute(String sql)	Executes a SQL statement that may return multiple results.
executeUpdate(String sql)	Executes an SQL INSERT, UPDATE or DELETE statement.
executeQuery(String sql)	Executes a SQL statement that returns a single ResultSet. (such as SELECT statement)
getResultSet()	Returns the current result as a ResultSet object.
getUpdateCount()	Returns the current result as an update count; if the result is a ResultSet or there are no more results, -1 is returned.
getMoreResults()	Moves to a Statement's next result.

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PreparedStatement Interface

- Extends the Statement interface
- Call prepareStatement() method of the Connection interface to create PreparedStatement Object
- Holds pre-compiled SQL statements
- Used to execute the SQL statement multiple times
- Enables us to retrieve, edit, or delete multiple records at a time.

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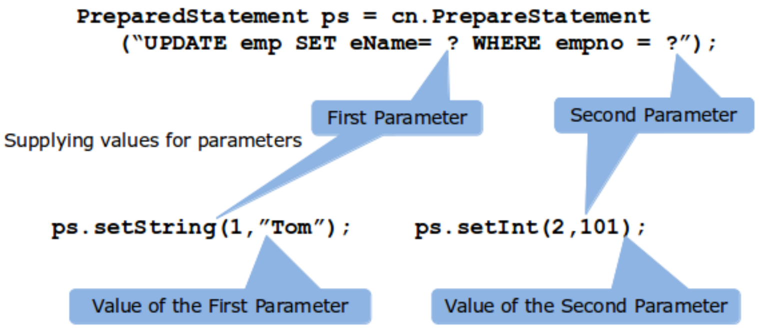
PreparedStatement Interface



```
PreparedStatement ps = cn.PrepareStatement
   ("UPDATE emp SET eName= ? WHERE empno = ?");
```

Supplying values for parameters

```
ps.setString(1,"Tom");     ps.setInt(2,101);
```

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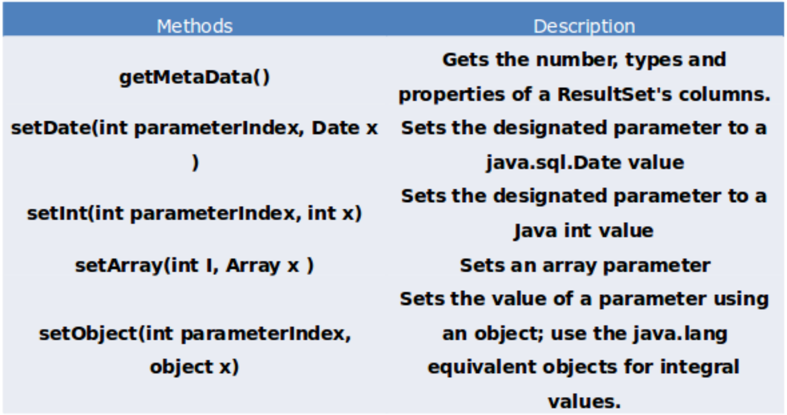
PreparedStatement Interface



Methods	Description
getMetaData()	**Gets the number, types and properties of a ResultSet's columns.**
setDate(int parameterIndex, Date x)	**Sets the designated parameter to a java.sql.Date value**
setInt(int parameterIndex, int x)	**Sets the designated parameter to a Java int value**
setArray(int I, Array x)	**Sets an array parameter**
setObject(int parameterIndex, object x)	**Sets the value of a parameter using an object; use the java.lang equivalent objects for integral values.**

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PreparedStatement Example

```
Statement stmt = con.createStatement();
String query="UPDATE emp SET eName =? WHERE empno =?
    ";
PreparedStatement ps=con.prepareStatement(query);
//Here 1 and 2 are the sequential number of values to be set.
ps.setString(1, "Tom");
ps.setInt(2,3);
ps.executeUpdate();
ResultSet rs = stmt.executeQuery("SELECT * FROM emp");
```

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CallableStatement Interface

- Extends the PreparedStatement interface
- Have a call to a stored procedure
- May take IN parameters, OUT Parameters, INOUT parameters.
- Calling a stored procedure

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- with no parameters

  {call procedure_name}

- Have a call to a stored procedure

  { call procedure_name [(?, ?, ?)]}

- May take IN parameters, OUT Parameters, INOUT parameters.

  {? = call procedure_name [(?, ?, ?,)]}

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CallableStatement Interface

- To create a CallableStatement object.

  CallableStatement cstmt=cn.prepareCall(âĂIJ{call
      procedure_name}âĂİ);

- Passing IN parameters is done using setXXX() methods
- Each OUT parameter must be registered in a log file using registerOutParameter() method
- getXXX() functions OUT parameters are read into application

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CallableStatement Interface

CallableStatement ct=cn.prepareCall(âĂIJ{call getTestData (?,?.?)}âĂİ);
ct.registerOutParameter(1,java.sql.Types.TINYINT); *// OUT*
ct.setFloat(2,1.34);*// IN*
ct.registerOutParameter(3,java.sql.Types.VARCHAR); *// INOUT*
ct.setString(3, âĂIJImranâĂİ); *// INOUT*
ct.executeQuery();
byte x=ct.getBytes(1); *// Getting IN*
String s=ct.getString(3); *// Getting INOUT*

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JDBC Exception Handling

Common exception classes used in the JDBC API:

- java.sql.SQLException
  - Database access error or other errors
- java.sql.BatchUpdateException
  - Subclass ofÂăSQLExceptionÂă
  - An error occurs during a batch update operation

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- java.sql.DataTruncation
  - A data values is unexpectedly truncated for some reasons
- java.sql.SQLWarning
  - database access warnings Âămay be retrieved from Connection, Statement and ResultSetÂăobjects

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Batch Update Facility

- What is a batch update?
  - A set of multiple update statements, submitted to the database as a unit.
- Why?
  - It is more efficient to send multiple update.JDBC 2.0 API provides this batch update facility.

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- How?

  addBatch() of Statement, to add a update statement to Batch.

  executeBatch() of Statement, submits a batch of commands to the database for execution.

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Sample Batch Operation

```
Statement stmt = con.createStatement();
stmt.addBatch("INSERT INTO COFFEES VALUES('Amaretto',
    49, 9.99, 0, 0)");
stmt.addBatch("INSERT INTO COFFEES VALUES('Hazelnut',
    49, 9.99, 0, 0)");
stmt.addBatch("INSERT INTO COFFEES VALUES('
    Amaretto_decaf', 49, 10.99, 0, 0)");
stmt.addBatch("INSERT INTO COFFEES VALUES('
    Hazelnut_decaf', 49, 10.99, 0, 0)");
int [] updateCounts = stmt.executeBatch();
```

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Meta data

- Data about a data is called metadata.
- Provides information about the Database/ResultSet.

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- Two Interfaces provide following information:

DatabasesMetaData	Comprehensive information about the database as a whole.
ResultSetMetaData	Information about the types and properties of the columns in a ResultSet object.

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DatabaseMetaData

```
DatabaseMetaData dbmd=
con.getMetaData();
```

Method's Description:

getDatabaseProductName() Returns the name of the database product.

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getDatabaseProductVersion() Returns the version of the database product.

getUserName() Returns our user name as known tothe database.

getDriverName() Returns the name of the JDBC driver.

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getDriverVersion() Returns the version of the JDBC driver.

getImportedKeys **(String catalog, String schema, String table)** Gets a description of the primary key columns that are referenced by a table's foreign key columns (the primary keys imported by a table).

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ResultSetMetaData

ResultSetMetaData rsmd= rs.getMetaData();

Method's Description:

getColumnCount() Returns the number ofc olumns in this ResultSet.

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getColumnName(int columnName) Gets a column's name.

getCoulmnType(int columnName) Retrieves a column's SQL type.

getTableName(int columnName) Gets a column's table name.

isCurrency(int columnName) Indicates whether the column is a cash value.

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Scrollable ResultSets

- ResultSets have been used in a sequential manner using ResultSet.next()

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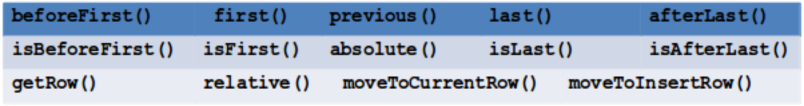
- A new method in JDBC allowed to create scrollable and /or update the ResultSets.

  createStatement(**int** resultSetType,**int**
      resultSetConcurrency)



beforeFirst()	first()	previous()	last()	afterLast()
isBeforeFirst()	isFirst()	absolute()	isLast()	isAfterLast()
getRow()	relative()	moveToCurrentRow()	moveToInsertRow()	

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Scrollable ResultSets

ResultSet Types

- TYPE_FORWARD_ONLY
  - This is the default type which allows only forward movement and columns can be generally read only once.
- TYPE_SCROLL_INSENSITIVE
  - Cursor is allowed to move backwards, forwards, and at random
  - Changes are invisible which indicates that the ResultSet is insensitive.

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- TYPE_SCROLL_INSENSITIVE
  - Move backwards, forwards, and at random
  - Allows a dynamic view of data and changes are visible which also means, the ResultSet is sensitive

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