

# Laboratory Handout

## Advanced Oracle & Java

Binary large objects — Java stored procedures — call specifications — triggers.

**Introduction** You have been introduced in the previous Oracle laboratory to the basics of JDBC. In the next sections, we will discuss two more advanced topics: how to run PL/SQL code from Java—and conversely, how to run Java code from PL/SQL. The two issues we are going to address during this laboratory have a larger scope than the ones in the previous laboratories.

**Java versus PL/SQL.** The considerations listed below outline why and when to use Java rather than PL/SQL:

- Java offers more opportunities for reuse accross applications (c.f. class Mod11Ck below)
- there are more Java programmers than PL/SQL programmers
- Java is potentially more efficient for non-database related programmatic tasks
- PL/SQL is a proprietary language only supported by Oracle.

By contrast, PL/SQL has the following advantages:

- PL/SQL is tightly integrated with the Oracle DBMS, therefore (arguably) easier to use for database applications
- it is more efficient for database-oriented programmatic tasks.

## BLOBs & Java

**Binary Large Objects (BLOBs).** BLOBs are non-atomic, unstructured blocks of binary data stored within a database. We will see in this section how BLOBs can be used to store pictures—and in the next section how Oracle uses BLOBs to store Java classes. As shown below, there exists a BLOB data type in Oracle.

```

CREATE TABLE pic_store
(
  description VARCHAR2(50),
  picture BLOB
)
/

```

Because of the nature of BLOBs, they own a specific INSERT procedure: an empty BLOB is first created using the Oracle built-in function `empty_blob()`. A stream is then established to the Oracle server to upload the data.

**Putting it to work...** The two classes in `PicDispClasses.jar` display pictures stored as BLOBs in Oracle. To avoid overloading the database, you will all use the same table `pic_store` and account `scott/tiger`<sup>1</sup>. Extract the source and class files from the jar archive and execute the program as follows:

```
jar xvf PicDispClasses.jar
```

```
java PicDisp <picture_description>
```

replacing `<picture_description>` by one of the values of the `description` field in the `pic_store` table<sup>2</sup>. Once the code is running, make sure you read and *understand* at least the database-related parts of the source code in `PicLoader.java`.

## Java Stored Procedures

We will now write a stored procedure that validates ISBN numbers using the *modulo 11 check-digit* algorithm (explained in appendix). A *trigger* (called *rules* in Postgres) will then be created to apply the check whenever data is inserted to the `books` table (c.f. active database concept). The validation procedure we will use only involves numerical computation, but no data-based processing: it is therefore a good candidate to be written in Java. Moreover, the java class once implemented can be reused in other database and non-database related applications. The `Mod11Ck` Java class below calculates the check-digit.

```

public class Mod11Ck {
  public static String calc(String digStr) {
    int len = digStr.length();
    int sum = 0, rem = 0;
    int[] digArr = new int[len];
    for (int k=1; k<=len; k++) // compute weighted sum

```

<sup>1</sup>So don't forget to login as `scott/tiger`.

<sup>2</sup>Note that you cannot display the content of a column of type BLOB in SQL\*Plus.

```

        sum += (11 - k) * Character.getNumericValue(digStr.charAt(k - 1));
    if ((rem = sum % 11) == 0) return "0";
    else if (rem == 1) return "X";
    else return (new Integer(11 - rem)).toString();
    }
}

```

Compile the Java class above and load it into Oracle by issuing the following command on *moya*:

```
comp-load-j ./Mod11Ck.java
```

Note that this is *not* a standard Oracle utility, but a script that I wrote to read your Oracle username and password from the `DBObject.conf` file (c.f. “Introduction to Oracle & Java” laboratory handout). Be aware that `DBObject.conf` is expected to be in the current directory.

You should be able to lookup the data dictionary to find out whether the Java class compiled successfully (c.f. “Oracles’s Data Dictionary” laboratory handout). The class will be stored in compiled format as a BLOB, in the database.

Next, we need to write a *call specification* to publish our java (static) method as a PL/SQL function.

```

CREATE OR REPLACE FUNCTION check_isbn (isbn VARCHAR2) RETURN VARCHAR2
AS LANGUAGE JAVA
NAME 'Mod11Ck.calc(java.lang.String) RETURN java.lang.String';
/

```

We can now write a trigger (c.f. rules in Postgres) that will validate the ISBN for each INSERT statement executed on the `books` table. If the last digit of the ISBN about to be inserted does not match the calculated check-digit, an exception is raised—leading the INSERT statement to be rolled-back.

```

CREATE OR REPLACE TRIGGER check_isbn_on_ins
BEFORE INSERT ON books
FOR EACH ROW
DECLARE
    new_isbn VARCHAR2(10);
BEGIN
    new_isbn := TO_CHAR(:NEW.isbn);
    IF NOT (LENGTH(new_isbn) = 10 AND
    SUBSTR(new_isbn,10,1) = check_isbn(SUBSTR(new_isbn,1,9)))
    THEN
        RAISE_APPLICATION_ERROR(-20000, 'The ISBN number supplied is invalid!');
    END IF;
END;
/

```

Try to understand how the trigger works.

## Appendix: The Modulo 11 Check-Digit Algorithm

ISBNs are often handled manually and there is therefore a need for a quick way to check whether a particular ISBN is *likely to be valid* or not. A typical ISBN is represented below, starting with a country code ( $c$ ), followed by a publisher code ( $p$ ) and a title code ( $t$ ). The tenth digit ( $\kappa$ ; called *check-digit*) depends on all the others. So if there is an alteration in one or more of the first nine digits—and the check-digit is re-calculated, its value is very likely to be different from its original value.

$$\underbrace{0}_c - \underbrace{201}_p - \underbrace{88954}_t - \underbrace{4}_\kappa$$

The modulo-11 check digit algorithm given below is implemented in the Java class `Mod11Ck`.

1. [Compute weighted sum.]  $s \leftarrow \sum_{k=1}^9 (11-k)n_k$  where  $n_k$  is the  $k^{\text{th}}$  digit in the ISBN.
2. [Get remainder.] Divide  $s$  by 11 and let  $r$  be the remainder.
3. [Find check-digit.]
  - 3.1. [ $r = 0$ ?] If  $r = 0$ , set  $\kappa \leftarrow 0$ . The algorithm terminates
  - 3.2. [ $r = 1$ ?] If  $r = 1$ , set  $\kappa \leftarrow \text{'X'}$ . The algorithm terminates.
  - 3.3. [Else.] If  $r > 1$ , set  $\kappa \leftarrow 11 - r$ . The algorithm terminates. ■