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A web database application was developed using Oracle8i with the Java and XML components. The purpose was to test whether these different technologies can work together to build a simple business application and bring it to the web using the Oracle built in Java technology, and to have its data displayed dynamically using the Extensible Markup Language technology. Problems were found when trying to use JavaServer Pages with the Oracle XML SQL Utility.

Technologies examined include Java stored procedures, JavaServer Pages, XSQL, the Oracle XML SQL Utility, XML, and XSLT. Oracle 8I version 8.1.7 was used.

Headings:

Relational Database - Oracle8I, XML, Java Stored Procedures, PL/SQL, JSP

Web Development - Scripting Languages, Java, JSP, XSQL

Web-enabled Database

Document Markup Languages - XML, XSL, XSLT

ORACLE8I WITH JAVA/XML – DOES IT WORK?

by Angela K. W. Hon

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Approved by:

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Advisor

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INTRODUCTION

Can a database be readily made web-enabled with the necessary business rules and data transformation for the Internet using the newly integrated Java and XML tools available in the Oracle 8i database management system?

The integration of Sun's Java and the Extensible Markup Language in the Oracle database management system has created a new way to develop web enabled database applications and to deliver information. Oracle Corporation was the first database vendor to integrate the Java Virtual Machine with their database server, called JServer (Patzer, 2001). Version 8.1.4 was the first to offer the ability to "java-enable" your database (North, 1999). For example, Java programmers who are unfamiliar with Oracle's proprietary PL/SQL language, can write stored procedures and functions in Java and load those procedures and functions directly into their database schema. In addition, Oracle has extended its support to application development with Java servlets and JavaServer Pages. As Patzer states, "whatever you can do with Java (non-visual, of course), you can do within Oracle (2001)".

Starting with the Oracle 8i versions (8.1.5 and up), XML support began (Oracle Corp., 1999). XML is a subset of the Standard Generalized Markup Language. The XML standard was introduced for a way to allow developers to separate content from presentation and to allow for the easier exchange of information over the Internet. Since there are no XML predefined tags, but rules to create a tagging system, it allows for industries to define their own markup languages and to share that tagging system with others in order to better exchange information. The adoption of XML by the World-Wide Web Consortium, the governing body of Internet language standards, was the first steps toward having a common format for Internet information exchange (Oracle Corp., 1999).

Oracles, hearing the demands of the market for better XML support in enterprise database servers, have enabled their database systems to handle storage of XML-formatted data, querying of XML data and extraction of data as XML, and the ability to access XML documents using the Document Object Model (Higgins, 2000).

Steve Muench, in his book Building Oracle XML Applications, states, "XML emerged in the in the age of Java and has been nearly inseparable from it (2000a, p. 174)". Muench adds that it is no surprise that Oracle has brought together Java and XML, which many have said are "portable code" and "portable data", respectively, together with Structured Query Language and gained much attention from developers (2000). Much of the XML infrastructure in Oracle is available for Java. With JServer, XML processing can be completed within the server instead of outside of it by command line (Muench, 2000).

This project is intended to test the achievability of using all these new technologies by building a banking database and bringing it to the web using only the tools made available by Oracle. A great deal of the literature available, including white papers from Oracle Corporation and Sun Microsystems, online magazines such as XMLmag and Java Enterprise Developer, imply the ease of using Java and XML to web-enable database applications, but little documents have been found on the difficulties of building these applications. Surely, there are complexities involved when trying to tie various technologies to work together in harmony.

This project is important because it can show whether or not a simple business application can be easily built and brought to the web using the Oracle built in Java technology, and to have its data displayed dynamically using the Extensible Markup Language technology. Since the Oracle Java/XML implementation is relatively new, there will probably be many other database vendors following suit with their rendition. It is important to establish early on if the technologies are capable of doing what are claimed. As mentioned earlier, little has been found on the intricacies involved with developing a full application.   This project may help to shed some light on what may lay ahead for other database application developers.

LITERATURE REVIEW

Yang, Linn, and Quadrato (1998) recognizes the need for technologies to provide a better way to bring dynamic content to the Internet. Yang et al. (1998) states that the "deterministic factor of a successful website" is its content, and to get dynamic content, databases must be involved. Yang et al's (1998) paper is primarily about their effort to study the different types of Java Database Connectivity (JDBC) drivers and their endeavor of incorporating web development as part of a Computer Science database course. Their paper is limited in that it studied the mechanism by which to connect to a database, but they did not study the application languages that would implement those drivers. Having drivers does not create dynamic content. They are rather just a bridge to getting data. However, their goal of using technology to bring dynamic data to the web is similar to this project's goal, and it reaffirms the need to examine the technologies available to students and developers alike to make the transition from the static to dynamic Web easier.

There is obvious anxiety regarding the technologies on hand. Aslam (1998) sees the importance of teaching students how to bring dynamic database content to the Internet, but considers powerful technologies such as Java a "burden (p. 297)" on students to use. The approach was to give students a four week assignment of building a web-based interaction with a database, but because of time constraints, did not want them to turn the assignment into a programming one. In Aslam's (1998) study, PHP was the scripting language of choice for its simplicity. Although Oracle does not make the claim that the JSP technology is simple to use, they do imply an "ease of use (Prasad, Kunisetty &

Basu, 2001)”. This project attempted to accomplish a goal similar to Aslam’s (1998). His goal was to show his students that designing web-based query processing is possible in a short amount of time. The goal of this project is to show whether or not technologies that are purported to be easy to use to build web-based query processing, truly work.

One might wonder why Java is the selected technology for Oracle and this project. As many web programmers who have experienced writing pages with dynamic data, the technology most widely used is the Common Gateway Interface, or CGI (McDonald, 1999). As McDonald (1999) notes, CGI can become a burdensome technology on the web-hosting machine, mainly because each call to the CGI creates a new process of the executable. Resources on the machine can quickly be consumed when many calls are made to the CGI script. The attractiveness of Java is that a call to a Java Servlet does not create new processes. Rather, a separate thread handles each call to the Java Servlet, instead of a new process (McDonald, 1999). As McDonald notes, a call to the servlet can establish a database connection, and that connection can be held between client requests. This persistent nature is ideal for database transactions because of the lack of overhead costs of constantly having to open and close a connection.

Prasad, Kunisetty, and Basu (2001) of the Oracle Corporation iterate the need of using Java Servlets and Server Pages as the answer to bringing dynamic content to the web. The basis of this white paper is to market the Oracle Internet Platform to the reader, so the contents must be taken with some precaution. HTML and XML have produced much discussion regarding the separation of content and presentation. Prasad et al. (2001)

introduce JSP as the technology that can separate them in coding. Whereas Java Servlets are usually coded with both content and presentation, JSP separates the two (Prasad et al, 2001) by using other technologies such as Java Beans to handle the dynamic generation of content. However, while servlets are actual Java code that an ordinary web developer might not be able to develop, JSP works as scripts, similar to PHP, and is supposedly easier to manipulate for the non-Java programmer. Dissimilar to PHP, though, is the ability to embed Java code and Java Beans directly into the script. This presents a problem with Prasad et al.'s (2001) suggestion that JSP is for the non-Java web developer. How does one effectively use JSP without knowing Java? Prasad et al.'s (2001) solution is to have a Java programmer develop those components. For a lone developer unfamiliar with Java but desiring to use the Oracle 8i platform and its web components, it may become a less achievable goal. Prasad et al. (2001) claim that Oracle's implementation of the JSP specification is the best in the market. Even with the program extensions provided, such as Java Beans for connection, and Oracle's JSP Markup Language to make development even simpler, there is still a learning curve to overcome for Java, as learned from this project. The ease of JSP may not readily be there for non-Java programmers. Many of Prasad et al.'s examples illustrating the use of a bean or of a built in class still require a certain amount of Java knowledge, albeit not as much as having to develop a servlet. Again, since the primary objective of this paper is to promote the Oracle products, one must be wary of all the claims.

Another component to this project is the Extensible Markup Language, or XML. XML is a subset of the Standard Generalized Markup Language, or SGML. SGML has been used for years in the publishing industry to define document formats and to create documents (Treese, 1998). However, its strict and complex nature never gained popularity among web developers. Instead, the beneficial features of SGML were used in order to create the specification for XML (Bosak, 1996). The World Wide Web Consortium's purpose in creating specifications for XML was "to enable the delivery of self-describing data structures of arbitrary depth and complexity to applications that require such structure" (Bosak, 1996). Many industries are now either developing or have developed XML standards for tagging their content data in order to share them with others in their industry. Though Bosak's paper was written in 1996, most of the desired results of XML are still being sought today. It will be interesting to see, though, when any of the desired outcomes of XML technologies will have an effect on the way people use the Internet.

Muench (2001), Oracle's proclaimed XML Evangelist, lists many reasons for the drive to provide more dynamic data on the Internet. Consumers, businesses, and infomediaries are all demanding more and faster access to data (Muench, 2001). Relational databases today are continuously trying to meet the demand, but as Muench (2001) asserts, E-commerce sites are still hitting the wall when it comes to integration with legacy systems and their data. Many are looking towards platform-independent XML as the key to solving the data integration problem. As Muench (2001) states, when data is needed for a certain application, database views can be used to transform the data into the XML format desired. Each type of view created for the same data can be considered different XML documents (p. 4). However, Muench's explanation of how XML can be used in a relational database does not address the problems of legacy data mentioned earlier. A lot of the data out there today are still sitting in systems that are not conducive to receiving and delivering XML. XML may provide the key to integration with new data, but does not solve the problem with interaction with legacy data.

Smith and Poulter (1999) state that XML should not be seen as the "cure-all for system interoperability" and that it has its limitations. Since XML is purely specification, and the implementation of the XML specification is up to the individual, so-called XML standards for certain industries isolate them from others not using the same standard. Smith and Poulter (1999) raise many concerns, but the main concern regarding XML standards development is the need to bring together e-commerce participants "to create a global environment providing significant interoperability between the systems used by all engaged (p. 110)" using the same ontology. This paper is significant to this project in that it details some ideas not previous thought of regarding the need for a common ontology in order to effectively use XML as a sharing mechanism. This project demonstrated the ability to create XML and display the data, but Smith and Poulter (1999) make a case for the necessity of not arbitrarily creating XML, which is a very important principle to remember.

The literature reviewed provided many new and interesting viewpoints, most interesting were the common fears regarding technologies such as Java for web development use. This project attempted to investigate whether those fears are founded. Also interesting were the varying viewpoints regarding XML. Many, such as Muench (2001) and Bosak (1996), saw it as the way to finally separate content from presentation, and a way to easily share data among entities. However, others, such as Smith and Poulter (1999), feared that if industries continued to independently create their own XML standards without consortia, then many might end up isolated with only the few they shared their ontology with to share their data. Unfortunately, no literature was found in regards to using both Java and XML with a relational database. This is understandable given that the implementation of both technologies in one database platform is extremely new. Oracle only just recently offered this capability. However, the literature reviewed here provides a better foundation of knowledge for XML, and a better understanding of the concerns regarding Java. This project attempts to tie all these technologies together and to see if a database driven dynamic content web site can be created.

METHODOLOGY

The technologies that were tested in this project include Oracle's PL/SQL, Java, XML, and XSLT. For Java, specifically, Java stored procedures, JavaServer Pages, and Java Servlets were tested. As for XML, XSQL pages and the Oracle XML SQL Utility were used. HTML forms were also used.

To prepare for development, Microsoft Windows 2000, Oracle 8i version 8.1.7 Personal Server, and Oracle JDeveloper 3.1 were installed.

In order to test the different technologies, a schema was set up in Oracle for a banking database. After defining the banking schema and pinpointing the necessary business rules, tables were created with the necessary keys.

The first test of Java came with the design and development of the scripts to uphold the business rules. Java stored procedures were used in combination with Oracle's PL/SQL language for database triggers and packages. As a counterpoint to Java, a PL/SQL stored procedure was created for one of the business rules.

A mockup was created for the user interface. With the mockup, decisions regarding what technologies were to be used were made for each page. Application development technologies such as JSP, Java Servlets, and XSQL were tested. The Oracle XML SQL Utility was also used. Also tested was the ability to return data from the database as XML and to transform the XML into HTML by XSLT stylesheets.

The methodology chosen is appropriate for this project because it attempts to use both the Java and XML technologies available with Oracle8i, but at a skill level suitable for low and mid-level web application developers with some Java experience. It attempts to discover if a database can be made readily available for the web using tools provided in Oracle 8i, Oracle's database for the Internet (Oracle Corp., 1999). Many supporters of Oracle imply the ease of transforming data stored in a database to dynamic content on the web. The methodology chosen seeks to verify this claim.

Figure 1 shows the timeline followed for the development portion of this project:

Activity	Time in hours
Install Windows 2000	2.5
Install Oracle Personal Server	5
Perform necessary DBA activities	1
Install JDeveloper	0.5
Design Banking Schema	4
Pinpoint Business Rules	2
Implement Schema to tables	1
Design and program business rules	15
Test and debug business rules	8
Mockup the user interface	1
Design and program each unit of the interface	25
After each page is completed test and debug	10
Test the user interface as a whole	1.5
Add necessary cosmetic touches	1
Total Hours:	77.5

Figure 1

RESULTS

Installation

Before any development could be done, some systems and database administration duties were performed. Windows 2000 Professional was installed on a laptop. Windows 2000 was chosen because the version of Oracle Server and JDeveloper attained required Windows NT or 2000.

After the Windows 2000 installation completed, Oracle 8i version 8.1.7 Personal Server was installed on the laptop. The database server software was downloaded from the Oracle Technology Network site at http://technet.oracle.com. All components of the server were installed, including the Apache Web Server with the JServer component. After installation was complete, the Oracle Database instance was set up and was called "ORCL". A schema was created for this project called "Project" and was given all the necessary rights for development.

Finally, JDeveloper was installed to act as the integrated development environment. JDeveloper has its own internal web server used for testing purposes.

Designing the Banking Schema

Next, the banking database schema was designed. Functionally, the database is intended to store checking and banking accounts, and transactions records such as withdrawals and deposits that will alter the data of the account records. Savings accounts also automatically accumulate interest on a monthly basis. The business rules of the schema were established.

The banking database schema consisted of eight entities (see Appendix A). The database holds data regarding bank clients, their checking and checking types, saving accounts and interest rate information, and transaction and transaction type information. Based on the relationships between the entities and the business rules pinpointed by the database functionality, 11 tables resulted (see Appendix B). Using SQL and Oracle's SQL *Plus, the 11 tables and the necessary keys to relate all the tables together were created (see Appendix C).

Designing and Programming the Business Rules

With the tables created, the next step was to design and program the necessary database triggers, procedures, and functions to uphold the business rules of the database.

The business rules for this database are the following:

1. If a client makes a transaction, the appropriate amount has to be credited or subtracted from the account balance.
2. If the transaction causes the checking account to fall below the minimum allowed balance, continue with the transaction, then add another transaction that penalizes the account for falling below the minimum.
3. Disallow transactions that will cause the account balance to fall below a zero balance.

4. An account can retrieve and deposit money with an “ATM”. Create an ATM fee transaction each time any transaction is completed by an ATM.
5. Each first of the month, calculate each savings account's interests, insert a new interest transaction, and update the associated account’s balance.

The first four business rules were upheld by a combination of PL/SQL triggers and Java stored procedures and functions (see Appendix D).

A database trigger contains code that is fired off whenever certain data manipulation language (DML), such as insert, update, or delete, is used on a table. The trigger can perform a myriad of operations, including retrieving and inserting information in other tables, and returning programmer-defined errors when certain conditions are met. It can also call other functions and procedures to run.

A Java stored procedure is a Java method that does not return a value. A stored procedure contains code that is compiled and stored in the database and can be called from any other program within the schema to run its code. A Java stored function is similar to the Java stored procedure except that it returns a value.

Figure 2 shows the code for a Java stored procedure used in this database. See Appendix E for all the stored procedure code.

```
public static void depositUpdateBal (float transAmount, String accountNum) throws SQLException
 {
   String sql = "UPDATE account SET balance = balance + ?, last_update = sysdate " +
   "WHERE account_number = ?";
     try {
      Connection conn = DriverManager.getConnection("jdbc:default:connection:");
      PreparedStatement prst = conn.prepareStatement(sql);
      prst.setFloat (1, transAmount);
      prst.setString (2, accountNum);
      prst.executeUpdate();
      prst.close();
      }
      catch (SQLException e) {
       System.err.println (e.getMessage());
       }
    }
```

Figure 2

A prepared SQL statement is created, with question marks holding the places for bind[1] variables that are passed when the procedure is called. Using an internal JDBC[2] default connection, the procedure opens a connection with the database. It uses the default connection because it is assumed that the database schema it is called from is the same as the one this procedure is stored in. After creating the connection, each bind variable is replaced with the actual argument passed. Finally, it executes the SQL statement and closes the JDBC connection.

In order to use Java stored procedures and functions, they have to be loaded into the database schema. Figure 3 shows the command to run to load the java classes.

[1] Bind variables are variables in SQL statements that must be replaced with a valid value before the statement can be successfully executed (Koch & Loney, 1997)

```
C:\$DocDir> loadjava –u project/masters@localhost:1521:orcl -v –r –t javacode.class
```

Figure 3

After the classes were loaded, the stored procedures and functions were published in the Oracle data dictionary. Using Oracle PL/SQL packages, call specifications were written (see Appendix F). There are two parts to a package, a package head and a package body. The package head contains the information about the contents of the body but no code (PL/SQL Programming, 1997). The package body contains the code that was specified in the package header. To publish Java stored procedures and functions, they are mapped to their equivalent PL/SQL counterparts (Java Stored Procedures Developer's Guide, 1999). Figure 4 shows a package header and body for Figure 2's procedure.

```
CREATE OR REPLACE PACKAGE banking_mgmt AS
  PROCEDURE deposit_update_bal (trans_amount NUMBER, account_num VARCHAR2);
END banking_mgmt;

CREATE OR REPLACE PACKAGE BODY banking_mgmt AS
  PROCEDURE deposit_update_bal (trans_amount NUMBER, account_num VARCHAR2) AS
  LANGUAGE JAVA
  NAME 'Banking.depositUpdateBal(float, java.lang.String)';
END banking_mgmt;
```

Figure 4

Since they are mapped to their PL/SQL counterparts, Java stored procedures can be called in any PL/SQL code as if a PL/SQL stored procedure were being called. Figure 5 shows a snapshot of the trigger that calls the above stored procedure.

[2] JDBC – stands for Java Database Connectivity – are used by Java to access and manipulate database data (Muench, 2000a)

```
IF (v_account_type = 'CHECKING') then
     IF (v_transaction_type = 'counter deposit') then
          banking_mgmt.deposit_update_bal (v_amount, v_account_number);
```

Figure 5

As a counterpoint to the Java stored procedures, a PL/SQL stored procedure was created for business rule 5 (see Appendix G). A Java version was attempted but after much debugging and testing, it still did not work properly. The amount of time needed to develop the PL/SQL procedure was far less than developing in Java. PL/SQL was more straightforward since it is a procedural language. As the PL/SQL version shows, there are multiple SQL statements executed, and a "for" loop is used to iterate through all the savings accounts to calculate the interest for each. As for the PL/SQL version, unlike Java, no JDBC connection is necessary, nor is it necessary to publish a call specification for this procedure. Since PL/SQL is native to Oracle, no additional work was necessary to use this procedure. Both types of procedures are compiled and stored in the database. The DBMS_JOB package was used to schedule the procedure to run every thirty days starting at the beginning of the month.

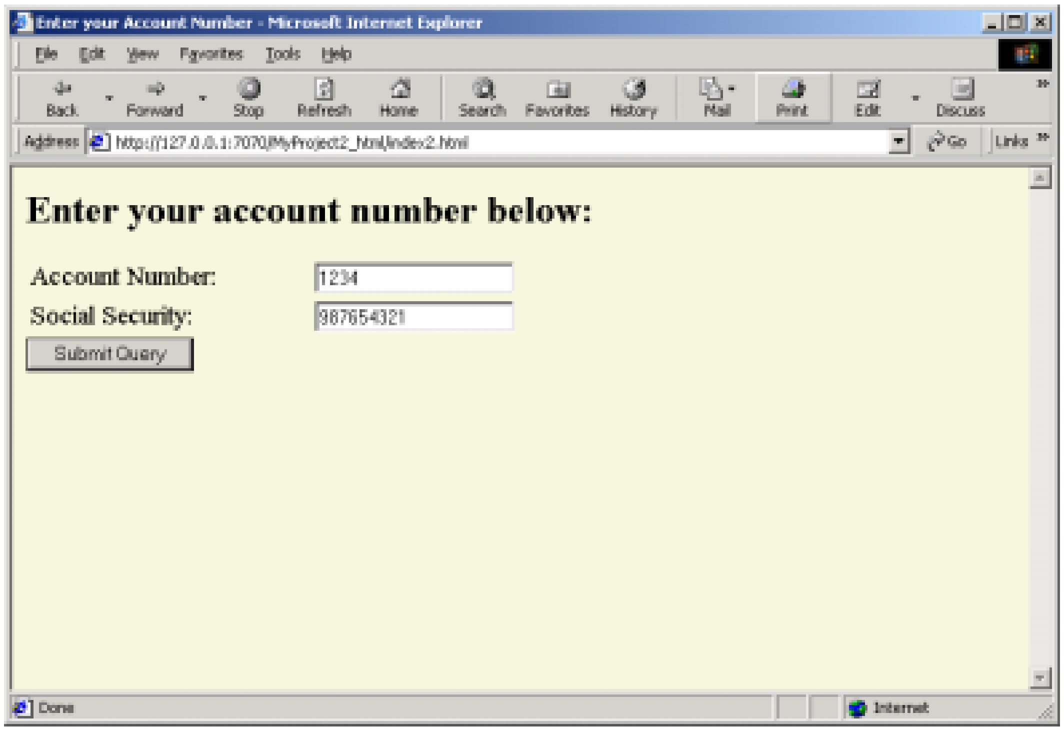
Developing the Java stored procedure and PL/SQL triggers and packages went smoothly, with the exception of the last business rule, which involved more programming than the first four. No major difficulties were encountered involving the loading and calling of the procedures. This was probably due to the fact that Oracle has integrated Java stored procedures since version 8.1.4 of their database. Any major problems were probably resolved and patched since then.

User Interface Design and Programming

The next step in development was to create the user interface mockup for the front end. Using the mockup, the entry point to the database and the subsequent interactions between the user and the database were determined. For a project of this scale, user interaction was limited to making transactions and retrieving account information from the database.

The first page was the entry point. Here, a client would enter their account number and social security number to identify them to the database. If the database were able to retrieve the account, the client would be brought to the next page that showed them their current balance. This page would also allow them to make other decisions on their account by clicking on certain buttons. Each button is part of a form that has their account and social security numbers hidden. Depending on the button they chose, they could either create a new transaction or get information on their past transactions.

At this point, certain decisions were made in regards to technology. An HTML form was used to gather client information, as shown in Figure 6.


Enter your Account Number - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss
Address http://127.0.0.1:7070/MyProject2_html/index2.html
Go Links
Done
Internet

Enter your account number below:

Account Number: 1234

Social Security: 987654321

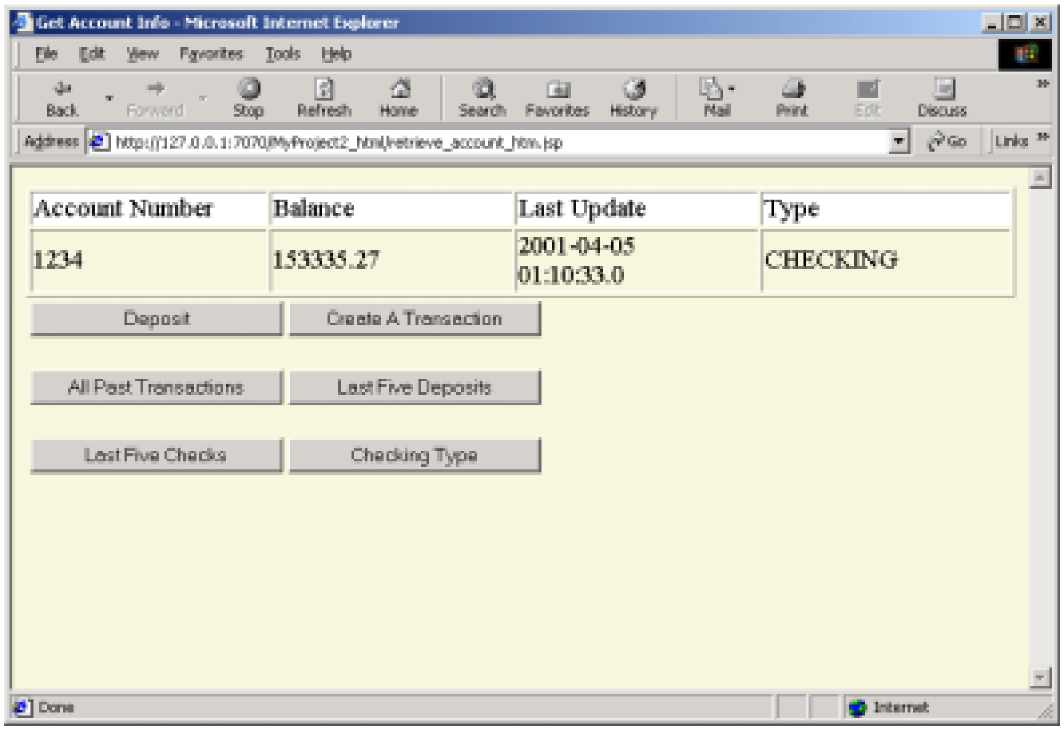
Submit Query

Figure 6

For the interaction with the database, the first attempt was to create a JavaServer Page (JSP) that used a Java Bean, named QueryIDBean, to query the database (see Appendix H), and return the results in XML format. A Java Bean is really a Java class with a set of methods that can be called by Servlets and JSP. QueryIDBean used another Java class called DBConnection (see Appendix I) to connect to the database via JDBC. Other bean methods include querying the database and moving through the resultset. Without the classes, the code to connect to a database and move through records would have been embedded in the JSP itself.

Using an XSLT stylesheet, the XML was to be transformed into HTML for the web. However, the account number and social security number of the client needed to be passed to the forms that would be created by the stylesheet. There is a language called JML that Oracle developed as the JSP markup language, which may have this interaction. However, it was difficult to set up in terms of the web server and JDeveloper. In order to avoid the possibility of upgrading, a different approach to this problem was taken.

Rather than returning XML, as previously hoped for the account data, JSP was embedded in an HTML page (see Appendix J). The Java bean was still used and it returned the data in an HTML formatted table, as shown in Figure 7. Within the same JSP page, session variables were used to pass the account and social security numbers to the other forms.


Get Account Info - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss
Address http://127.0.0.1:7070/MyProject2_html/retrieve_account_htm.jsp
Go Links
Deposit
Create A Transaction
All Past Transactions
Last Five Deposits
Last Five Checks
Checking Type
Done
Internet

Account Number	Balance	Last Update	Type
1234	153335.27	2001-04-05 01:10:33.0	CHECKING

Figure 7

A second attempt at using the combination of Java and XML was with a page intended to return the last five transactions of a clients account. A JSP was created that called the database connection class, prepared a SQL statement, then instantiated a new OracleXMLQuery instance (see Appendix K), part of the Oracle XML SQL Utility (XSU). This utility can be used both inside the Oracle server and outside by command line. It is intended to provide a rich layer of services to work with results of SQL queries in XML and to process incoming XML documents for insertion into the database schema (Muench, 2000).

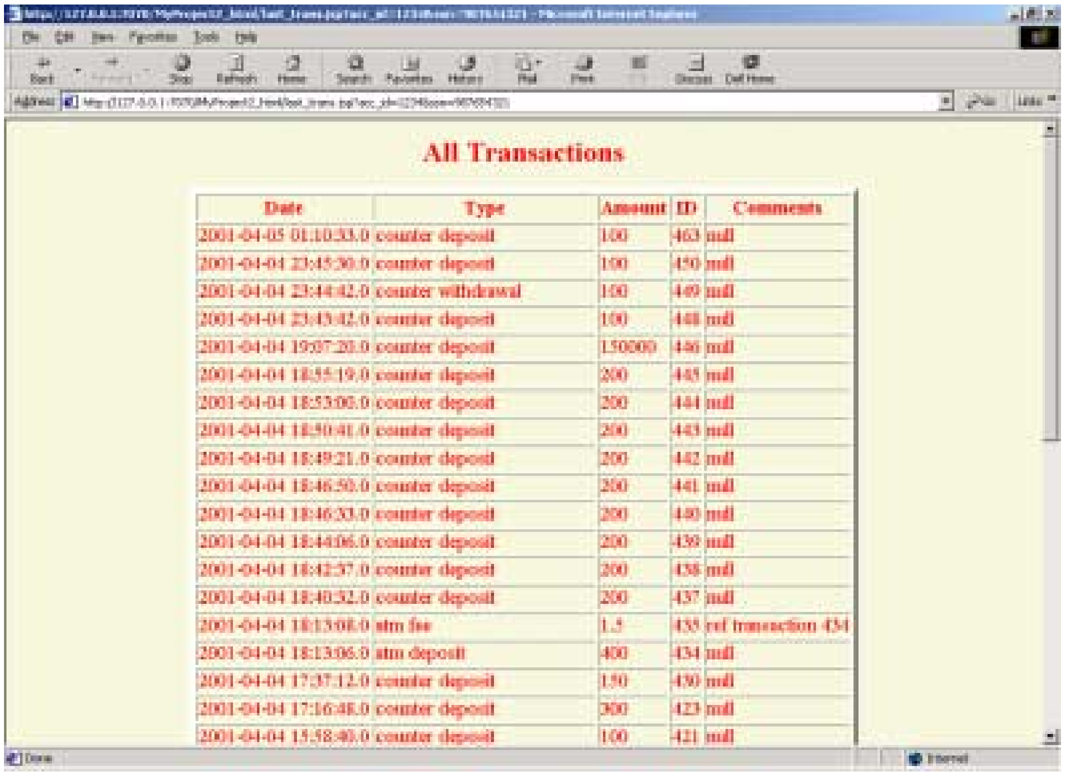
The OracleXMLQuery class has many additional methods, which were used, such as setting the maximum number of rows returned, creating the XML returned document, and setting the stylesheet to use for the XML data returned.

Using Microsoft's Internet Explorer 5.0, the JSP was run without a stylesheet set and was found to work with the XSU. The browser returned a resultset in XML canonical form. A XSLT stylesheet was applied to try to transform the XML data into HTML (see Appendix L). However, when the JSP was run again through IE5, a blank page returned. When the source was viewed, it was found that the XML data was there, but the stylesheet did not work. The resources used for this project all indicated that XSLT stylesheets worked with a browser such as IE 5.0.

In an attempt to make the stylesheets work, the web browser was upgraded to version IE5.5. That did not improve the parsing situation. Since XML and XSLT transformations are parsed on the client side, the Microsoft XML Parser was upgraded from version 2.5 to 3.0, in side-by-side mode, to attempt to fix the problem. Using side-by-side mode, both versions of the parser were available for use. Again, this did not work. The Parser was then installed in replace mode, to remove the older version. The XSLT stylesheets worked. However, the JSP pages that utilized the Oracle XML SQL Utility stopped working. The XML was being returned not well formed. The XML declaration was appearing on the second line of the XML file, while it was necessary for the declaration to be on the first line of the form. According to Muench (2001), this was a common problem with JavaServer Pages, though he did not mention a way to fix the problem with the XSU.

After having attempted two JSPs using the XSU, the parsing problems caused its abandonment. Instead, a JSP script not using the XSU, named last_trans.jsp, was created. In the body of the JSP, a while loop was used in order to return the XML in canonical form (see Appendix M) using QueryIDBean. Granularity was lost though, in comparison to the XSU. Some features, such as limiting the number of rows to return were not available using JSP.

To return XML, within a JSP while loop, tags were defined for the resultset. The stylesheet, new_style.xsl (see Appendix N), used the tags defined in order to appropriately apply the transformation, as shown in Figure 8.



All Transactions

Date	Type	Amount	ID	Comments
2001-04-05 01:10:33.0	counter deposit	100	463	null
2001-04-04 23:45:30.0	counter deposit	100	450	null
2001-04-04 23:44:42.0	counter withdrawal	100	449	null
2001-04-04 23:43:42.0	counter deposit	100	448	null
2001-04-04 19:07:20.0	counter deposit	150000	446	null
2001-04-04 18:55:19.0	counter deposit	200	445	null
2001-04-04 18:53:00.0	counter deposit	200	444	null
2001-04-04 18:50:41.0	counter deposit	200	443	null
2001-04-04 18:49:21.0	counter deposit	200	442	null
2001-04-04 18:46:50.0	counter deposit	200	441	null
2001-04-04 18:46:33.0	counter deposit	200	440	null
2001-04-04 18:44:06.0	counter deposit	200	439	null
2001-04-04 18:42:37.0	counter deposit	200	438	null
2001-04-04 18:40:32.0	counter deposit	200	437	null
2001-04-04 18:13:08.0	atm fee	1.5	435	ref transaction 434
2001-04-04 18:13:06.0	atm deposit	400	434	null
2001-04-04 17:37:12.0	counter deposit	150	430	null
2001-04-04 17:16:48.0	counter deposit	300	423	null
2001-04-04 15:58:40.0	counter deposit	100	421	null

Figure 8

The template style was used for the XSLT stylesheet. Instead of creating a single root node at the top of the stylesheet, and telling the stylesheet to do everything below it for each matching XML element, a template treats each element individually and applies different transformations to each one. A similar script, which retrieved only deposit transactions (see Appendix O), was transformed by the single-root node template, trans_style.xsl. The results were the same, but the template style allowed more flexibility.

As a counterpoint to the JSP that retrieved deposit transactions, XSQL was used to create a script performing the same functionality. Oracle designed XSQL as a way for non-programmers to develop web-based applications. According to the Oracle 8i Application

Developer’s Guide for XML, XSQL utilizes the XML Parser for Java version 2 and the XML SQL Utility for generating XML pages for SQL queries (2000). Anyone with SQL knowledge can create an XSQL page. It is intended to hide all the complexities involved including the creation of a connection to the database, querying the database, and returning the resultset, all of which a Java developer would have to worry about if they were developing Java servlets or JSPs.

Independent of what type of DML was to be executed, a database connection needed to be defined in the XSQLConfig.xml file. This file holds all the necessary configuration information for XSQL servlets. Figure 9 shows the entry created in order to setup a connection o the schema “project”.

```
<connection name="banking">
   <username>project</username>
   <password>masters</password>
   <dburl>jdbc:oracle:thin:@localhost:1521:ORCL</dburl>
   <driver>oracle.jdbc.driver.OracleDriver</driver>
</connection>
```

Figure 9

Since it is an XML page, all entries have to be well-formed. When a connection to the database is needed in an XSQL servlet, the connection tag’s name attribute would be used to identify the appropriate connection.

The past deposit transaction XSQL script, last_five_dep.xsql, contained an SQL statement selecting a defined number of columns. Unlike the JSP, XSQL did not require an explicit loop in order to produced the XML for each resultset row, as figure 10 shows. Only the SQL statement was necessary.

```
<?xml version="1.0" ?>
<?xml-stylesheet type="text/xsl" href="trans_style.xsl"?>

<xsql:query connection="banking" rowset-element="Transactions" row-element="Transaction"
max-rows="5" xmlns:xsql="urn:oracle-xsql">

  SELECT to_char(transaction_date, ’MM-DD-YYYY’) as "Date", transaction_type as "Type",
    amount as "Amount", transaction_id as "ID", comments as "Comments"
  FROM transaction
  WHERE account_number = {@acc_id} AND transaction_type = ’counter deposit’
  OR transaction_type = ’atm deposit’

</xsql:query>
```

Figure 10

The XSU looped through the resultset behind the scenes. This is an added bonus for non-programmers who are unfamiliar with control structures such as loops and conditional statements. The resultset columns were defined the same way as the tags for last_trans.jsp in the SQL select statement, so the same trans_style.xsl was applied in order to transform the query results HTML. Although explicitly using one of the classes of the XSU did not work in one of the previous pages, the XSU worked fine running in the background for the XSQL servlets. This made evident that the problems with the XSU must have been related to its use in a JavaServer Page.

As the previous three scripts showed, the SQL select statements can contain an alias for each column, as in XSQL. In the JSP scripts, how the resultsets were tagged was independent of the SQL statement and what the actual data contained, thereby separating content from presentation. A final XSQL page created used the wildcard * in the select statement (see Appendix P). The * indicated to the database server to return all columns in the resultset. When no columns are specified in an XSQL, the XSU returns the resultset using the table attribute names for the tags. This allows for faster querying. Using one of the templates already used by another page above, this page was transformed into an HTML table, demonstrating that creating the most general template allowed for a variety of pages to utilize it. This was one of the simplest pages to create.

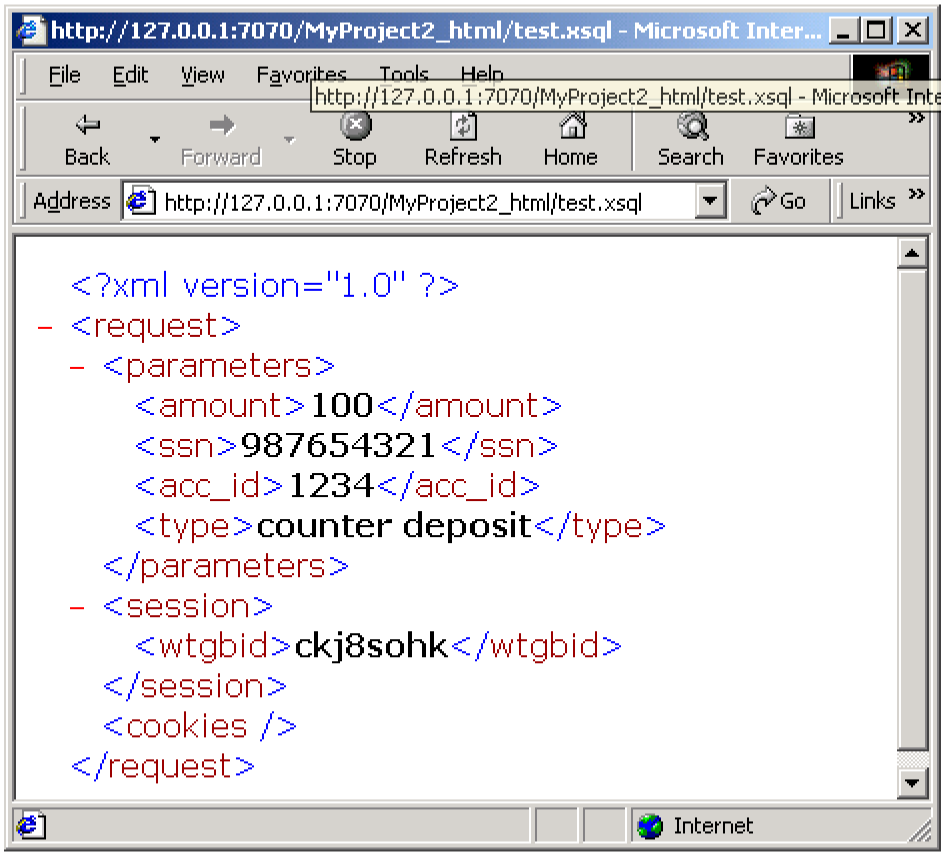
Another attempt at using the combination of Java and XML was with the "counter deposit" page. This page contained a form that passes the account number and transaction amount to an XSQL servlet page that would complete the deposit transaction.

In order to do an XSQL insertion, an XML stylesheet was created (see Figure 11) to turn the form parameter values into XML canonical form with tags named after the attributes in the transaction table.

```
<?xml version="1.0" ?>
<ROWSET xmlns:xsl="http://www.w3.org/1999/XSL/Transform" xsl:version="1.0">
  <xsl:for-each select="request/parameters">
    <ROW>
      <TRANSACTION_TYPE><xsl:value-of select="type"/></TRANSACTION_TYPE>
      <AMOUNT><xsl:value-of select="amount"/></AMOUNT>
      <CLIENT_SSN><xsl:value-of select="ssn"/></CLIENT_SSN>
      <ACCOUNT_NUMBER><xsl:value-of select="acc_id"/></ACCOUNT_NUMBER>
    </ROW>
  </xsl:for-each>
</ROWSET>
```

Figure 11

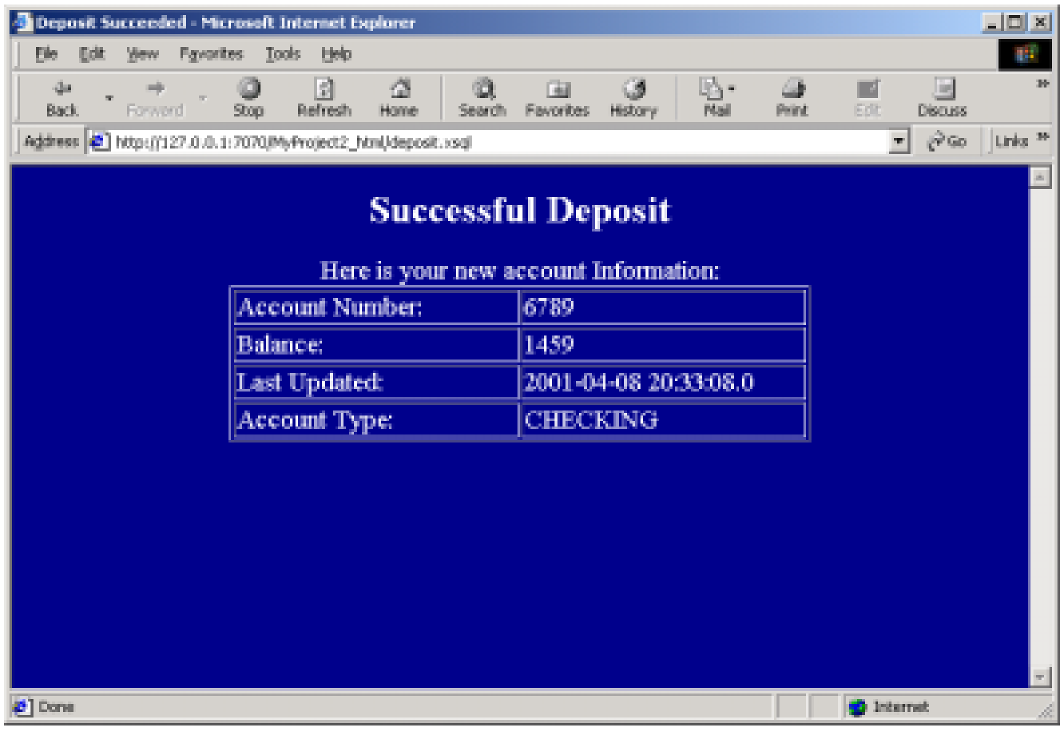
This was necessary because, as Figure 12 shows, the XSQL page would return a request document with all the form parameter values, but the tags surrounding each parameter value would use the names given in the form, and not the names of the actual attributes in the database table. The table attribute names were necessary in order to insert each value into the correct column.


http://127.0.0.1:7070/MyProject2_html/test.xsql - Microsoft Inter...
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites
Address http://127.0.0.1:7070/MyProject2_html/test.xsql
Go Links
Internet

```
  <?xml version="1.0" ?>
- <request>
  - <parameters>
      <amount>100</amount>
      <ssn>987654321</ssn>
      <acc_id>1234</acc_id>
      <type>counter deposit</type>
    </parameters>
  - <session>
      <wtgbid>ckj8sohk</wtgbid>
    </session>
    <cookies />
  </request>
```

Figure 12

If left as is, a successful insertion would return another XML page with little feedback to the client other than one row was inserted. If the insertion were unsuccessful, an XML error message would be returned. For better usability, an extra SQL statement was added that returned the current balance of the account in XML and created an XSLT stylesheet to transform the data. Using an additional stylesheet (see Appendix Q) containing an XSLT case statement, a successful transaction would return current account information in an HTML formatted table (see figure 13), and an unsuccessful transaction would return the error message, also formatted in a table (see figure 14). Appropriately, the error message returned in figure 14 came from one of the triggers created for the business rule implementation.

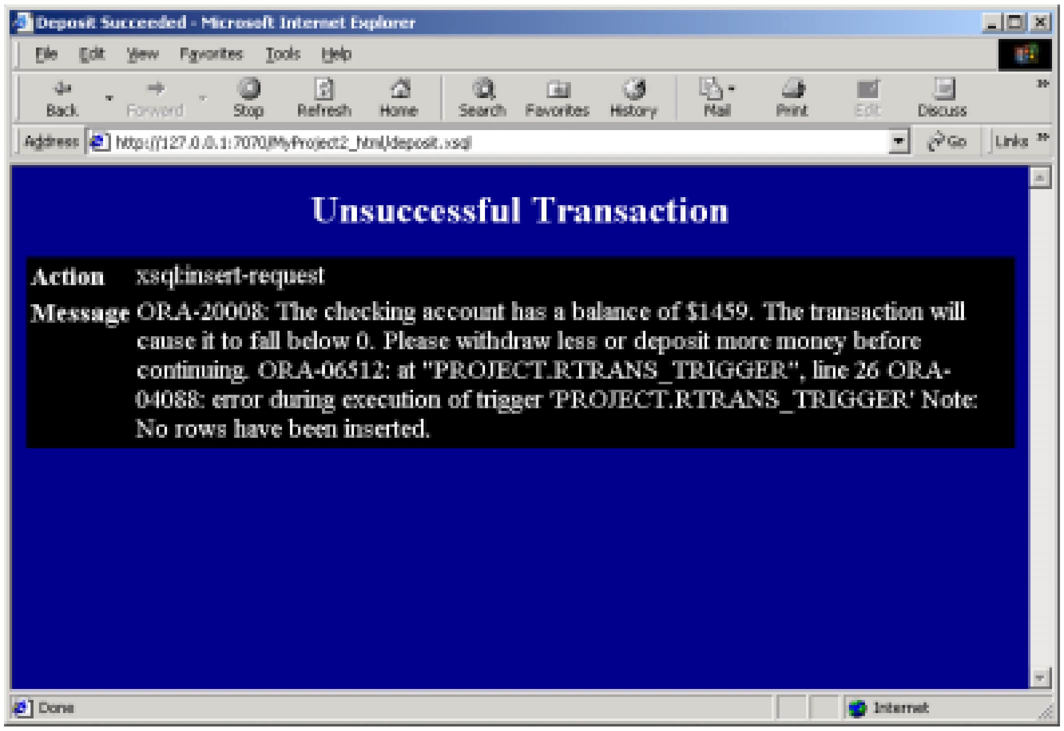

Deposit Succeeded - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss
Address http://127.0.0.1:7070/MyProject2_html/deposit.xsql
Go Links
Done
Internet

Successful Deposit

Here is your new account Information:

Account Number:	6789
Balance:	1459
Last Updated:	2001-04-08 20:33:08.0
Account Type:	CHECKING

Figure 13


Deposit Succeeded - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Discuss
Address http://127.0.0.1:7070/MyProject2_html/deposit.xsql
Go Links
Done
Internet

Unsuccessful Transaction

Action	xsql:insert-request
Message	ORA-20008: The checking account has a balance of $1459. The transaction will cause it to fall below 0. Please withdraw less or deposit more money before continuing. ORA-06512: at "PROJECT.RTRANS_TRIGGER", line 26 ORA-04088: error during execution of trigger 'PROJECT.RTRANS_TRIGGER' Note: No rows have been inserted.

Figure 14

A second page similar to the deposit was created, but a QueryIDBean was used to get the option values for a select list within the form (see Appendix R) with a complex SQL query. As with any scripting language, this was easy to do with JSP.

An attempt was made to use a Java Servlet to insert a new deposit transaction. However, similar to the problems I encountered with business rule 5, after much debugging and testing, the idea was abandoned. For a low to mid-level programmer, Java Servlets add much more complexity, albeit greater granularity and control, than JavaServer Pages and XSQL Servlets.

As the scripts showed, there was an added layer of complexity for using XSQL and JSP with XML. Instead of using one script to create a form and gather form parameter values to insert into a database, a developer has to first spend time creating an XSQL script with the DML statement, and then transform the form parameter values into XML, before any data can be inserted into the database.

Evaluation

The criteria used to evaluate the results of this project, and whether if it was successful, are shown in figure 15:

Time	**how much was spent debugging and solving problems versus actual development**
Problems	**what types of problems were encountered**
Complexity of the pages	**both for development and product – how complex was it to build the pages, and how complex were the resulting pages**

Figure 15

As the time table shows, more time was spent during the development, testing, and debugging phases of the web pages than for the development of the stored procedures. As mentioned earlier, few problems were encountered during the implementation of the business rules, most likely due to the fact that using Java stored procedures in Oracle was not a new integration. Though there was Java programming involved, the procedures needed for this project were all simple and similar, only differing in what kind of DML to execute. Someone new to Java stored procedures can easily figure out how to create a procedure, such as the ones used here, with a little help from Oracle documentation.

In terms of the web pages, problems encountered with the Oracle XML SQL Utility and the Microsoft parser slowed down development dramatically. The XSU was purported to work in many of the resources. Finding an explanation from Oracle was difficult. No documentation was found to note problems with JSP and the XSU. Muench (2001) answered a forum question regarding this problem, but when asked to explain how to fix it, no answer was given. Time was also spent finding software fixes at the Microsoft and Oracle site. At the time of development, the version of the XML Development Kit, which contained all the parsers and utilities including the XSU, installed with the Oracle server was the latest available. Upgrading the Microsoft software also took time and deduction since installing the parser in different modes caused different results with the pages. Debugging the code for the classes was considered, but forsaken because of the time it would take and the high probability that the problem was not within the class.

After parser problems were solved, the actual development went more quickly. Using the JSP and XSQL scripting languages, less time was spent on the intricacies of syntax, control structures and other pure programming aspects, which are expected in Java Servlets and Java stored procedures. Still, some Java development was needed in order to create the Java Bean and the connection class. This was necessary to eliminate repetitive coding because of their frequent use. If they were not created, the Java code would have been embedded in the JSP each time it was needed. Also, because of the limited time frame for the completion of this project, designing and building more complex pages would have been difficult. In addition, time was spent on configuration and debugging because some of the documentation available was not straightforward.

Since XML was used in most of the scripts, time was spent creating XSLT stylesheets for transformations of data going to and coming from the database. It is understandable to have to transform data coming from the server to a web friendly format, but transforming to insert data added extra layers of work. In this type of situation, the ability to use XML seemed like more added work than a benefit.

With the problems of the XSU, the intricacies of the Java Servlets, the actual complexity of the resulting pages were low. Both the XSU and Java Servlets would have allowed more control and more complex transactions. One example of the limitations of JSP is the inability to get metadata for the resultsets. In a Java Servlet, metadata could have been dynamically retrieved for each column in the resultset to use as tags. In the JSP scripts, SQL column aliases and hand coding of the tags were used. The JSP technology was developed by Sun for the purpose of allowing non-Java web developers to use Java in their pages. Unseen to the web developer who chooses JSP, JavaServer Pages are compiled into Java Servlets, but in development, are wrapped up simply for use.

CONCLUSION

Based on the criteria used for evaluation, and the actual product, it can be said that building a Java/XML web database may be a little more difficult than alleged to be. A few problems were faced when it came to compatibility with parsers and versions with XML. Since XML is considered to be a relatively young "language", and many of the software industry is scrambling to be the first and the best in implementing it with their software products, many disparities still arise when trying to use it across different platforms. One glaring problem was illustrated when trying to use Sun Microsystem's JSP technology in conjunction with Microsoft's XML Parser and the Oracle database server.

Another difficulty was the necessity of Java programming experience, even for JSP. Indeed it is a scripting language, but its effective use required knowledge of Java on the part of the developer. Although the Java programs written for the development of this project were not too complex, an understanding of basic Java and JDBC programming were still necessary.

Nevertheless, the web application built is considered to be a success. Not only did the application adhere to business rules because of Java and PL/SQL, data was dynamically brought to the web with JSP and XSQL, and successfully displayed using XML and XSLT. Although, the user interface mocked up inherently limited the complexity of the project, given time, a more complex interface could be built with the tools available.

Both XSQL and JSP worked nicely for this project. After getting past some of the programming problems, pages became easier and faster to develop. The reusable nature of the Java Bean and connection class contributed to the accelerated pace. Some of Aslam's (1998) fears regarding Java should be alleviated with the outcome of this project. Java's JSP technology allows the power of the language to be used in the form of an easier scripting language.

Interaction with Oracle was fast and seamless. Though only a subset of the technologies offered by Oracle were used in this project, the results still showed that the tools did indeed work together to bring dynamic content to the web.

Much was learned with the development of this project. The Oracle database, with its integrated technologies, is a very powerful platform for any type of developer at any experience level. However, even with the advances in XML integration technologies, developers must beware of some of the pitfalls of developing with XML, such as the platform incompatibilities illustrated in this project. Nevertheless, Oracle's database for the Internet should be taken advantage of. This project showed that the technologies available in the platform mostly work, and a dynamic web database application can be built in a short amount of time.

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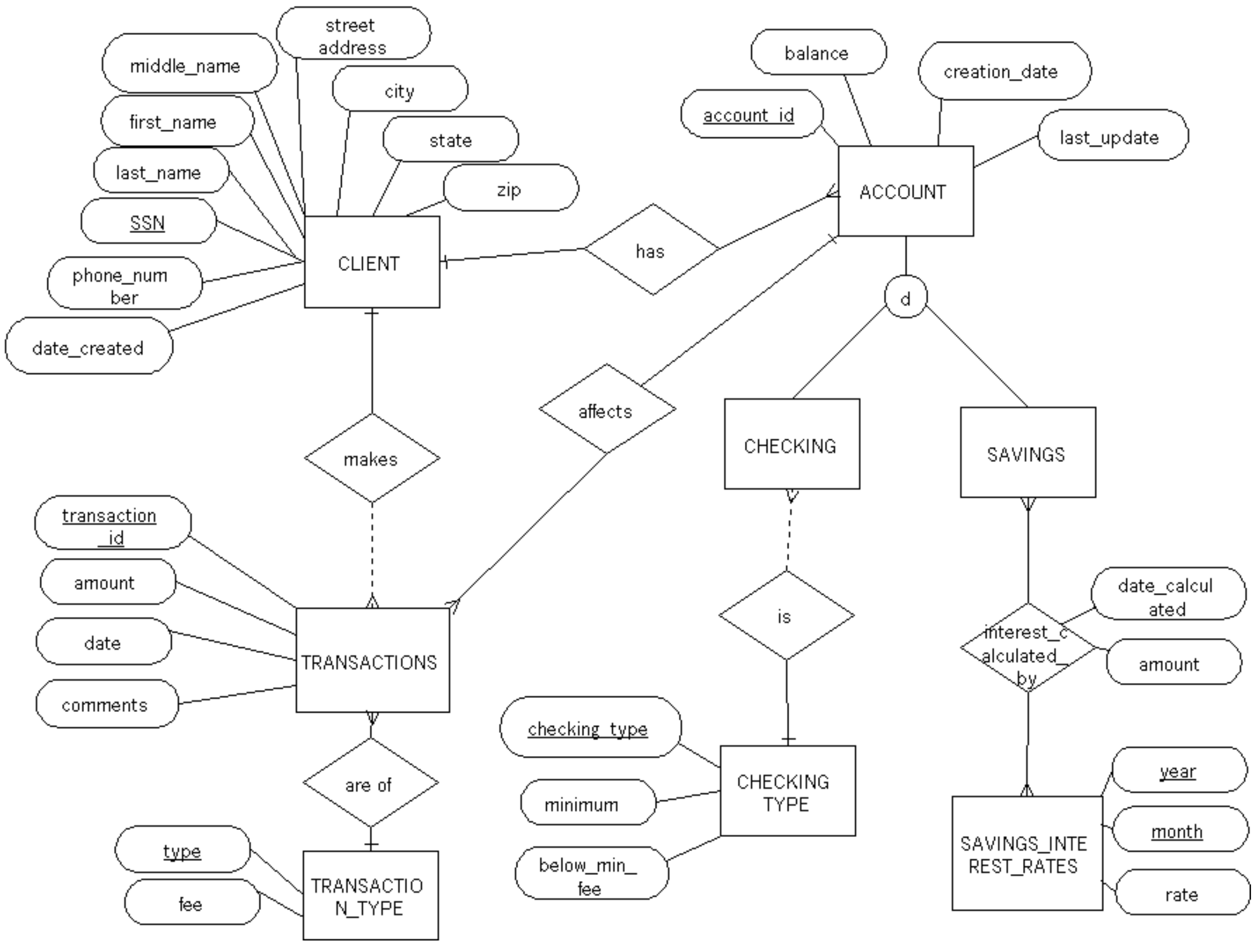
APPENDIX A

Banking Database Entity Relationship Diagram



APPENDIX B

Banking Database Tables

Client (ssn varchar2(9), last_name varchar2(30), first_name varchar2(30), middle_name varchar2(30), street_address varchar2(25), city varchar2(20), state varchar2(2), zip varchar2(9), phone_number varchar2(10), date_created date)

Transaction (transaction_id number, transaction_type varchar2(25) (FK from Transaction_Type), amount number, transaction_date date, comments varchar2 (100), client_ssn (FK from Client), account_number (FK references account))

Transaction_Type (transaction_type varchar2(25), fee number (5,2));

Account (account_number varchar2(15), balance number, creation_date date, last_update date, type varchar2(8), client_ssn varchar2(9) (FK from client), account_type varchar2(8))

Savings_Account (account_number varchar2(15) (FK from account), current_total_interest number)

Savings_Interest_Rate (year varchar2(4), month varchar2(2), rate_percent number)

Interest_Calculated_By (savings_account_number (FK from Savings_Account), year (FK from Savings_Interest_Rate, month (FK from Savings_Interest_Rate), date_calculated date, amount number)

Checking_Account (account_number varchar2(15) (FK from account), checking_type (FK from Checking_Type))

Checking_Type (type varchar2 (15), minimum_balance number, below_min_fee number)

APPENDIX C

Schema DDL and DML SQL Statements

TABLES

```
create table CLIENT (ssn varchar2(9) primary key, last_name varchar2(30) not null,
first_name varchar2(30) not null, middle_name varchar2(30), street_address varchar2(25)
not null, city varchar2(20) not null, state varchar2(2) not null, zip varchar2(10) not null,
phone_number varchar2(10), date_created date not null);
```

```
create table TRANSACTION (transaction_id number primary key, transaction_type
varchar2(50) not null, amount number not null, transaction_date date not null, comments
varchar2 (100), client_ssn varchar2(9) not null, account_number varchar2(15) not null);
```

```
create table TRANSACTION_TYPE (transaction_type varchar2(25) primary key, fee
number (5,2) not null);
```

```
create table ACCOUNT (account_number varchar2(15) primary key, creation_date date
not null, balance number not null, client_ssn varchar2(9) not null, last_update date,
account_type varchar2(8));
```

```
create table SAVINGS_ACCOUNT (account_number varchar2(15) primary key,
current_total_interest number);
```

```
create table CHECKING_ACCOUNT (account_number varchar2(15) primary key,
checking_type varchar2(15) not null);
```

```
create table SAVINGS_INTEREST_RATE (year number(4), month number(2),
rate_percent number(3,3) not null, primary key (year, month));
```

```
create table INTEREST_CALCULATED_BY (savings_account_number varchar2(15),
year number(4),month number(2), date_calculated date not null, amount number not null,
primary key (savings_account_number, year, month));
```

```
create table CHECKING_TYPE (type varchar2 (15) primary key, minimum_balance
number not null, below_min_fee number not null);
```

VIEWS

```
create or replace view fee_trans as select * from transaction;
```

ADDITIONAL CONSTRAINTS

APPENDIX C (cont.)

```
alter table transaction add constraint check_amount CHECK (amount > 0);
alter table transaction add constraint type_fk_trans foreign key (transaction_type)
references transaction_type;
alter table transaction add constraint ssn_fk_trans foreign key (client_ssn) references
client;
alter table transaction add constraint accnum_fk_trans foreign key (account_number)
references Account;
alter table account add constraint clientssn_fk_acc foreign key (client_ssn) references
Client;
alter table account add constraint check_acctype CHECK (account_type IN
(’CHECKING’, ’SAVINGS’));
alter table savings_account add constraint accnum_sav_fk foreign key (account_number)
references account;
alter table checking_account add constraint accnum_ch_fk foreign key (account_number)
references account;
alter table checking_account add constraint ct_fk_checktype foreign key (checking_type)
references checking_type;
```

DATA INSERTIONS

```
insert into transaction_type values (’counter deposit’, 0);
insert into transaction_type values (’new account’, 0);
insert into transaction_type values (’atm deposit’, 1.50);
insert into transaction_type values (’check’, 0);
insert into transaction_type values (’counter withdrawal’, 0);
insert into transaction_type values (’atm withdrawal’, 1.50);
insert into transaction_type values (’atm fee’, 0);
insert into transaction_type values (’below minimum balance collegiate’, 25.00);
insert into transaction_type values (’below minimum balance personal’, 25.00);
insert into transaction_type values (’below minimum balance free’, 30.00);
insert into transaction_type values (’below minimum balance express’, 40.00);

insert into checking_type values (’collegiate’, 100.00, 25.00);
insert into checking_type values (’personal’, 250.00, 25.00);
insert into checking_type values (’free’, 150.00, 30.00);
insert into checking_type values (’express’, 50.00, 40.00);
insert into checking_account values (’82736673’, sysdate, 0, ’987654321’, ’personal’);

insert into savings_interest_rate values (2001, 03, .035);
insert into savings_interest_rate values (2001, 04, .045);
insert into savings_interest_rate values (2001, 05, .025);
insert into savings_interest_rate values (2001, 06, .056);
```

APPENDIX C (cont.)

```
insert into savings_interest_rate values (2001, 07, .032);
insert into savings_interest_rate values (2001, 08, .012);


insert into client (ssn, last_name, first_name, middle_name, street_address, city, state,
zip, phone_number, date_created) values (‘987654321’, ‘Hon, ‘Angela’, ‘K’, ‘2345
Drive’, ‘new york’, ‘ny’, ‘11111’, ‘7877658754’, sysdate);

insert into account (account_number, creation_date, balance, client_ssn, last_update,
account_type) values (‘1234’, sysdate, 0, ‘987654321’, sysdate, ‘CHECKING’);

insert into account (account_number, creation_date, balance, client_ssn, last_update,
account_type) values (‘7890’, sysdate, 0, ‘987654321’, sysdate, ‘SAVINGS’);

insert into checking_account (account_number, checking_type) values (‘1234’, ‘free’);

insert into transaction (transaction_type, amount, transaction_date, client_ssn,
account_number) values ('counter deposit', 1000, sysdate, '987654321', '1234');

insert into transaction (transaction_type, amount, transaction_date, client_ssn,
account_number) values ('atm deposit', 1000, sysdate, '987654321', '7890');

insert into transaction (transaction_type, amount, transaction_date, client_ssn,
account_number) values ('atm withdrawal', 200, sysdate, '987654321', '1234');

insert into transaction (transaction_type, amount, transaction_date, client_ssn,
account_number) values ('check', 200, sysdate, '987654321', '7890');
```

APPENDIX D

PL/SQL Package and Triggers for Table Transaction

```
CREATE OR REPLACE PACKAGE trans_var_pack AS
  --Declare externally visible (global) variables
    v_transaction_ids  transaction.transaction_id%TYPE;
    v_transaction_types transaction.transaction_type%TYPE;
    v_amounts transaction.amount%TYPE;
    v_transaction_dates transaction.transaction_date%TYPE;
    v_ssns  transaction.client_ssn%TYPE;
    v_comments  transaction.comments%TYPE;
    v_account_numbers transaction.account_number%TYPE;
    v_account_types account.account_type%TYPE;
END trans_var_pack;


CREATE OR REPLACE TRIGGER RTRANS_TRIGGER
  BEFORE INSERT or UPDATE on transaction
  --instead of INSERT on checking_transaction
  --Must use an instead of trigger on object views

    FOR EACH ROW
      DECLARE
        NewID number;
        v_balance number;
        v_acc_type account.account_type%TYPE;
      BEGIN

        IF inserting THEN

            --if the transactions are anything other than deposits, make sure the balance will
            be above
            --zero after the transactions.  Get the account type to determine if checking or
            savings

            --get the account type
            SELECT account_type INTO v_acc_type
            FROM account
            WHERE account_number = :new.account_number;

            --checking account
            IF ((v_acc_type = 'CHECKING') AND
                        ((:new.transaction_type != 'counter deposit') AND (:new.transaction_type
                        != 'atm deposit') AND (SUBSTR (:new.transaction_type, 1, 5) != 'below')
                        AND (:new.transaction_type != 'atm fee'))) THEN
```

APPENDIX D (cont.)

```
      SELECT balance INTO v_balance
      FROM account
      WHERE account_number = :new.account_number;

      IF (v_balance - :new.amount < 0) THEN
              RAISE_APPLICATION_ERROR (-20008, 'The checking account has a
              balance of $' || v_balance ||
              '.  The transaction will cause it to fall below 0.  Please withdraw less or
              deposit more money ' || 'before continuing.');
      END IF;

    --savings account
  ELSIF ((v_acc_type = 'SAVINGS') AND ((:new.transaction_type != 'counter
  deposit') AND (:new.transaction_type != 'atm deposit'))) THEN

      SELECT balance INTO v_balance
      FROM account
      WHERE account_number = :new.account_number;

      IF (v_balance -:new.amount < 0) THEN
              RAISE_APPLICATION_ERROR (-20009, 'The savings account has a
              balance of $' || v_balance ||
              '.  The transaction will cause it to fall below 0.  Please withdraw less or
              deposit more money ' ||
                'before continuing.');
      END IF;

  END IF;

  select trans_seq.nextval into NewID from dual;
  :new.transaction_id := NewID;

  :new.transaction_date := sysdate;

  --capture all the values for the record that will be inserted
  trans_var_pack.v_transaction_ids := :new.transaction_id;
  trans_var_pack.v_transaction_types := :new.transaction_type;
  trans_var_pack.v_amounts := :new.amount;
  trans_var_pack.v_transaction_dates := :new.transaction_date;
  trans_var_pack.v_ssns := :new.client_ssn;
  trans_var_pack.v_account_numbers := :new.account_number;
```

APPENDIX D (cont.)

```
      --assign the account type value to the global variable to be used in the after insert
      --trigger
      trans_var_pack.v_account_types := v_acc_type;

      --use the debug package to see what is being passed
      debug.reset;
      debug.debug ('transid ', trans_var_pack.v_transaction_ids);
      debug.debug ('transtype ', trans_var_pack.v_transaction_types);
      debug.debug ('acc_type ', trans_var_pack.v_account_types);

    else IF UPDATING
       :new.transaction_id := :old.transaction_id;

    END IF;

END RTRANS_TRIGGER;

--Statement level trigger for transaction table
CREATE OR REPLACE TRIGGER STRANS_TRIGGER
  AFTER INSERT ON transaction
  --AFTER INSERT ON checking_transaction
  --can't use regular triggers on views, have to use instead of triggers.  Can't use instead of
  --triggers here, so must resort to a long statement level trigger on transaction

    DECLARE
      v_transaction_id  transaction.transaction_id%TYPE;
      v_transaction_type  transaction.transaction_type%TYPE;
      v_amount  transaction.amount%TYPE;
      v_transaction_date  transaction.transaction_date%TYPE;
      v_ssn  transaction.client_ssn%TYPE;
      v_comments  transaction.comments%TYPE;
      v_account_number  transaction.account_number%TYPE;
      v_account_type account.account_type%TYPE;

      new_trans_type transaction.transaction_type%TYPE;
      new_fee transaction_type.fee%TYPE;
      atm_fee transaction_type.fee%TYPE;
      cur_balance account.balance%TYPE;
      min_balance checking_type.minimum_balance%TYPE;
      check_type  checking_type.type%TYPE;
      min_fee checking_type.below_min_fee%TYPE;
      BEGIN
```

APPENDIX D (cont.)

```
--Get the values for all the variables, except v_comments, from the global variables
v_transaction_id := trans_var_pack.v_transaction_ids;
v_transaction_type := trans_var_pack.v_transaction_types;
v_amount := trans_var_pack.v_amounts;
v_transaction_date := trans_var_pack.v_transaction_dates;
v_ssn := trans_var_pack.v_ssns;
v_account_number := trans_var_pack.v_account_numbers;
v_account_type := trans_var_pack.v_account_types;

debug.debug (’transaction_id ’, v_transaction_id);
debug.debug (’trans_type ’, v_transaction_type);
debug.debug (’amount ’, v_amount);
debug.debug (’trans_date ’, v_transaction_date);
debug.debug (’ssn ’, v_ssn);
debug.debug (’account_number ’, v_account_number);

--Start the if statements.  The transaction_type will be checked to instigate the
--appropriate actions.

--check if a checking transaction or a savings transaction
IF (v_account_type = ’CHECKING’) THEN

  --counter_deposit just update the account balance
  IF (v_transaction_type = ’counter deposit’) THEN
    banking_mgmt.deposit_update_bal (v_amount, v_account_number);

  --atm_deposit get the current charge for the atm_deposit
  ELSIF (v_transaction_type = ’atm deposit’) THEN
    atm_fee := banking_mgmt.get_fee (’atm deposit’);

    --if fee does not return an error, insert a new transaction
    --into the transaction table for charging the fee
    --then, update the account balance with the deposit amount subtracting the fee
    IF (atm_fee != -1) THEN
      new_trans_type := ’atm fee’;
     banking_mgmt.insert_trans (v_account_number, new_trans_type, v_ssn,
    atm_fee, ’ref transaction ’ || v_transaction_id);
      banking_mgmt.deposit_update_bal_fee (v_amount, atm_fee, account_number);

    ELSE RAISE_APPLICATION_ERROR (-20001, ’Could not retrieve the fee for
    an atm deposit transaction’);
    END IF;
```

APPENDIX D (cont.)

```
    --if counter withdrawal or check or atm, check if account current balance is above
    --minimum.  if so, do nothing but update account.  If not, charge a fee, then update
    --the balancewith the withdrawal and the fee

    ELSIF ((v_transaction_type = ’counter withdrawal’) OR (v_transaction_type =
    ’check’) OR (v_transaction_type = ’atm withdrawal’)) then

      --first, if this is an atm transaction, charge the fee and subtract the amount
      IF (v_transaction_type = ’atm withdrawal’) THEN
        atm_fee := banking_mgmt.get_fee (’atm withdrawal’);

        --make sure fee isn’t minus 1, or raise app error
       IF (atm_fee != -1) THEN

        --insert a new fee transaction
        new_trans_type := ’atm fee’;


      banking_mgmt.insert_trans (v_account_number, new_trans_type, v_ssn, atm_fee,
      ’ref transaction ’ || v_transaction_id);

        --just reduce the balance by the fee first, the actual transaction amount will be
        --reduced in the outer if block
        banking_mgmt.reduction_update_bal (atm_fee, v_account_number);

       --raise app error
      ELSE RAISE_APPLICATION_ERROR (-20002, ’Could not retrieve the fee for
      an ATM transaction’);

   END IF;

END IF;

      --get current balance
      cur_balance := banking_mgmt.get_balance (v_account_number);
      debug.debug (’current balance ’, cur_balance);

      --get account type minimum balance
      min_balance := checking_mgmt.get_minimum (v_account_number);
      debug.debug (’minimum balance ’, min_balance);

      IF ((cur_balance != -1) AND (min_balance != -1)) THEN

        --check if current balance is greater than minimum balance
```

APPENDIX D (cont.)

```
            IF ((cur_balance - v_amount) < min_balance) THEN

              --get penalty fee for being below minimum allowed balance
              min_fee := checking_mgmt.get_min_fee (v_account_number);
              debug.debug ('min fee ', min_fee);

              --get checking type
              check_type := checking_mgmt.get_check_type (v_account_number);
              debug.debug ('check type', check_type);

              IF ((min_fee != -1) AND (check_type IS NOT NULL)) THEN

                --insert a new penalty fee transaction
                new_trans_type := 'below minimum balance ' || check_type;
              banking_mgmt.insert_trans (v_account_number, new_trans_type, v_ssn,
              min_fee, 'ref transaction ' || v_transaction_id);

                --update the checking account's balance
                banking_mgmt.reduction_update_bal_fee (v_amount, min_fee, v
                v_account_number);

              ELSE RAISE_APPLICATION_ERROR (-20003, 'Could not retrieve the
appropriate fee for falling below minimum balance or the account checking type');
              END IF;

            --current balance greater than min balance
            ELSIF ((cur_balance - v_amount) >= min_balance) THEN

              --just deduct the transaction amount from the current balance
              banking_mgmt.reduction_update_bal (v_amount, v_account_number);

            END IF;

          --raise app error if either current balance or minimum balance is minus 1
          else RAISE_APPLICATION_ERROR (-20004, 'Could not retrieve information
          regarding the account current balance and minimum allowed balance');
          END IF;


      END IF;

       ELSIF (v_account_number = 'SAVINGS') THEN

         IF (v_transaction_type = 'counter deposit') THEN
```

APPENDIX D (cont.)

```
  --counter deposit, just update balance
  banking_mgmt.deposit_update_bal (v_amount, v_account_number);

ELSIF (v_transaction_type = 'atm deposit') THEN

  --atm deposit, insert a new fee transaction, then update balance
  atm_fee := banking_mgmt.get_fee ('atm deposit');

  --if fee does not return an error, insert a new transaction
  --into the transaction table for charging the fee
  --then, update the account balance with the deposit amount subtracting the fee
  IF (atm_fee != -1) THEN
    new_trans_type := 'atm fee';
    banking_mgmt.insert_trans (v_account_number, new_trans_type, v_ssn,
    atm_fee, 'ref transaction ' || v_transaction_id);
    banking_mgmt.deposit_update_bal_fee (v_amount, atm_fee,
   v_account_number);
 ELSE RAISE_APPLICATION_ERROR (-20005, 'Could not retrieve the fee for

  atm deposit transaction');
 END IF;

ELSIF (v_transaction_type = 'atm withdrawal') THEN

  --atm withdrawal, get the fee, insert new fee transaction, then update balance
  atm_fee := banking_mgmt.get_fee ('atm withdrawal');

  --if fee does not return an error, insert a new transaction
  --into the transaction table for charging the fee
  --then, update the account balance with the deposit amount subtracting the fee
  IF (atm_fee != -1) THEN
    new_trans_type := 'atm fee';
    banking_mgmt.insert_trans (v_account_number, new_trans_type, v_ssn,
    atm_fee, 'ref transaction ' || v_transaction_id);
    banking_mgmt.reduction_update_bal_fee (v_amount, atm_fee,
    v_account_number);
  ELSE RAISE_APPLICATION_ERROR (-20006, 'Could not retrieve the fee for
    an atm withdrawal transaction');
  END IF;

ELSIF (v_transaction_type = 'counter withdrawal') THEN

  --counter withdrawal, update balance
  banking_mgmt.reduction_update_bal (v_amount, v_account_number);
```

APPENDIX D (cont.)

```
    ELSIF (v_transaction_type = 'savings check') THEN

      --using checks from the savings account costs a nominal fee, get fee, insert new
      --transaction then update balance

      --get the fee for savings check transaction
      new_fee := banking_mgmt.get_fee ('savings check');

      --if fee does not return minus 1, insert a new transaction
      IF (new_fee != -1) THEN
        new_trans_type := 'savings check';
        banking_mgmt.insert_trans (v_account_number, new_trans_type, v_ssn,
        new_fee, 'ref transaction ' || v_transaction_id);

         --update the account balance
         banking_mgmt.reduction_update_bal_fee (v_amount, new_fee,
         v_account_number);

      ELSE RAISE_APPLICATION_ERROR (-20007, 'Could not retrieve the fee for a
         savings check transaction');
      END IF;

    END IF;

  END IF;

END STRANS_TRIGGER;
```

APPENDIX E

Java Stored Procedures

```
import java.sql.*;
import java.io.*;
import oracle.jdbc.driver.*;

 public class Banking extends Object {

  public static void depositUpdateBal (float transAmount, String accountNum) throws
SQLException
  {
    String sql = "UPDATE account SET balance = balance + ?, last_update = sysdate " +
    "WHERE account_number = ?";
      try {
       Connection conn = DriverManager.getConnection("jdbc:default:connection:");
       PreparedStatement prst = conn.prepareStatement(sql);
       prst.setFloat (1, transAmount);
       prst.setString (2, accountNum);
       prst.executeUpdate();
       prst.close();
       }
       catch (SQLException e) {
        System.err.println (e.getMessage());
        }
       }

  public static void depositUpdateBalFee (float transAmount, float fee, String
accountNum) throws SQLException
  {
    String sql = "UPDATE account SET balance = balance + ? - ?, last_update = sysdate"+
    " WHERE account_number = ?";
      try {
       Connection conn = DriverManager.getConnection ("jdbc:default:connection:");
       PreparedStatement prst = conn.prepareStatement(sql);
       prst.setFloat (1, transAmount);
       prst.setFloat (2, fee);
       prst.setString (3, accountNum);
       prst.executeUpdate();
       prst.close();
       }
       catch (SQLException e){
        System.err.println (e.getMessage());
        }
      }
```

APPENDIX E (cont.)

```
 public static void reductionUpdateBal (float transAmount, String accountNum) throws
SQLException
 {
   String sql = "UPDATE account SET balance = balance - ? " +
   "WHERE account_number = ?";
     try {
       Connection conn = DriverManager.getConnection("jdbc:default:connection:");
       PreparedStatement prst = conn.prepareStatement(sql);
       prst.setFloat (1, transAmount);
       prst.setString (2, accountNum);
       prst.executeUpdate();
       prst.close();
       }
     catch (SQLException e){
       System.err.println (e.getMessage());
       }
 }

 public static void reductionUpdateBalFee (float transAmount, float fee, String
accountNum) throws SQLException
 {
   String sql = "UPDATE account SET balance = balance - ? - ?, last_update = sysdate" +
   " WHERE account_number = ?";
   try {
     Connection conn = DriverManager.getConnection("jdbc:default:connection:");
     PreparedStatement prst = conn.prepareStatement(sql);
     prst.setFloat(1, transAmount);
     prst.setFloat(2, fee);
     prst.setString(3, accountNum);
     prst.executeUpdate();
     prst.close();
     }
   catch (SQLException e){
   System.err.println (e.getMessage());
   }
 }

 public static float getBalance (String accountNumber)
 {
   String sql = "SELECT balance FROM account WHERE account_number = ?";
   float balance =0;

   try {
     Connection conn = DriverManager.getConnection("jdbc:default:connection:");
```

APPENDIX E (cont.)

```
    PreparedStatement prst = conn.prepareStatement(sql);
    prst.setString (1, accountNumber);
    ResultSet rset = prst.executeQuery();

    while (rset.next())
    {
      balance = rset.getFloat(1);
    }
    rset.close();
    prst.close();
    return balance;
  }
  catch (SQLException e)
  {
    System.err.println (e.getMessage());
    return -1;
  }
}

 public static float getFee (String type)
{
  String sql = "SELECT fee from Transaction_Type where transaction_type = ?";
  float fee = 0;
  try {
    Connection conn = DriverManager.getConnection("jdbc:default:connection:");
    PreparedStatement prst = conn.prepareStatement(sql);
    prst.setString (1, type);
    ResultSet rset = prst.executeQuery();
    while (rset.next())
      {
      fee = rset.getFloat(1);
      }
    rset.close();
    prst.close();
    return fee;
  }
  catch (SQLException e)
  {
  System.err.println (e.getMessage());
  return -1;
  }
}

public static void insertTrans (String accountNum, String transType, String clientSsn,
```

APPENDIX E (cont.)

```
    float feeAmount, String newComments)
    {
    String sql = "Insert into fee_trans (transaction_type, amount, transaction_date, " +
    "client_ssn, comments, account_number) values (?, ?, sysdate, ?, ?, ?)";
    try{
      Connection conn = DriverManager.getConnection("jdbc:default:connection:");
      PreparedStatement prst = conn.prepareStatement(sql);
      prst.setString (1, transType);
      prst.setFloat (2, feeAmount);
      prst.setString (3, clientSsn);
      prst.setString (4, newComments);
      prst.setString (5, accountNum);
      prst.executeQuery();
      prst.close();
      }
    catch (SQLException e)
    {
      System.err.println (e.getMessage());
    }
  }

}
```

APPENDIX E (cont.)

```
import java.sql.*;
import java.io.*;
import oracle.jdbc.driver.*;

 public class Checking extends Object {

  public static float getMinimum (String accNum)
  {
    String sql = "SELECT minimum_balance FROM checking_type WHERE type IN " +
    "(SELECT checking_type FROM checking_account WHERE account_number = ?)";
    float minBal = 0;

    try {
      Connection conn  = DriverManager.getConnection ("jdbc:default:connection:");
      PreparedStatement prst = conn.prepareStatement(sql);
      prst.setString(1, accNum);
      ResultSet rset = prst.executeQuery();

      while (rset.next())
      {
        minBal = rset.getFloat(1);
      }

      rset.close();
      prst.close();
      return minBal;
    }
    catch (SQLException e)
    {
      System.err.println (e.getMessage());
      return -1;
    }
  }

 public static float getMinFee (String accNum)
  {
    String sql = "SELECT below_min_fee FROM checking_type WHERE type IN " +
    "(SELECT checking_type FROM checking_account WHERE account_number = ?)";

    float fee = 0;
    try {
      Connection conn = DriverManager.getConnection("jdbc:default:connection:");
      PreparedStatement prst = conn.prepareStatement(sql);
      prst.setString (1, accNum);
```

APPENDIX E (cont.)

```
      ResultSet rset = prst.executeQuery();
      while (rset.next())
        {
        fee = rset.getFloat(1);
        }
      rset.close();
      prst.close();
      return fee;
    }
    catch (SQLException e)
    {
    System.err.println (e.getMessage());
    return -1;
    }
  }

   public static String getCheckType (String accNum)
  {
    String sql = "SELECT checking_type FROM checking_account WHERE
account_number =?";

    String checkType = "";
    try {
      Connection conn = DriverManager.getConnection("jdbc:default:connection:");
      PreparedStatement prst = conn.prepareStatement(sql);
      prst.setString (1, accNum);
      ResultSet rset = prst.executeQuery();
      while (rset.next())
        {
        checkType = rset.getString(1);
        }
      rset.close();
      prst.close();
      return checkType;
    }
    catch (SQLException e)
    {
    System.err.println (e.getMessage());
    return null;
    }
  }
}
```

APPENDIX F

Package Specification and Body for Java Stored Procedures

```
CREATE OR REPLACE PACKAGE banking_mgmt AS
  PROCEDURE deposit_update_bal (trans_amount NUMBER, account_num
   VARCHAR2);
  PROCEDURE deposit_update_bal_fee (trans_amount NUMBER, fee NUMBER,
   account_num VARCHAR2);
  PROCEDURE reduction_update_bal (trans_amount NUMBER, account_num
   VARCHAR2);
  PROCEDURE reduction_update_bal_fee (trans_amount NUMBER, fee NUMBER,
   account_num VARCHAR2);
  FUNCTION get_balance (account_number VARCHAR2) RETURN NUMBER;
  FUNCTION get_fee (type VARCHAR2) RETURN NUMBER;
  PROCEDURE insert_trans (account_num VARCHAR2, trans_type VARCHAR2,
   client_ssn VARCHAR2, fee_amount NUMBER, new_comments VARCHAR2);
END banking_mgmt;

CREATE OR REPLACE PACKAGE BODY banking_mgmt AS
  PROCEDURE deposit_update_bal (trans_amount NUMBER, account_num
   VARCHAR2) AS LANGUAGE JAVA
   NAME 'Banking.depositUpdateBal(float, java.lang.String)';
  PROCEDURE deposit_update_bal_fee (trans_amount NUMBER, fee NUMBER,
   account_num VARCHAR2) AS LANGUAGE JAVA
   NAME 'Banking.depositUpdateBalFee(float, float, java.lang.String)';
  PROCEDURE reduction_update_bal (trans_amount NUMBER, account_num
   VARCHAR2) AS LANGUAGE JAVA
   NAME 'Banking.reductionUpdateBal (float, java.lang.String)';
  PROCEDURE reduction_update_bal_fee (trans_amount NUMBER, fee NUMBER,
    account_num VARCHAR2) AS LANGUAGE JAVA
   NAME 'Banking.reductionUpdateBalFee (float, float, java.lang.String)';
  FUNCTION get_balance (account_number VARCHAR2) RETURN NUMBER AS
    LANGUAGE JAVA
    NAME 'Banking.getBalance (java.lang.String) return float';
  FUNCTION get_fee (type VARCHAR2) RETURN NUMBER AS LANGUAGE JAVA
    NAME 'Banking.getFee (java.lang.String) return float';
  PROCEDURE insert_trans (account_num VARCHAR2, trans_type VARCHAR2,
    client_ssn VARCHAR2, fee_amount NUMBER, new_comments VARCHAR2) AS
    LANGUAGE JAVA
    NAME 'Banking.insertTrans (java.lang.String, java.lang.String, java.lang.String,
    float, java.lang.String)';
END banking_mgmt;
```

APPENDIX F (cont.)

```
PACKAGE checking_mgmt AS
  FUNCTION get_minimum (acc_num VARCHAR2) RETURN NUMBER;
  FUNCTION get_min_fee (acc_num VARCHAR2) RETURN NUMBER;
  FUNCTION get_check_type (acc_num VARCHAR2) RETURN VARCHAR2;
END checking_mgmt;

PACKAGE BODY checking_mgmt AS
  FUNCTION get_minimum (acc_num VARCHAR2) RETURN NUMBER AS
   LANGUAGE JAVA
   NAME ’Checking.getMinimum (java.lang.String) return float’;
  FUNCTION get_min_fee (acc_num VARCHAR2) RETURN NUMBER AS
   LANGUAGE JAVA
   NAME ’Checking.getMinFee (java.lang.String) return float’;
  FUNCTION get_check_type (acc_num VARCHAR2) RETURN VARCHAR2 AS
   LANGUAGE JAVA
END checking_mgmt;
```

APPENDIX G

PL/SQL Stored Procedure for Interest Calculation

```
--Stored procedure to calculate the monthly interest for a savings account.
--Once calculated, a new record is inserted into table interest_calculated_by.
--Then the interest is added to the savings_account current_total_interest attribute.
--Finally, the balance is updated in the account table.

CREATE OR REPLACE PROCEDURE calculate_interest AS

--local variables
v_rate savings_interest_rate.rate_percent%TYPE;
v_interest interest_calculated_by.amount%TYPE;
v_month savings_interest_rate.month%TYPE;
v_year savings_interest_rate.year%TYPE;

Begin
  v_month := to_char(sysdate, 'MM');
  v_year := to_char(sysdate, 'YYYY');

  --get the current interest rate
  SELECT rate_percent into v_rate
  FROM savings_interest_rate
  WHERE month = v_month and year = v_year;

  --loop through all the savings accounts
  FOR savaccount IN (SELECT account_number, balance FROM account
  WHERE account_type = 'SAVINGS') LOOP

  --calculate the account earned interest
  v_interest := (savaccount.balance * v_rate);

  --insert the new interest record into table
  INSERT into interest_calculated_by (savings_account_number, month, year,
date_calculated,
  amount) values (savaccount.account_number, v_month, v_year, sysdate, v_interest);

  --update the current_total_interest field of the savings account
  UPDATE savings_account
  SET current_total_interest = current_total_interest + v_interest
  WHERE account_number = savaccount.account_number;

  --update the savings account balance
  UPDATE account
  SET balance = balance + v_interest, last_update = sysdate
```

APPENDIX G (cont.)

```
  WHERE account_number = savaccount.account_number;

  END LOOP;
  COMMIT;

END calculate_interest;
```

APPENDIX H

QueryIDBean – Java Database Query Bean

```
import java.sql.*;

public class QueryIDBean
{
  Connection cn = null;
  ResultSet rset = null;
  boolean ownConnection = true;

  public void createConnect (Connection conn)
  {
    cn = conn;
    ownConnection = false;
  }

  public void createQuery (String sql)
  {
    try
    {
      if (cn == null)
        cn = DBConnection.dbConnect();
        rset = cn.createStatement().executeQuery(sql);
    }
    catch (SQLException e)
    {}
  }

  public boolean next()
  {
    try
    {     return (rset != null) ? rset.next() : false;    }
    catch (SQLException e)
    {     return false;    }
  }

  public String column (int columnNumber)
  {
    try
    {     return (rset != null) ? rset.getString(columnNumber) : "";    }
    catch (SQLException e)
    {     return "";    }
  }
```

APPENDIX H (cont.)

```
public void close()
  {
    try
    {
      rset.close();
      if (ownConnection)
      {        cn.close();      }
    }
    catch (Exception e)
    {}
  }
}
```

APPENDIX I

DBConnection – Connection Class

```
import java.sql.*;
import java.util.*;
import oracle.jdbc.driver.*;

public class DBConnection extends Object {

  public static Connection dbConnect() throws SQLException
  {
    String username = "project";
    String password = "masters";
    String jconnect = "jdbc:oracle:thin:@localhost:1521:ORCL";

    Connection cn = null;

    try
    {
      //Register the driver
      Driver dr = new oracle.jdbc.driver.OracleDriver();

      //Connect the JDBC thin driver
      cn = DriverManager.getConnection(jconnect, username, password);

      cn.setAutoCommit(false);

      return cn;
    }
    catch (Exception e)
    {
      throw new SQLException("Error loading JDBC Driver");
    }
  }

}
```

APPENDIX J

Retrieve_account_htm.jsp

```
<jsp:useBean id="qid" class="QueryIDBean" scope="session" />

<jsp:useBean id="acc_id" class="oracle.jsp.jml.JmlString" scope="session" >
<jsp:setProperty name="acc_id" property="value" param="acc_id" />
</jsp:useBean>

<jsp:useBean id="ssn" class="oracle.jsp.jml.JmlString" scope="session" >
<jsp:setProperty name="ssn" property="value" param="clientssn" />
</jsp:useBean>


<HTML>
<HEAD>
<TITLE>
Get Account Info
</TITLE>
</HEAD>
<BODY bgcolor="beige">

<% qid.createQuery("SELECT a.account_number, a.balance, a.last_update,
a.account_type" +
" FROM account a WHERE a.account_number = " + request.getParameter("acc_id") + "
AND a.client_ssn = " + request.getParameter("clientssn")); %>

<%while (qid.next()) { %>

  <table border="1" width="100%">
    <tr bgcolor="white">
      <td width="200">Account Number</td>
      <td width="200">Balance</td>
      <td width="200">Last Update</td>
      <td width="200">Type</td>
    </tr>
    <tr>
      <td width="100"><%= qid.column(1) %></td>
      <td width="100"><%= qid.column(2) %></td>
      <td width="100"><%= qid.column(3) %></td>
      <td width="100"><%= qid.column(4) %></td>
    </tr>
  </table>

  <table border="0">
```

APPENDIX J (cont.)

```
<tr>
 <td width="100">
     <form action="deposit.jsp" method="post">
       <input type="hidden" name="acc_id" value="<%= acc_id.getValue()
        %>"></input>
       <input type="hidden" name="ssn" value="<%= ssn.getValue() %>"></input>
       <input type="submit" size=181 style="WIDTH: 181px; HEIGHT: 25px"
       name="Deposit" value="Deposit"></input>
     </form>
   </td>
   <td width="100">
     <form action="transaction.jsp" method="post">
       <input type="hidden" name="acc_id" value="<%= acc_id.getValue()
       %>"></input>
       <input type="hidden" name="ssn" value="<%= ssn.getValue() %>"></input>
       <input type="submit" size=181 style="WIDTH: 181px; HEIGHT: 25px"
       name="Create A Transaction" value="Create A Transaction"></input>
     </form>
   </td>
  </tr>
  <tr>
   <td width="100">
     <form action="last_trans.jsp" method="get">
       <input type="hidden" name="acc_id" value="<%= acc_id.getValue()
       %>"></input>
       <input type="hidden" name="ssn" value="<%= ssn.getValue() %>"></input>
       <input type="submit" size=181 style="WIDTH: 181px; HEIGHT: 25px"
       value="All Past Transactions"></input>
     </form>
   </td>
   <td width="100">
     <form action="last_five_dep.xsql" method="post">
       <input type="hidden" name="acc_id" value="<%= acc_id.getValue()
       %>"></input>
       <input type="hidden" name="ssn" value="<%= ssn.getValue() %>"></input>
       <input type="submit" size=181 style="WIDTH: 181px; HEIGHT: 25px"
       name="lastfivedep" value="Last Five Deposits"></input>
     </form>
   </td>
  </tr>
  <tr>
   <td width="100">
     <form action="checks.xsql" method="post">
```

APPENDIX J (cont.)

```
          <input type="hidden" name="acc_id" value="<%= acc_id.getValue()
           %>"></input>
          <input type="hidden" name="ssn" value="<%= ssn.getValue() %>"></input>
          <input type="submit" size=181 style="WIDTH: 181px; HEIGHT: 25px"
          name="lastfivechecks" value="Last Five Checks"></input>
        </form>
      </td>
      <td width="100">
        <form action="checking_type.jsp" method="post">
          <input type="hidden" name="acc_id" value="<%= acc_id.getValue()
          %>"></input>
          <input type="hidden" name="ssn" value="<%= ssn.getValue() %>"></input>
          <input type="submit" size=181 style="WIDTH: 181px; HEIGHT: 25px"
          name="checkingtype" value="Checking Type"></input>
        </form>
      </td>
    </tr>
  </table>
<% } qid.close(); %>
</BODY>
</HTML>
```

APPENDIX K

Last_five_trans.jsp

```
<jsp:directive.page contentType = "text/xml" import="java.sql.*, DBConnection,
oracle.xml.sql.query.*"/>
<%
  //connect to db
  Connection conn = DBConnection.dbConnect();

  //get the parameter of to search for
  String param = request.getParameter ("acc_id");

  //SQL statement to search for all transactions by the passed ID
  String sql = "SELECT transaction_date as \"Date\", transaction_type as \"Type\"," +
              " amount as \"Amount\", transaction_id as \"ID\", comments as \"Comments\""
+
              " FROM transaction" +
              " WHERE account_number = " + param +
              " ORDER BY transaction_date desc";

  //Create an Oracle XML object - page 427
  OracleXMLQuery oxmlq = new OracleXMLQuery (conn, sql);

  oxmlq.setStyleSheet("trans_style.xsl");

  //Retrieve only the first five transactions, which would be the most recent
  oxmlq.setMaxRows(5);

  //Set the document element for the rowset
  oxmlq.setRowsetTag("Transactions");

  //Set the row tag for each row in the result
  oxmlq.setRowTag("Transaction");

  //Get the XML results as a String and write to the output stream
  out.println(oxmlq.getXMLString());

  //Close the db connection
  conn.close();
%>
```

APPENDIX L

Trans_style.xsl

```
<?xml version="1.0"?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/1999/XSL/Transform" version="1.0">
  <xsl:output method="html" indent="no"/>
    <xsl:template match="/">
    <html>
      <title>Transaction Information</title>
      <body bgcolor="beige" text="blue">
        <xsl:for-each select="Transactions">
          <table border="5">
            <tr bgcolor="grey">
              <td>Date</td>
              <td>Type</td>
              <td>Amount</td>
              <td>ID</td>
              <td>Comments</td>
            </tr>
            <xsl:for-each select="Transaction">
              <tr>
                <td valign="top">
                <xsl:value-of select="Date"/>
                </td>
                <td valign="top">
                <xsl:value-of select="Type"/>
                </td>
                <td valign="top">
                <xsl:value-of select="Amount"/>
                </td>
                <td valign="top">
                <xsl:value-of select="ID"/>
                </td>
                <td valign="top">
                <xsl:value-of select="Comments"/>
                </td>
              </tr>
            </xsl:for-each>
          </table>
        </xsl:for-each>
      </body>
    </html>
  </xsl:template>
</xsl:stylesheet>
```

APPENDIX M

Last_trans.jsp

```
<?xml version="1.0"?>
<?xml-stylesheet type="text/xsl" href="new_style.xsl"?>

<Transactions>
<jsp:useBean id="tid" class="QueryIDBean"/>
<%@ page contentType="text/xml" %>

<% tid.createQuery("SELECT t.transaction_date, t.transaction_type, t.amount,
t.transaction_id, t.comments" +
" FROM transaction t WHERE account_number = " + request.getParameter("acc_id") +
" ORDER BY transaction_date DESC"); %>

<%while (tid.next()) { %>

  <Transaction>
    <Date><%= tid.column(1) %></Date>
    <Type><%= tid.column(2) %></Type>
    <Amount><%= tid.column(3) %></Amount>
    <ID><%= tid.column(4) %></ID>
    <Comments><%= tid.column(5) %></Comments>
  </Transaction>

<% } tid.close(); %>

</Transactions>
```

APPENDIX N

New_trans.xsl

```
<?xml version="1.0"?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/1999/XSL/Transform" version="1.0">
  <xsl:output method="html" indent="no"/>

  <xsl:template match="Transaction/*" mode = "ColHead">
    <th>
      <xsl:value-of select="name(.)"/>
    </th>
  </xsl:template>

  <xsl:template match="/">
    <html>
      <body bgcolor="beige" text="red">
      <center><h2>All Transactions</h2>
       <xsl:apply-templates/>
      </center>
      </body>
    </html>
  </xsl:template>
  <xsl:template match="Transactions">
    <table bgcolor="beige" border="5">
      <xsl:apply-templates select="Transaction[1]/*" mode="ColHead"/>
    <xsl:apply-templates/>
    </table>
  </xsl:template>
  <xsl:template match="Transaction">
    <tr class="Highlight">
    <xsl:apply-templates/>
    </tr>
  </xsl:template>
  <xsl:template match="Transaction/*">
    <td>
    <xsl:apply-templates/>
    </td>
  </xsl:template>
</xsl:stylesheet>
```

APPENDIX O

Last_five_dep.jsp

```
<?xml version="1.0"?>
<?xml-stylesheet type="text/xsl" href="trans_style.xsl"?>

<Transactions>
<jsp:useBean id="tid" class="QueryIDBean"/>
<%@ page contentType="text/xml" %>

<% tid.createQuery("SELECT t.transaction_date, t.transaction_type, t.amount,
t.transaction_id, t.comments" +
" FROM transaction t WHERE account_number = " + request.getParameter("acc_id") +
" AND transaction_type = ’atm deposit’ OR transaction_type = ’counter deposit’ ORDER
BY transaction_date DESC"); %>

<%while (tid.next()) { %>

  <Transaction>
    <Date><%= tid.column(1) %></Date>
    <Type><%= tid.column(2) %></Type>
    <Amount><%= tid.column(3) %></Amount>
    <ID><%= tid.column(4) %></ID>
    <Comments><%= tid.column(5) %></Comments>
  </Transaction>

<% } tid.close(); %>

</Transactions>
```

APPENDIX P

Selectall.xsql

```
<?xml version="1.0" ?>
<?xml-stylesheet type="text/xsl" href="new_style.xsl"?>


<xsql:query connection="banking" rowset-element="Transactions" row-
element="Transaction" xmlns:xsql="urn:oracle-xsql">

Select * from transaction where account_number = {@acc_id} AND
transaction_type=’CHECK’

</xsql:query>
```

APPENDIX Q

Current_account.xsl

```
<html xmlns:xsl="http://www.w3.org/1999/XSL/Transform" xsl:version="1.0">

 <head>
  <title>Deposit Succeeded</title>
 </head>

 <body bgcolor="darkblue" text="white" vlink="beige" link="white">

 <xsl:choose>
 <xsl:when test="//xsql-error">
 <center><h2>Unsuccessful Transaction</h2>
  <table style="background:black">
   <xsl:for-each select="//xsql-error">
   <tr>
    <td><b>Action</b></td>
    <td><xsl:value-of select="@action"/></td>
   </tr>
   <tr valign="top">
    <td><b>Message</b></td>
    <td><xsl:value-of select="message"/></td>
   </tr>
   </xsl:for-each>
  </table>
  </center>
 </xsl:when>

 <xsl:otherwise>
 <center><h2>Successful Transaction</h2>
 Here is your new account Information:
 <table border="1">
  <xsl:for-each select="page/account">
   <tr>
    <td width="200">Account Number:</td>
    <td width="200"><xsl:value-of select="account_number"/></td>
   </tr>
   <tr>
    <td width="200">Balance:</td>
    <td width="200"><xsl:value-of select="balance"/></td>
   </tr>
   <tr>
    <td width="200">Last Updated:</td>
    <td width="200"><xsl:value-of select="last_update"/></td>
```

APPENDIX Q (cont.)

```
</tr>
      <tr>
        <td width="200">Account Type:</td>
        <td width="200"><xsl:value-of select="account_type"/></td>
      </tr>
    </xsl:for-each>
  </table>
  </center>
  </xsl:otherwise>
  </xsl:choose>

  </body>
</html>
```

APPENDIX R

Transaction.jsp

```
<jsp:useBean id="acc_id" class="oracle.jsp.jml.JmlString" scope="session" >
<jsp:setProperty name="acc_id" property="value" param="acc_id" />
</jsp:useBean>

<jsp:useBean id="ssn" class="oracle.jsp.jml.JmlString" scope="session" >
<jsp:setProperty name="ssn" property="value" param="clientssn" />
</jsp:useBean>

<jsp:useBean id="qtype" class="QueryIDBean" scope="session" />

<% qtype.createQuery("SELECT transaction_type FROM transaction_type" +
" where transaction_type not like ’below%’ and transaction_type not like ’new%’" +
" and transaction_type not like ’____fee’"); %>

<HTML>
<HEAD>
<TITLE>
Enter the transaction information
</TITLE>
</HEAD>
<BODY>
<H2>
Account Number: <%= acc_id.getValue() %>
<form action = "deposit.xsql" method="post">
<input type = "hidden" name = "acc_id" value="<%= acc_id.getValue() %>"><br>
<input type = "hidden" name = "ssn" value="<%= ssn.getValue() %>"><br>
Transaction Amount: <input type = "text" name = "amount"><br>
Transaction Type:   <SELECT NAME="type">
<% while (qtype.next()) { %>
  <OPTION><%= qtype.column(1) %></OPTION>
<% } qtype.close(); %>
</SELECT>


<input type="submit" name="deposit" value="submit"><br>
</form>
</H2>


</BODY>
</HTML>
```