

Core Java

Agenda

- Q & A
- JDBC
 - Calling Stored procedure
 - Transactions
 - ResultSet types/concurrency
- Reflection
- Annotations

JDBC

- JDBC is a specification -- Interfaces and Helper classes.
- This specs is implemented by RDBMS drivers e.g. Oracle driver, MySQL driver, ...

PreparedStatement Programming steps

- step 1: Add JDBC driver into the project classpath.
- step 2: Load and register Driver class (One-time).
- step 3: Create the connection using DriverManager.
- step 4: Create the PreparedStatement with SQL (parameterized) query.
- step 5: Execute the query (executeUpdate() or executeQuery()) and process the result.
- step 6: Close statement & connection.

DAO class

- In enterprise applications there are multiple tables and frequent data transfer from database is needed.
- Instead of writing JDBC code in multiple Java files of the application (as and when needed), it is good practice to keep all the JDBC code in a centralized place -- in a single application layer.

- DAO (Data Access Object) class is standard way to implement all CRUD operations specific to a table. It is advised to create different DAO for different table.
- DAO classes makes application more readable/maintainable.

Call Stored Procedure using JDBC (without OUT parameters)

- Stored Procedure - Get all quotes along with user name.

```
DELIMITER //
```

```
CREATE PROCEDURE sp_getquotes(IN p_userid INT)
```

```
BEGIN
```

```
    SELECT q.quote, q.author, q.created_at, u.first_name, u.last_name FROM quotes q INNER JOIN users u ON  
    q.user_id = u.id WHERE u.id=p_userid;
```

```
END;
```

```
//
```

```
DELIMITER ;
```

```
CALL sp_getquotes(1);
```

- JDBC use CallableStatement interface to invoke the stored procedures.
- CallableStatement interface is extended from PreparedStatement interface.
- Steps to call Stored procedure are same as PreparedStatement.
 - Create connection.
 - Create CallableStatement using con.prepareCall("CALL ...").
 - Set IN parameters using stmt.setXYZ(...);
 - Execute the procedure using stmt.executeQuery() or stmt.executeUpdate().

- Close statement & connection.
- To invoke stored procedure, in general `stmt.execute()` is called. This method returns true, if it is returning `ResultSet` (i.e. multi-row result). Otherwise it returns false, if it is returning update/affected rows count.

```
boolean isResultSet = stmt.execute();
if(isResultSet) {
    ResultSet rs = stmt.getResultSet();
    // process the ResultSet
}
else {
    int count = stmt.getUpdateCount();
    // process the count
}
```

Call Stored Procedure using JDBC (with OUT parameters)

- Stored Procedure - Get quote and author of given quote id -- using OUT parameters.

```
DELIMITER //

CREATE PROCEDURE sp_getquote_details(IN p_id INT, OUT p_quote VARCHAR(500), OUT p_author VARCHAR(40))
BEGIN
    SELECT quote INTO p_quote FROM quotes WHERE id=p_id;
    SELECT author INTO p_author FROM quotes WHERE id=p_id;
END;
//

DELIMITER ;
```

```
CALL sp_getquote_details(1, @quote, @author);  
SELECT @quote, @author;
```

- Steps to call Stored procedure with out params.
 - Create connection.
 - Create CallableStatement using con.prepareCall("CALL ...").
 - Set IN parameters using stmt.setXYZ(...) and register out parameters using stmt.registerOutParam(...).
 - Execute the procedure using stmt.execute().
 - Get values of out params using stmt.getXYZ(paramNumber).
 - Close statement & connection.

Transaction Management

- RDBMS Transactions
 - Transaction is set of DML operations to be executed as a single unit. Either all queries in tx should be successful or all should be discarded.
 - The transactions must be atomic. They should never be partial.

```
CREATE TABLE accounts(id INT, type CHAR(30), balance DOUBLE);  
INSERT INTO accounts VALUES (1, 'Saving', 30000.00);  
INSERT INTO accounts VALUES (2, 'Saving', 2000.00);  
INSERT INTO accounts VALUES (3, 'Saving', 10000.00);  
  
SELECT * FROM accounts;  
  
START TRANSACTION;  
--SET @@autocommit=0;  
  
UPDATE accounts SET balance=balance-3000 WHERE id=1;  
UPDATE accounts SET balance=balance+3000 WHERE id=2;  
  
SELECT * FROM accounts;
```

```
COMMIT;  
-- OR  
ROLLBACK;
```

- JDBC transactions (Logical code)

```
try(Connection con = DriverManager.getConnection(DB_URL, DB_USER, DB_PASSWORD)) {  
    con.setAutoCommit(false); // start transaction  
    String sql = "UPDATE accounts SET balance=balance+? WHERE id=?";  
    try(PreparedStatement stmt = con.prepareStatement(sql)) {  
        stmt.setDouble(1, -3000.0); // amount=3000.0  
        stmt.setInt(2, 1); // accid = 1  
        cnt1 = stmt.executeUpdate();  
        stmt.setDouble(1, +3000.0); // amount=3000.0  
        stmt.setInt(2, 2); // accid = 2  
        cnt2 = stmt.executeUpdate();  
        if(cnt1 == 0 || cnt2 == 0)  
            throw new RuntimeException("Account Not Found");  
    }  
    con.commit(); // commit transaction  
}  
catch(Exception e) {  
    e.printStackTrace();  
    con.rollback(); // rollback transaction  
}
```

ResultSet

- ResultSet types
 - TYPE_FORWARD_ONLY -- default type
 - next() -- fetch the next row from the db and return true. If no row is available, return false.

```
while(rs.next()) {  
    // ...  
}
```

- TYPE_SCROLL_INSENSITIVE

- next() -- fetch the next row from the db and return true. If no row is available, return false.
- previous() -- fetch the previous row from the db and return true. If no row is available, return false.
- absolute(rownum) -- fetch the row with given row number and return true. If no row is available (of that number), return false.
- relative(rownum) -- fetch the row of next rownum from current position and return true. If no row is available (of that number), return false.
- first(), last() -- fetch the first/last row from db.
- beforeFirst(), afterLast() -- set ResultSet to respective positions.
- INSENSITIVE -- After taking ResultSet if any changes are done in database, those will NOT be available/accessible using ResultSet object. Such ResultSet is INSENSITIVE to the changes (done externally).

- TYPE_SCROLL_SENSITIVE

- SCROLL -- same as above.
- SENSITIVE -- After taking ResultSet if any changes are done in database, those will be available/accessible using ResultSet object. Such ResultSet is SENSITIVE to the changes (done externally).

- ResultSet concurrency

- CONCUR_READ_ONLY -- Using this ResultSet one can only read from db (not DML operations). This is default concurrency.
- CONCUR_UPDATABLE -- Using this ResultSet one can read from db as well as perform INSERT, UPDATE and DELETE operations on database.

```
String sql = "SELECT roll, name, marks FROM students";  
stmt = con.prepareStatement(sql, ResultSet.TYPE_SCROLL_SENSITIVE, ResultSet.CONCUR_UPDATABLE);  
rs = stmt.executeQuery();
```

```
rs.absolute(2); // moves the cursor to the 2nd row of rs  
rs.updateString("name", "Bill"); // updates the 'name' column of row 2 to be Bill
```

```
rs.updateDouble("marks", 76.32); // updates the 'marks' column of row 2 to be 76.32
rs.updateRow(); // updates the row in the database
```

```
rs.moveToInsertRow(); // moves cursor to the insert row -- is a blank row
rs.updateInt(1, 9); // updates the 1st column (roll) to be 9
rs.updateString(2, "AINSWORTH"); // updates the 2nd column (name) of to be AINSWORTH
rs.updateDouble(3, 76.23); // updates the 3rd column (marks) to true 76.23
rs.insertRow(); // inserts the row in the database
rs.moveToCurrentRow();
```

```
rs.absolute(2); // moves the cursor to the 2nd row of rs
rs.deleteRow(); // deletes the current row from the db
```

Reflection

- .class = Byte-code + Meta-data + Constant pool + ...
- When class is loaded into JVM all the metadata is stored in the object of java.lang.Class (heap area).
- This metadata includes class name, super class, super interfaces, fields (field name, field type, access modifier, flags), methods (method name, method return type, access modifier, flags, method arguments, ...), constructors (access modifier, flags, ctor arguments, ...), annotations (on class, fields, methods, ...).

Reflection applications

- Inspect the metadata (like javap)
- Build IDE/tools (Intellisense)
- Dynamically creating objects and invoking methods
- Access the private members of the class

Get the java.lang.Class object

- way 1: When you have class-name as a String (taken from user or in properties file)

```
Class<?> c = Class.forName(className);
```

- way 2: When the class is in project/classpath.

```
Class<?> c = ClassName.class;
```

- way 3: When you have object of the class.

```
Class<?> c = obj.getClass();
```

Access metadata in java.lang.Class

- Name of the class

```
String name = c.getName();
```

- Super class of the class

```
Class<?> supcls = c.getSuperclass();
```

- Super interfaces of the class


```
Class<?> supintf[] = c.getInterfaces();
```

- Fields of the class

```
Field[] fields = c.getFields(); // all fields accessible (of class & its super class)
```

```
Field[] fields = c.getDeclaredFields(); // all fields in the class
```

- Methods of the class

```
Method[] methods = c.getMethods(); // all methods accessible (of class & its super class)
```

```
Method[] methods = c.getDeclaredMethods(); // all methods in the class
```

- Constructors of the class

```
Constructor[] ctors = c.getConstructors(); // all ctors accessible (of class & its super class)
```

```
Constructor[] ctors = c.getDeclaredConstructor(); // all ctors in the class
```

Invoking method dynamically

```
```Java
public class Middleware {
 public static Object invoke(String className, String methodName, Class[] methodParamTypes, Object[]
methodArgs) throws Exception {
 // load the given class
 Class c = Class.forName(className);
 // create object of that class
 Object obj = c.newInstance(); // also invokes param-less constructor
 // find the desired method
 Method method = c.getDeclaredMethod(methodName, methodParamTypes);
 // allow to access the method (irrespective of its access specifier)
 method.setAccessible(true);
 // invoke the method on the created object with given args & collect the result
 Object result = method.invoke(obj, methodArgs);
 // return the results
 return result;
 }
}
```

```Java
// invoking method statically
Date d = new Date();
String result = d.toString();
```

```Java
// invoking method dyanmically
String result = Middleware.invoke("java.util.Date", "toString", null, null);
```
```

Reflection Tutorial

- https://youtu.be/lAoNJ_7LD44
- <https://youtu.be/UVWdtk5ibK8>

Annotations

- Added in Java 5.0.
- Annotation is a way to associate metadata with the class and/or its members.
- Annotation applications
 - Information to the compiler
 - Compile-time/Deploy-time processing
 - Runtime processing
- Annotation Types
 - Marker Annotation: Annotation is not having any attributes.
 - @Override, @Deprecated, @FunctionalInterface ...
 - Single value Annotation: Annotation is having single attribute -- usually it is "value".
 - @SuppressWarnings("deprecation"), ...
 - Multi value Annotation: Annotation is having multiple attribute
 - @RequestMapping(method = "GET", value = "/books"), ...

Pre-defined Annotations

- @Override
 - Ask compiler to check if corresponding method (with same signature) is present in super class.
 - If not present, raise compiler error.
- @FunctionalInterface
 - Ask compiler to check if interface contains single abstract method.
 - If zero or multiple abstract methods, raise compiler error.
- @Deprecated
 - Inform compiler to give a warning when the deprecated type/member is used.
- @SuppressWarnings
 - Inform compiler not to give certain warnings: e.g. deprecation, rawtypes, unchecked, serial, unused
 - @SuppressWarnings("deprecation")
 - @SuppressWarnings({"rawtypes", "unchecked"})
 - @SuppressWarnings("serial")
 - @SuppressWarnings("unused")

Meta-Annotations

- Annotations that apply to other annotations are called meta-annotations.
- Meta-annotation types defined in `java.lang.annotation` package.

@Retention

- `RetentionPolicy.SOURCE`
 - Annotation is available only in source code and discarded by the compiler (like comments).
 - Not added into .class file.
 - Used to give information to the compiler.
 - e.g. `@Override`, ...
- `RetentionPolicy.CLASS`
 - Annotation is compiled and added into .class file.
 - Discarded while class loading and not loaded into JVM memory.
 - Used for utilities that process .class files.
 - e.g. Obfuscation utilities can be informed not to change the name of certain class/member using `@SerializedName`, ...
- `RetentionPolicy.RUNTIME`
 - Annotation is compiled and added into .class file. Also loaded into JVM at runtime and available for reflective access.
 - Used by many Java frameworks.
 - e.g. `@RequestMapping`, `@Id`, `@Table`, `@Controller`, ...

@Target

- Where this annotation can be used.
- `ANNOTATION_TYPE`, `CONSTRUCTOR`, `FIELD`, `LOCAL_VARIABLE`, `METHOD`, `PACKAGE`, `PARAMETER`, `TYPE`, `TYPE_PARAMETER`, `TYPE_USE`
- If annotation is used on the other places than mentioned in `@Target`, then compiler raise error.

@Documented

- This annotation should be documented by javadoc or similar utilities.

@Repeatable

- The annotation can be repeated multiple times on the same class/target.

@Inherited

- The annotation gets inherited to the sub-class and accessible using `c.getAnnotation()` method.

Custom Annotation

- Annotation to associate developer information with the class and its members.

```
@Inherited
@Retention(RetentionPolicy.RUNTIME) // the def attribute is considered as "value" = @Retention(value =
RetentionPolicy.RUNTIME )
@Target({TYPE, CONSTRUCTOR, FIELD, METHOD}) // { } represents array
@interface Developer {
    String firstName();
    String lastName();
    String company() default "Sunbeam";
    String value() default "Software Engg";
}

@Repeatable
@Retention(RetentionPolicy.RUNTIME)
@Target({TYPE})
@interface CodeType {
    String[] value();
}
```

```
//@Developer(firstName="Nilesh", lastName="Ghule", value="Technical Director") // compiler error --
@Developer is not @Repeatable
@CodeType({"businessLogic", "algorithm"})
@Developer(firstName="Nilesh", lastName="Ghule", value="Technical Director")
class MyClass {
```

```
// ...
@Developer(firstName="Rajiv", lastName="K", company="Sunbeam Pune")
private int myField;
@Developer(firstName="Rahul", lastName="Sansuddi")
public MyClass() {

}
@Developer(firstName="Yogesh", lastName="K", company="Sunbeam Pune")
public void myMethod() {
    @Developer(firstName="James", lastName="Bond") // compiler error
    int localVar = 1;
}
}
```

```
// @Developer is inherited
@CodeType("frontEnd")
@CodeType("businessLogic") // allowed because @CodeType is @Repeatable
class YourClass extends MyClass {
    // ...
}
```

Annotation processing (using Reflection)

```
Annotation[] anns = MyClass.class.getDeclaredAnnotations();
for (Annotation ann : anns) {
    System.out.println(ann.toString());
    if(ann instanceof Developer) {
        Developer devAnn = (Developer) ann;
        System.out.println(" - Name: " + devAnn.firstName() + " " + devAnn.lastName());
        System.out.println(" - Company: " + devAnn.company());
        System.out.println(" - Role: " + devAnn.value());
    }
}
```

```
}
System.out.println();

Field field = MyClass.class.getDeclaredField("myField");
anns = field.getAnnotations() ;
for (Annotation ann : anns)
    System.out.println(ann.toString());
System.out.println();

//anns = YourClass.class.getDeclaredAnnotations();
anns = YourClass.class.getAnnotations();
for (Annotation ann : anns)
    System.out.println(ann.toString());
System.out.println();
```

Annotation tutorials

- Part 1: <https://youtu.be/7zjWPJqIPRY>
- Part 2: <https://youtu.be/CafN2ABJQcg>

Java Proxies (Tutorials)

- Not in our/C-DAC syllabus, but a useful topic.
- Part 1: https://youtu.be/4X_sZNOeR7g
- Part 2: <https://youtu.be/jRv3GJuudA>