

Communications of the Association for Information Systems

Volume 9

Article 25

11-16-2002

AMCIS 2002 Workshops and Panels VI: Technical Note: Implementing Java-Based Stored Technical Procedures in the Oracle Database

Ruben E. Quinonez

California State University-Pomona, requinonez@csupomona.edu

Follow this and additional works at: <https://aisel.aisnet.org/cais>

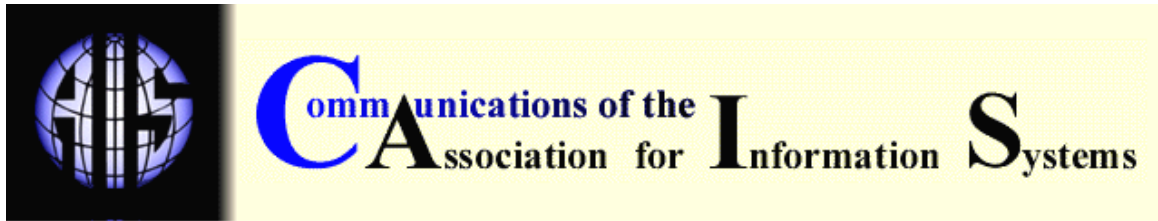
Recommended Citation

Quinonez, Ruben E. (2002) "AMCIS 2002 Workshops and Panels VI: Technical Note: Implementing Java-Based Stored Technical Procedures in the Oracle Database," *Communications of the Association for Information Systems*: Vol. 9 , Article 25.

DOI: 10.17705/1CAIS.00925

Available at: <https://aisel.aisnet.org/cais/vol9/iss1/25>

This material is brought to you by the AIS Journals at AIS Electronic Library (AISeL). It has been accepted for inclusion in Communications of the Association for Information Systems by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.



SPECIAL ISSUE ON THE AMCIS 2002 WORKSHOPS VI: TECHNICAL NOTE: IMPLEMENTING JAVA-BASED STORED PROCEDURES IN THE ORACLE DATABASE

Ruben E. Quinonez
Computer Information Systems
California State University-Pomona
requinonez@csupomona.edu

ABSTRACT

This technical note provides an introduction to writing stored procedures using the Java language. The primary purpose of the workshop is to demonstrate the steps required to publish a Java method inside the Oracle 8i Lite database environment.

KEYWORDS: Oracle, Java, stored-procedures, database

I. INTRODUCTION

Java is becoming a programming language of choice [Stewart, 2002]. With its object-oriented and cross-platform features [Koffman & Wolz, 2002], Java brings a one-size-fits-all paradigm to application development. Application developers can benefit from learning a language that can be used across a wide range of operating systems. In addition to application development, Java is also used inside database development environments. Starting with the 8i release, Oracle supports Java for the development of database stored-procedures and triggers. This new development platform provides the cross-platform benefits not previously possible with Oracle's proprietary PL/SQL language. Businesses can now implement business rules into procedures that can be accessed from inside the database via Java-based stored-procedures or from stand-alone Java applications. Similarly, developers can leverage their Java programming skills when writing applications as well as database stored-procedures. This common development environment is expected to bring synergies particularly in applications that have a database component.

This article covers the development of Java static methods, how they are imported into the Oracle environment and how they can be used as stored-procedures. This article is designed for faculty with some knowledge of Java and Oracle database who are interested in integrating the two technologies in either a database course or a Java programming course.

II. STEPS FOR WRITING JAVA-BASED STORED-PROCEDURES

The steps required for publishing Java-based stored-procedures are:

1. Write a Java static method
2. Compile the method and test it outside the database
3. Import the method into the database
4. Publish the method as a database function
5. Execute the database function from the database SQL prompt

The example used in this article is based on a simple task: write a stored-procedure that adds two numbers. This simple task minimizes unnecessary Java and/or database complexities and it concentrates on the steps required to integrate the two technologies.

III. THE JAVA STEPS

Many options are available for writing Java classes. The developer environment used for this article is Sun's Java 2 SDK version 1.3.1_04¹. Despite its command line interface, Sun's SDK is easy to install and it requires only about 35MB of hard disk space. Any Java runtime environment can be used as long as it supports the Java Native Interface (JNI).

Step 1: Write a Java static method

The Java class written for this workshop is called Mathlib.java. Its contents are as follows:

```
public class Mathlib {  
  
    public static void main(String args[]) {  
        System.out.println (Addnumbers(1,2));  
    }  
  
    public static int Addnumbers(int x, int y) {  
        return x + y;  
    } // Add  
}
```

One important detail in the Mathlib class is that method Addnumbers is static. Static means that the method belongs to the class, not to a class instance. Mathlib will not be instantiated inside the database environment.

One of the challenges in stored-procedure development is debugging. There are no provisions for debugging Java code inside the database environment. Therefore, the Java code must be free of bugs before loading it into the database. To simplify the process and concentrate on issues related to the Java code, a main method was added to the class only for the purpose of being able to run it (and debug it) as a stand-alone application.

Step 2: Compile the method and test it outside the database

Using the command line interface of Sun's SDK, compile the Java class:

```
C:\ javac Mathlib.java
```

¹ Available for download at <http://java.sun.com/j2se/1.3/download.html>

Once compiled², the class is executed:

```
C:\java Mathlib
3
```

When the class is executed, its main method calls Addnumbers method and it passes two arguments: 1, 2. The Addnumbers method then returns to main the sum of the two arguments. Main uses System.out.println to display the answer: 3.

The next section discusses the steps required to publish the Java method inside the Oracle database.

IV. THE DATABASE STEPS

The database used for this article is Oracle 8i Lite release 4.0.1. Keep in mind that even minor release updates may change the procedures required to publish Java methods.

Now that we have a compiled the class, we are ready to import it into the Oracle database. The steps required for the database are executed using Oracle's SQL utility, SQL Plus.

Step 3: Import the method into the database

The syntax for loading Java classes in the Oracle environment is:

```
CREATE OR REPLACE JAVA CLASS USING BFILE ('java-directory', 'class-name');
```

where java-directory is the location of the java class and class-name is the name of the class. In our example, the directory is c:\data\javaoracle and the class name is Mathlib.class. Therefore, the command issued is:

```
SQL> CREATE OR REPLACE JAVA CLASS USING BFILE ('c:\data\javaoracle','Mathlib.class')
/
```

```
Operation 0 succeeded.
```

Note that the SQL utility returned the message "Operation 0 succeeded". This indicates that the Java class was successfully loaded into the database. Another important detail is the use of the slash ("/") instead of the traditional semicolon³.

Step 4: Publish the method as a database function

The next step is to publish the method as a database function⁴. The syntax for publishing the method is:

```
CREATE OR REPLACE FUNCTION function-name (argument-list)
RETURN INT AS LANGUAGE JAVA NAME 'method-name' (argument-type-list)
return return-type
```

Where function-name is the name of the Java method once published in the database (which may be different from the Java method name), argument-list is the argument type and name used in the Java method. Method-name is the Java method prefixed by its class name. Argument-

² The compilation step produces a file with the extension ".class" that will be used when importing it to the database.

³ The Oracle 8i Lite requires a slash instead of a semicolon for Step 4 of this workshop. Step 3 can be executed with a semicolon or a slash.

⁴ A Java class is called a function once loaded into the database environment.

type-list is the argument type list (excluding the argument names) required by the method. Lastly, the return-type is the data type returned by the Java method. In our example, the command is:

```
SQL> CREATE OR REPLACE FUNCTION AddNumbers (x int, y int)
  2 RETURN INT AS LANGUAGE JAVA NAME 'Mathlib.AddNumbers (int, int)
  3 return int'
  4 /
Operation 0 succeeded
```

In this example, the integer data type (“int”) is common to Java and Oracle. Other data types may not be the same. For example, Java uses “String” for string data while Oracle uses CHAR, VARCHAR, or VARCHAR2 for string data. For more details, refer to Oracle 8i Lite documentation located at *directory-name/DOC/LITE/jdg/html/jdgovrw.htm#1011219* (where directory-name is the location of your Oracle 8i installation).

Step 5: Execute the database function

Now that we have loaded and published the Java method as a database function, we are ready to test it. One convenient way is to use Oracle’s “dual” table⁵. Therefore, using the “dual” table, the command is:

```
SQL> SELECT AddNumbers (5, 3) FROM DUAL;

ADDNUMBERS
-----
          8
```

The final task is to execute the function using data from a table. In this article, we use a sample table called Mathlib. The SQL commands used to create and populate the Mathlib table are:

```
SQL> create table Mathlib (
  2 x      number(2),
  3 y      number(2)
  4 );
```

Table created.

```
SQL> insert into Mathlib values (1,1);
```

1 row created.

```
SQL> insert into Mathlib values (2,2);
```

1 row created.

Executing the function Addnumbers against the Mathlib table results in:

```
SQL> SELECT x,y,AddNumbers (x,y) FROM Mathlib;
```

X	Y	ADDNUMBERS
1	1	2
2	2	4

⁵ The “dual” table is a dummy table that can be used to test database functions.

Note that function Addnumbers can accept as arguments a column name of an existing table, a constant, or the result of a calculation. The important criterion is that the two arguments are integers.

V. INCORPORATING JAVA STORED-PROCEDURES TO THE CLASSROOM

Oracle Java-based stored-procedures are by their very nature the integration of Java and Oracle. As such, Java-based stored-procedures can be incorporated into courses that have as prerequisites at least one of the two technologies (Java or Oracle). At my university, students complete an introductory course in Java before taking a database course. Therefore, I found it convenient to introduce them to Java stored-procedures in their database class. Other potential areas are intermediate or advanced level Java courses assuming that the students took a database class previously.

VI. CONCLUSION

Java-based stored-procedures offer a one-size-fits-all paradigm to application development as well as database procedure development. In addition, this technology provides students with an integrative view of systems development. As it applies to students learning business application development, Java and databases should not be considered independent technologies but rather interrelated components of a business application. This workshop is designed with the goal of assisting faculty interested in integrating the two technologies in either a database or a Java programming course.

Editor's Note: This technical note is based on the author's workshop at AMCIS 2002 in Dallas, Texas. It was received on September 13, 2002 and was published on November 16, 2002 together with the other articles from the Workshops and Panels. The special issue was under the editorship of Les Ball.

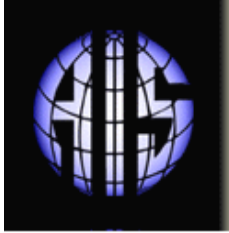
REFERENCES

- Koffman, E., & Wolz, U. (2002). *Problem Solving with Java*. Boston MA: Addison Wesley.
- Stewart, B. (2002). *Java as a Teaching Language*. O'Reilly. Retrieved 2/25/2002, 2002, from the World Wide Web: http://java.oreilly.com/news/teachjava_0101.html

ABOUT THE AUTHOR

Ruben E. Quinonez is assistant professor of Computer Information Systems at Cal Poly Pomona. He completed his Ph.D. at the Claremont Graduate University. He has over ten years of industry experience in the areas of application and database development.

Copyright © 2002 by the Association for Information Systems. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and full citation on the first page. Copyright for components of this work owned by others than the Association for Information Systems must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, or to redistribute to lists requires prior specific permission and/or fee. Request permission to publish from: AIS Administrative Office, P.O. Box 2712 Atlanta, GA, 30301-2712 Attn: Reprints or via e-mail from ais@gsu.edu.



Communications of the Association for Information Systems

ISSN: 1529-3181

EDITOR-IN-CHIEF

Paul Gray
Claremont Graduate University

AIS SENIOR EDITORIAL BOARD

Cynthia Beath Vice President Publications University of Texas at Austin	Paul Gray Editor, CAIS Claremont Graduate University	Sirkka Jarvenpaa Editor, JAIS University of Texas at Austin
Edward A. Stohr Editor-at-Large Stevens Inst. of Technology	Blake Ives Editor, Electronic Publications University of Houston	Reagan Ramsower Editor, ISWorld Net Baylor University

CAIS ADVISORY BOARD

Gordon Davis University of Minnesota	Ken Kraemer Univ. of California at Irvine	Richard Mason Southern Methodist University
Jay Nunamaker University of Arizona	Henk Sol Delft University	Ralph Sprague University of Hawaii

CAIS SENIOR EDITORS

Steve Alter U. of San Francisco	Chris Holland Manchester Business School, UK	Jaak Jurison Fordham University	Jerry Luftman Stevens Institute of Technology
------------------------------------	--	------------------------------------	---

CAIS EDITORIAL BOARD

Tung Bui University of Hawaii	H. Michael Chung California State Univ.	Candace Deans University of Richmond	Donna Dufner U. of Nebraska -Omaha
Omar El Sawy University of Southern California	Ali Farhoomand The University of Hong Kong, China	Jane Fedorowicz Bentley College	Brent Gallupe Queens University, Canada
Robert L. Glass Computing Trends	Sy Goodman Georgia Institute of Technology	Joze Gricar University of Maribor Slovenia	Ruth Guthrie California State Univ.
Juhani Iivari University of Oulu Finland	Munir Mandviwalla Temple University	M.Lynne Markus Bentley College	Don McCubbrey University of Denver
Michael Myers University of Auckland, New Zealand	Seev Neumann Tel Aviv University, Israel	Hung Kook Park Sangmyung University, Korea	Dan Power University of Northern Iowa
Nicolau Reinhardt University of Sao Paulo, Brazil	Maung Sein Agder University College, Norway	Carol Saunders University of Central Florida	Peter Seddon University of Melbourne Australia
Doug Vogel City University of Hong Kong, China	Hugh Watson University of Georgia	Rolf Wigand University of Arkansas	Peter Woolcott University of Nebraska- Omaha

ADMINISTRATIVE PERSONNEL

Eph McLean AIS, Executive Director Georgia State University	Samantha Spears Subscriptions Manager Georgia State University	Reagan Ramsower Publisher, CAIS Baylor University
---	--	---