HCL Informix 14.10

HCL Informix Embedded SQLJ User's Guide

Contents

Chapter 1. Embedded SQLJ for HCL Informix®

The *Informix® Embedded SQLJ User's Guide* contains information about using Informix® Embedded SQLJ.

This guide is for programmers who want to write Java™ programs that can:

- Connect to Informix® databases.
- Issue SQL statements to manipulate data in the database.

These topics are written with the assumption that you have the following background:

- A working knowledge of your computer, your operating system, and the utilities that your operating system provides
- Experience with the Java™ programming language
- Experience working with relational databases or exposure to database concepts
- Experience with the SQL query language

Introduction to HCL Informix® embedded SQLJ

This chapter explains what you can do with Informix® Embedded SQLJ and provides an overview of how embedded SQLJ works.

What is embedded SQLJ?

Informix® Embedded SQLJ enables you to embed SQL statements in your Java™ programs. Informix® Embedded SQLJ consists of:

- The SQLJ translator, which translates SQLJ code into Java™ code
- A set of Java™ classes that provide runtime support for SQLJ programs

Informix® Embedded SQLJ includes the standard SQLJ implementation, as defined by the SQLJ consortium, plus specific Informix® extensions. The rest of this manual refers to Informix® Embedded SQLJ as *Embedded SQLJ*. The standard SQLJ implementation is referred to as *traditional Embedded SQLJ*.

How does embedded SQLJ work?

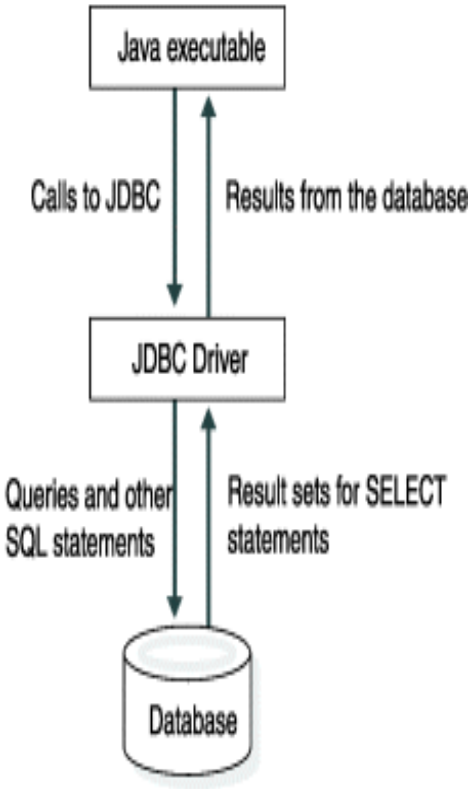
When you use Embedded SQLJ, you embed SQL statements in your Java™ source code. You use the SQLJ translator to convert the embedded SQL statements to Java™ source code with calls to JDBC. JDBC is the JavaSoft specification of a standard application programming interface (API) that allows Java™ programs to access database management systems.

Finally, you use the Java™ compiler to compile your translated Java™ program into an executable Java™ **.class** file, as shown in Figure 1: Translation and Compilation of an Embedded SQLJ Program on page 2.

Figure 1. Translation and Compilation of an Embedded SQLJ Program

When you run your program, it uses the Informix® JDBC Driver to connect to the Informix® database, as shown in Figure 2: Runtime Architecture for Embedded SQLJ Programs on page 2.

Figure 2. Runtime Architecture for Embedded SQLJ Programs



See the *Informix® JDBC Driver Programmer's Guide* for information about using the Informix® JDBC Driver.

Embedded SQLJ versus JDBC

Embedded SQLJ does not support dynamic SQL; you must use the JDBC API if you want to use dynamic SQL. Your Embedded SQLJ program can call the JDBC API to perform a dynamic operation (the SQLJ connection-context object that you use to connect an Embedded SQLJ program to the database contains a JDBC **Connection** object that you can use to create JDBC statement objects).

If you are using static SQL, Embedded SQLJ provides the following advantages:

- **Default connection context.** You only need to set the default connection context once within a program; then every subsequent Embedded SQLJ statement uses this connection context unless you specify otherwise.
- **Reduced statement complexity.** For example, you do not need to explicitly bind each variable; Embedded SQLJ performs binding for you. Generally, this feature allows you to create smaller programs than with the JDBC API.
- **Compile-time syntax and semantics checking.** The Embedded SQLJ translator checks the syntax of SQL statements.
- **Compile-time type checking.** The Embedded SQLJ translator and the Java™ compiler check that the Java™ data types of arguments are compatible with the SQL data types of the SQL operation.
- **Compile-time schema checking.** You can connect to a sample database schema during translation to check that your program uses valid SQL statements for the tables, views, columns, stored procedures, and so on in your sample.

Preparation to use embedded SQLJ

You must install and set up software before you can develop embedded SQLJ programs.

What components do you need?

You need the following software to create and run SQLJ programs:

- Informix® Embedded SQLJ.
- database server.
- A supported Java software development kit to create your programs.
- Informix® JDBC Driver to enable your programs to connect to the database server.

Program Examples

Informix® Embedded SQLJ includes sample online programs in the **/demo/sqlj** directory. The README file in this directory briefly explains what each of the programs demonstrates and how to set up, compile, and run the programs. The programs also enable you to verify that Informix® Embedded SQLJ and Informix® JDBC Driver are correctly installed. The examples in this manual are taken from these sample programs.

Fundamentals of embedded SQLJ programs

Each SQLJ statement in an Embedded SQLJ program is identified by **#sql** at the beginning of the statement. The SQLJ translator recognizes **#sql** and translates the rest of the statement into Java™ code using JDBC calls.

You can use a class called **ConnectionManager** (located in a file in the **/demo/sqlj** directory) to initiate a JDBC connection. The **ConnectionManager** class uses a JDBC driver and a database URL to connect to a database. Database URLs are described in Database URLs on page 26.

To enable your embedded SQLJ program to connect to a database, you assign values to the following data members of the **ConnectionManager** class in the file **/demo/sqlj/ConnectionManager.java**:

Member	Description
UID	The user name
PWD	The password for the user name
DRIVER	The JDBC driver
DBURL	The URL for the database

You must include the directory that contains your **ConnectionManager.class** file (produced when you compile **ConnectionManager.java**) in your **CLASSPATH** environment variable definition.

Your Embedded SQLJ program connects to the database by calling the **initContext()** method of the **ConnectionManager** class, as follows:

```
ConnectionManager.initContext();
```

The ConnectionManager class on page 26 provides details about the functionality of the **initContext()** method.

As an alternative to using the **ConnectionManager** class, you can write your own input methods to read the values of user name, password, driver, and database URL from a file or from the command line.

The connection context that you set up is the *default* connection context; all **#sql** statements execute within this context, unless you specify a different context. For information about using nondefault connection contexts, see Nondefault connection contexts on page 26.

Embedded SQL statements

Embedded SQL statements can appear anywhere that Java™ statements can legally appear. SQL statements must appear within curly braces, as follows:

```
#sql
{
INSERT INTO customer VALUES
( 101, "Ludwig", "Pauli", "All Sports Supplies",
"213 Erstwild Court", "", "Sunnyvale", "CA",
"94086", "408-789-8075"
)
};
```

You can use the SELECT...INTO statement to retrieve data into Java™ variables (*host variables*). Host variables within SQL statements are designated by a preceding colon (:). For example, the following query places values in the variables *customer_num*, *fname*, *lname*, *company*, *address1*, *address2*, *city*, *state*, *zipcode*, and *phone*:

```
#sql
{
SELECT *  INTO :customer_num, :fname, :lname, :company,
:address1, :address2, :city, :state, :zipcode,
:phone
FROM customer
WHERE customer_num = 101
};
```

SQL statements are case insensitive and can be written in uppercase, lowercase, or mixed-case letters. Java™ statements are case sensitive (and so are host variables).

You use SELECT...INTO statements for queries that return a single record; for queries that return multiple rows (a *result set*), you use an iterator object, described in the next section.

Result sets and iterators

Embedded SQLJ uses result-set iterator objects rather than cursors to manage result sets (cursors are used by languages such as Informix® ESQL/C). A result-set iterator is a Java™ object from which you can retrieve the data returned by a SELECT statement. Unlike cursors, iterator objects can be passed as parameters to a method.

Important: Names of iterator classes must be unique within an application.

When you declare an iterator class, you specify a set of Java™ variables to match the SQL columns that your SELECT statement returns. There are two types of iterators: positional and named.

Positional iterators

The order of declaration of the Java™ variables of a positional iterator must match the order in which the SQL columns are returned. You use a FETCH...INTO statement to retrieve data from a positional iterator.

For example, the following statement generates a positional iterator class with five columns, called **CustIter**:

```
#sql iterator CustIter( int , String, String, String, String, String );
```

This iterator can hold the result set from the following SELECT statement:

```
SELECT customer_num, fname, lname,  address1,
address2, phone
FROM   customer
```

Named iterators

The name of each Java™ variable of a named iterator must match the name of a column returned by your SELECT statement; order is irrelevant. The matching of SQL column name and iterator column name is case insensitive.

You use accessor methods of the same name as each iterator column to obtain the returned data, as shown in the example in A simple embedded SQLJ program on page 6. The SQLJ translator uses the iterator column names to create accessor methods. Iterator column names are case sensitive; therefore, you must use the correct case when you specify an accessor method.

You cannot use the FETCH...INTO statement with named iterators.

For example, the following statement generates a named iterator class called **CustRec**:

```
#sql iterator CustRec(
int    customer_num,
String fname,
String lname ,
String company ,
String address1 ,
```

```
String address2 ,
String city ,
String state ,
String zipcode ,
String phone
);
```

This iterator class can hold the result set of any query that returns the columns defined in the iterator class. The result set from the query can have more columns than the iterator class, but the iterator class cannot have more columns than the result set. For example, this iterator class can hold the result set of the following query because the iterator columns include all of the columns in the **customer** table:

```
SELECT *  FROM customer
```

A simple embedded SQLJ program

The sample program **Demo03.sqlj** demonstrates the use of a named iterator to retrieve data from a database.

This simple program outlines a standard sequence for many Informix® Embedded SQLJ programs:

1. Import necessary Java™ classes.
2. Declare an iterator class.
3. Define the **main()** method.

   All Java™ applications have a method called **main**, which is the entry point for the application (where the interpreter starts executing the program).
4. Connect to the database.

   The constructor of the application makes the connection to the database by calling the **initContext()** method of the **ConnectionManager** class.
5. Run queries.
6. Create an iterator object and populate it by running a query.
7. Handle the results.
8. Close the iterator.

You can find the **Demo03.sqlj** sample program code in the `$INFORMIXDIR/jdbc/demo/sqlj` directory.

The embedded SQLJ language

This chapter provides detailed information about using the Embedded SQLJ language. For syntax and reference information about specific statements, refer to the *Informix® Guide to SQL: Syntax*.

Embedded SQLJ has some differences from the earlier embedded SQL languages defined by ANSI/ISO: ESQL/C, ESQL/ADA, ESQL/FORTRAN, ESQL/COBOL, and ESQL/PL/1. The major differences are as follows:

- The SQL connection statement of traditional embedded SQL is replaced by a Java™ connection-context object. This approach enables Embedded SQLJ programs to open multiple database connections simultaneously.
- In Embedded SQLJ there is no host variable definition section (preceded by a BEGIN DECLARE SECTION statement and terminated by an END DECLARE SECTION statement). All legal Java™ variables can be used as host variables.
- Embedded SQLJ does not include the WHENEVER...GOTO/ CONTINUE statement, because Java™ has well-developed rules for declaring and handling exceptions.
- Embedded SQLJ uses iterator objects rather than cursors to manage result sets. A result-set iterator is a Java™ object from which you can retrieve the data returned by a SELECT statement. Unlike cursors, iterator objects can be passed as parameters to methods.
- Embedded SQLJ supports access to data in columns of iterator objects by name, through generated accessor methods. You can also access this data by position using the FETCH...INTO statement, as used by traditional embedded SQL.
- Unlike other host languages, Java™ allows null data. Therefore, you do not need to use null indicator variables with Embedded SQLJ.
- Embedded SQLJ does not include dynamic SQL; you must use JDBC instead.

The files containing your Embedded SQLJ source code must have the extension .**sqlj**; for example, **custapp.sqlj**.

Embedded SQLJ statements

To identify Embedded SQLJ statements to the SQLJ translator, each SQLJ statement must begin with **#sql**. The SQLJ translator recognizes **#sql** and translates the statement into Java™ code.

SQL statements

Embedded SQLJ supports SQL statements at the SQL92 Entry level, with the following additions:

- The EXECUTE PROCEDURE statement, for calling SPL routines and user-defined routines
- The EXECUTE FUNCTION statement, for calling stored functions
- The BEGIN...END block

SQL statements must appear within curly braces, as follows:

```
#sql
{
create table customer
(
customer_num            serial(101),
fname                   char(15),
lname                   char(15),
company                 char(20),
address1                char(20),
address2                char(20),
city                    char(15),
state                   char(2),
zipcode                 char(5),
phone                   char(18),
primary key (customer_num)
```

```
)
};
```

An SQL statement that is not enclosed within curly braces will generate a syntax error.

SQL statements are case insensitive (unless delimited by double quotes) and can be written in uppercase, lowercase, or mixed-case letters. Java™ statements are case sensitive.

Host variables

Host variables are variables of the host language (in this case Java™) that appear within SQL statements. A host variable represents a parameter, variable, or field and is prefixed by a colon (:), as in the following example:

```
#sql [ctx] { SELECT INTO customer WHERE customer_num = :cust_no };
```

You use the SELECT statement with the INTO (as shown in this example), the FETCH statement with the INTO clause (described in Positional iterators on page 9), or an accessor method (described in Named iterators on page 9) to retrieve data into host variables.

SELECT statements that return a single row

You use the SELECT...INTO statement for queries that return a single record of data. For queries that return multiple rows (called a *result set*) you use an iterator object, as described in the next section, Result sets on page 8.

The SELECT...INTO statement includes a list of host variables in the INTO clause to which the selected data is assigned. For example:

```
#sql
{
SELECT *  INTO :customer_num, :fname, :lname, :company,
:address1, :address2, :city, :state, :zipcode,
:phone
FROM customer
WHERE customer_num = 101
};
```

The number of selected expressions must match the number of host variables. The SQL types must be compatible with the host variable types. If you use online checking, the SQLJ translator checks that the order, number, and types of the SQL expressions and host variables match. For information on how to perform online checking, see Online checking on page 24.

Result sets

Embedded SQLJ uses iterator objects to manage result sets returned by SELECT statements. A result-set iterator is a Java™ object from which you can retrieve the data returned from the database. Iterator objects can be passed as parameters to methods and manipulated like other Java™ objects.

Important: Names of iterator classes must be unique within an application.

When you declare an iterator object, you specify a set of Java™ variables to match the SQL columns that your SELECT statement returns. There are two types of iterators: positional and named.

Positional iterators

The order of declaration of the Java™ variables in a positional iterator must match the order in which the SQL columns are returned.

For example, the following statement generates a positional iterator class called **CustIter** with six columns:

```
#sql iterator CustIter( int , String, String, String, String, String );
```

This iterator can hold the result set from the following SELECT statement:

```
SELECT customer_num, fname, lname,  address1,
address2, phone
FROM   customer
```

You run the SELECT statement and populate the iterator object with the result set by using an Embedded SQLJ statement of the form:

```
#sql iterator-object = { SELECT ...};
```

For example:

```
CustIter cust_rec;
#sql  [ctx] cust_rec = { SELECT customer_num, fname, lname,  address1,
address2, phone
FROM   customer
};
```

You retrieve data from a positional iterator into host variables using the FETCH...INTO statement:

```
#sql { FETCH :cust_rec
INTO :customer_num, :fname, :lname,
:address1, :address2, :phone
};
```

The SQLJ translator checks that the types of the host variables in the INTO clause of the FETCH statement match the types of the iterator columns in corresponding positions.

The types of the SQL columns in the SELECT statement must be compatible with the types of the iterator. These type conversions are checked at translation time if you perform online checking. For information about setting up online checking, see Online checking on page 24. For a listing of SQL and Java™ type mappings, see SQL and Java type mappings on page 12.

Named iterators

The name of each Java™ variable of a named iterator must match the name of a column returned by your SELECT statement; order is irrelevant. The matching of SQL column names and iterator column names is case insensitive.

For example, the following statement generates a named iterator class called **CustRec**:

```
#sql iterator CustRec(
int    customer_num,
String fname,
String lname ,
String company ,
String address1 ,
String address2 ,
String city ,
String state ,
String zipcode ,
String phone
);
```

This iterator can hold the result set of any query that returns the columns defined in the iterator class. You use accessor methods of the same name as each iterator column to obtain the returned data, as shown in the example in A simple embedded SQLJ program on page 6. The SQLJ translator uses the iterator column names to create accessor methods. Iterator column names are case sensitive; therefore, you must use the correct case when you specify an accessor method.

You cannot use the FETCH...INTO statement with named iterators.

The following example illustrates the use of named iterators:

```
// Declare Iterator of type CustRec
CustRec cust_rec;

#sql cust_rec = { SELECT *  FROM customer };

int row_cnt = 0;
while ( cust_rec.next() )
{
System.out.println("===================================");
System.out.println("CUSTOMER NUMBER :" + cust_rec.customer_num());
System.out.println("FIRST NAME      :" + cust_rec.fname());
System.out.println("LAST NAME       :" + cust_rec.lname());
System.out.println("COMPANY         :" + cust_rec.company());
System.out.println("ADDRESS         :" + cust_rec.address1() +"\n" +
"                " + cust_rec.address2());
System.out.println("CITY            :" + cust_rec.city());
System.out.println("STATE           :" + cust_rec.state());
System.out.println("ZIPCODE         :" + cust_rec.zipcode());
System.out.println("PHONE           :" + cust_rec.phone());
System.out.println("===================================");
System.out.println("\n\n");
row_cnt++;
}
System.out.println("Total No Of rows Selected :" + row_cnt);
cust_rec.close() ;
```

The **next()** method of the iterator object advances processing to successive rows of the result set. It returns `FALSE` after it fails to find a row to retrieve.

The Java™ compiler detects type mismatches for the accessor methods.

The validity of the types and names of the iterator columns and their related columns in the SELECT statement are checked at translation time if you perform online checking. For information about setting up online checking, see Online checking on page 24.

Column aliases

When an expression returned by a SELECT statement has an SQL name that is not a valid Java™ identifier, use SQL column aliases to rename them. For example, the name **Not valid for Java™** is acceptable as a column name in SQL, but not as a Java™ identifier. You can use a column alias that has a name acceptable as a Java™ identifier by using the AS clause:

```
SELECT "Not valid for Java" AS "Col1" FROM tablename
```

When you create a named iterator class for this query, you specify the column alias name for the Java™ variable, as in:

```
#sql iterator Iterator_name (String Col1);
```

Iterator methods

Both named and positional iterator objects have the following methods:

- **rowCount()**

  Returns the number of rows retrieved by the iterator object
- **close()**

  Closes the iterator; raises **SQLException** if the iterator is already closed
- **isClosed()**

  Returns `TRUE` after the iterator's **close()** method has been called; otherwise, it returns `FALSE`

Positional iterators also have the **endFetch()** method. The **endFetch()** method returns `TRUE` when no more rows are available.

Named iterators also have the **next()** method. The **next()** method advances processing to successive rows of the result set. It returns `FALSE` after it fails to find a row to retrieve. For an example of how to use the **next()** method, see Named iterators on page 9.

Positioned updates and deletes

To perform positioned updates and deletes in a result set, you use the WHERE CURRENT OF clause with a host variable that contains an iterator object. For example:

```
#sql { delete_statement/update_statement
       WHERE CURRENT OF :iter };
```

At runtime, the variable *:iter* must contain an open iterator object that contains a result set selected from the same table accessed by the query in either *delete_statement* or *update_statement*. The current row of that iterator object is deleted or updated.

SQL query execution and monitoring

You can monitor and modify the execution of an SQL query by using the *execution context* associated with it. An execution context is an instance of the class **sqlj.runtime.ExecutionContext**; an execution context is associated with each executable SQL operation in an Embedded SQLJ program.

You can supply an execution context explicitly for an SQL statement:

```
#sql [execCtx] {SQL_statement};
```

If you do not explicitly supply an execution context, the SQL statement uses the default execution context for the connection context you are using.

If you want to supply an explicit connection context and an explicit execution context, the SQL statement looks like this:

```
#sql [connCtx, execCtx] {SQL_statement };
```

You use the **getExecutionContext()** method of the connection context to obtain that connection's default execution context.

The execution-context object has attributes and methods that provide information about an SQL operation and the ability to modify its execution.

For each of the following attributes, there is a method called **getattribute** that reads the value of the attribute, and a method called **setattribute** that sets its value. The attributes are:

Attribute	Description
MaxRows	The maximum number of rows a query can return
MaxFieldSize	The maximum number of bytes that can be returned as data for any column or output variable
QueryTimeout	The number of seconds to wait for an SQL operation to complete
SQLWarnings	Any warnings that occurred during the last SQL operation
UpdateCount	The number of rows updated, inserted, or deleted during the last SQL operation

SPL routine and function calls

You can call a Stored Procedure Language (SPL) procedure by using the EXECUTE PROCEDURE statement. For example:

```
#sql { EXECUTE PROCEDURE proc_name(:arg_name) };
```

You can call a stored function by using the EXECUTE FUNCTION statement. For example:

```
#sql {EXECUTE FUNCTION func_name (func_arg ) into :num };
```

SQL and Java™ type mappings

When you retrieve data from a database into an iterator object (see Result sets on page 8) or into a host variable, you must use Java™ types that are compatible with the SQL types. The following table shows valid conversions from SQL types to Java™ types.

SQL type	Java™ type
BIGINT, BIGSERIAL	bigint
BLOB	byte[]
BOOLEAN	boolean
BYTE	byte[]
CHAR, CHARACTER	String
CHARACTER VARYING	String
CLOB	byte[]
DATE	java.sql.Date
DATETIME	java.sql.Timestamp
DECIMAL, NUMERIC, DEC	java.math.BigDecimal
FLOAT, DOUBLE PRECISION	double
INT8	long
INTEGER, INT	int
INTERVAL	IfxIntervalDF, IfxIntervalYM[1 on page 14]
LVARCHAR	String
MONEY	java.math.BigDecimal
NCHAR, NVARCHAR	String
SERIAL	int
SERIAL8	long
SMALLFLOAT	float[2 on page 14]
SMALLINT	short
TEXT	String
VARCHAR	String

Table notes:

1. IfxIntervalYM and IfxIntervalDF are HCL Informix® extensions to JDBC 2.0.
2. This mapping is JDBC compliant. You can use Informix® JDBC Driver to map SMALLFLOAT data type (via the JDBC FLOAT data type) to the Java™ double data type for backward compatibility by setting the IFX_GET_SMFLOAT_AS_FLOAT environment variable to 1.

You must also use compatible Java™ types for host variables that are arguments to SQL operations. This table shows valid conversions from Java™ types to SQL types.

Java™ type	**SQL type**
java.math.BigDecimal	DECIMAL
boolean	BOOLEAN
byte[]	BYTE
java.sql.Date	DATE
double	FLOAT[1 on page 15]
float	SMALLFLOAT
int	INT
long	INT8
short	SMALLINT
String	CHAR
java.sql.Time	DATETIME
java.sql.Timestamp	DATETIME
com.informix.jdbc.IfxIntervalDF	INTERVAL
com.informix.jdbc.IfxIntervalYM	INTERVAL

Table note:

1. This mapping is JDBC compliant. You can use Informix® JDBC Driver to map the Java™ double data type (via the JDBC FLOAT data type) to the HCL Informix® SMALLFLOAT data type for backward compatibility by setting the IFX_GET_SMFLOAT_AS_FLOAT environment variable to 1.

Important: Unlike other host languages (for example, C), Java™ allows null data. Therefore, you do not need to use null indicator variables with Embedded *SQLJ*. The Java™ `null` value is equivalent to the *SQL* `NULL` value.

Language character sets

Embedded SQLJ supports Java's Unicode escape sequences. Also, if you set your Java™ property **file.encoding** to `8859_1` (or do not set it at all), you can use the Latin-1 character set.

To process files with a different encoding-for example, SJIS-you have the following choices:

- Use the JDK tool **native2ascii** to convert the native encoded source to a source with ASCII encoding.
- Set `file.encoding=SJIS` in **java.properties** in the Java™ home directory.
- Invoke the SQLJ translator using the following command:

```
java ifxsqlj -Dfile.encoding=SJIS file.sqlj
```

Java™ package importation

Your Embedded SQLJ programs need to import the JDBC API (**java.sql.***) and SQLJ runtime (**sqlj.runtime.***) packages to which they refer. The classes you are likely to commonly use are:

- In package **java.sql** for the JDBC API:

  The **SQLException** class-includes all runtime exceptions raised by Embedded SQLJ-and classes you explicitly use, such as **java.sql.Date**, **java.sql.ResultSet**.
- In package **sqlj.runtime** for SQLJ runtime:

  SQLJ stream types (explicitly referenced): for example, **BinaryStream**, the **ConnectionContext** class, and the reference implementation of Embedded SQLJ classes (in **sqlj.runtime.ref**).

SQLJ reserved names

This section lists names reserved by the SQLJ translator. Do not use these names in your Embedded SQLJ programming.

Parameter, field, and variable names

The string **_sJT** is a reserved prefix for generated variable names. Do not use this prefix for the names of:

- Variables declared within blocks that include SQL statements
- Parameters to methods that contain SQL statements
- Fields in classes that contain SQL statements or whose subclasses contain SQL statements

Class names and filenames

Do not declare classes that conflict with the names of internal classes. Do not create files that conflict with generated internal resource files.

The SQLJ translator creates internal classes and resource files for use by generated code. The names of these files and classes have a prefix composed of the name of the original input file followed by the string **_SJ**. For example, if you translate a file called **File1.sqlj** that uses the package **COM.foo**, the names of some of the internal classes produced are:

- **COM.foo.File1_SJInternalClass**
- **COM.foo.File1_SJProfileKeys**
- **COM.foo.File1_SJInternalClass$Inner**
- **COM.foo.File1_SJProfile0**
- **COM.foo.File1_SJProfile1**

Generated files for these internal classes, which are created in the same directory as the input file, **File1.sqlj**, are called:

- **File1_SJInternalClass.java** (includes the class **COM.foo.File1_SJInternalClass$Inner**)
- **File1_SJProfileKeys.java**
- **File1_SJProfile0.ser**
- **File1_SJProfile1.ser**

Files with the **.ser** extension are internal resource files that contain information about SQL operations in an **.sqlj** file.

Handling errors

Some iterator and connection-context methods might raise exceptions specified by the JDBC API **SQLException** class. For information about using **SQLException** methods to obtain information about these errors, refer to your JDBC API documentation.

Embedded SQLJ source code processing

This chapter describes how to create executable Java™ programs from your Embedded SQLJ source code. It explains:

- How to use the SQLJ translator
- Basic translation and compilation options
- Advanced translation and compilation options
- How to use property files
- How to perform online checking

SQL program translation, compiling, and running

You use the command **java ifxsqlj** to create executable Java™ **.class** files from your Embedded SQLJ source code.

When you run the **java ifxsqlj** command with an **.sqlj** source file, the source file is processed in two stages. In the first stage, called *translation*, the SQLJ translator creates a Java™ source file (with the extension **.java)**. For example, when you process a file called **File1.sqlj**, the SQLJ translator creates a file called **File1.java**. The SQLJ translator also creates internal resource files with the extension **.ser**.

In the second stage of processing, the SQLJ translator passes **.java** files to a Java™ compiler. Compilation creates files with the extension **.class**; in this example, your compiled Java™ program is called **File1.class**. An internal resource file named **profilekeys.class** is also created. If your program includes an iterator, a file called **iterator_name.class** is produced.

Tip: To perform translation only, execute the **java ifxsqlj** command with the **-compile** option set to `FALSE`. For information about the **-compile** option, see Advanced options for the ifxsqlj command on page 20.

To create a complete application, you must include the directories that contain the SQLJ runtime classes in **sqlj.runtime.*** in your **CLASSPATH** environment variable definition. The SQLJ runtime files are available in **ifxsqlj.jar**, the file that you installed when you first installed the Embedded SQLJ product, as described in A simple embedded SQLJ program on page 6.

In addition, you must include the locations of **ifxtools.jar** and the relevant version of the JDK in your **CLASSPATH** definition. At runtime, you must also include the location of **ifxjdbc.jar**; however, you do not need to include this file location when translating or compiling your application.

You run your Embedded SQLJ program like any other Java™ program, by using the Java™ interpreter, as follows:

```
java File1
```

The ifxsqlj command

You use the **java ifxsqlj** command to translate and compile your Embedded SQLJ source code. You run the **java ifxsqlj** command at the DOS or UNIX™ prompt.

The syntax of the **java ifxsqlj** command is as follows:

```
java ifxsqlj optionlist filelist
```

optionlist

A set of options separated by spaces. Some options have prefixes to indicate they are to be passed to utilities other than the SQLJ translator, such as the Java™ compiler.

filelist

A list of filenames separated by spaces: for example, `file1.sqlj file2.sqlj`

You must include the absolute or relative path to the files in *filelist*.

The files can have the extension **.sqlj** or **.java**. You can specify **.sqlj** files together with **.java** files on the same command line.

If you have **.sqlj** and **.java** files that require access to code in each other's file, enter all of these files on the command line for the same execution of the **java ifxsqlj** command.

You can use an asterisk (*) as a wildcard to specify filenames; for example, **c*.sqlj** processes all files beginning with **c** that have the extension **.sqlj**.

When you run the **java ifxsqlj** command, your **CLASSPATH** environment variable must be set to include any directories that contain **.class** files and .**ser** files the translator needs to access for type resolution of variables in your Embedded SQLJ source code.

Basic options for the ifxsqlj command

The following table lists the basic options available for use with the **java ifxsqlj** command.

Option

Description

-d

Specifies the root output directory for generated **.ser** and **.class** files

If you do not specify this option, files are generated under the directory of the input **.sqlj** file.

-dir

Specifies the root output directory for generated **.java** files

If you do not specify this option, files are generated under the directory of the input **.sqlj** file.

-encoding

Specifies the GLS encoding for **.sqlj** and **.java** input files and for **.java** generated files

If unspecified, the setting of the **file.encoding** property for the Java™ interpreter is used.

The **-encoding** option is also passed to the Java™ compiler.

-help

Displays option names, descriptions, and current settings

The list displays:

- The name of the option
- The type of the option (for example, if it is Boolean) or a selection of allowed values
- The current value
- A description of the option
- Whether the property is at its default, or was set by either a property file or the command line

No translation or compilation is performed when you specify the **-help** option.

-linemap

Enables the mapping of line numbers between the generated **.java** file and the original **.sqlj** file

The **-linemap** option is useful for debugging because it allows you to trace compilation and execution errors back to your Embedded SQLJ source code.

For the **-linemap** option to be effective, the name of the **.sqlj** source code file must match the name of the class it implements.

-props

Specifies the name of the property file from which to read options

The ifxprofp tool on page 25 explains how to use property files.

-status

Displays status messages while the **java ifxsqlj** command is running

-version

Displays the version of Embedded SQLJ you are using

No translation or compilation is performed when you specify the **-version** option.

-warn

Specifies a list of flags in a comma-separated string for controlling the display of warning and information messages during translation

The flags are:

- **all**/**none**. Turns on or off all warnings and information messages
- **null**(default)/**nonull**. Specifies whether the translator checks nullable columns and nullable Java™ variable types for conversion loss when data is transferred between database columns and Java™ host variables

  The translator must connect to the database for this option to be in effect.
- **precision**(default)/**noprecision**. Specifies whether the translator checks for loss of precision when data is transferred between database columns and Java™ variables

  The translator must connect to the database for this option to be in effect.
- **portable**(default)/**noportable**. Turns on or off warning messages about the portability of Embedded SQLJ statements
- **strict**(default)/**nostrict**. Specifies whether the translator checks named iterators against the columns returned by a SELECT statement and issues a warning for any mismatches

  The translator must connect to the database for this option to be in effect.
- **verbose**(default)/**noverbose**. Turns on or off additional information messages about the translation process

  The translator must connect to the database for this option to be in effect.

For example, the following setting of the **-warn** option turns off all warnings and then turns on the precision and nullability checks:

-warn=none,null,precision

Advanced options for the ifxsqlj command

The following table lists the advanced options available for use with the **java ifxsqlj** command. Many of these options are for online checking, which is discussed in Online checking on page 24.

Option

Description

-cache

Turns on the caching of results from online checking

Caching saves you from unnecessary connections to the database in subsequent runs of the translator for the same file.

Results are written to the file **SQLChecker.cache** in your current directory. The cache holds serialized representations of all SQL statements that translated without errors or warnings. The cache is cumulative and grows through successive invocations of the translator.

You empty the cache by deleting the **SQLChecker.cache** file.

Caching is off by default; you turn caching on by setting the **-cache** option to `true`, `1`, or `on`; for example, `-cache=true`. You turn caching off by setting the option to `false`, `0`, or `off`.

-compile

Set this flag to `false` to disable processing of **.java** files by the compiler. This applies to generated **.java** files and to **.java** files specified on the command line.

-compiler-executable

Specifies a particular Java™ compiler for the **java ifxsqlj** command to use

If not specified, the translator uses **javac**. If you do not specify a directory path, the **java ifxsqlj** command searches for the executable according to the setting of your **PATH** environment variable.

-compiler-encoding-flag

Set this flag to `false` to prevent the value of the SQLJ **-encoding** option from being automatically passed to the compiler.

-compiler-output-file

If you have instructed the Java™ compiler to output its results to a file, use the **-compiler-output-file** option to specify the filename.

-driver

Specifies a list of JDBC drivers that can be used to interpret JDBC connection URLs for online checking (see Online checking on page 24)

You specify a class name or a comma-separated list of class names. For example, specify Informix® JDBC Driver as follows:

-driver=com.informix.jdbc.IfxDriver

-offline

Specifies a Java™ class to implement off-line checking

The default off-line checker class is **sqlj.semantics.OfflineChecker**.

Off-line checking only runs when online checking does not (either because online checking was not enabled or because it stopped because of error). Off-line checking verifies SQL syntax and the usage of Java™ types.

With off-line checking, there is no connection to the database.

-online

Specifies a Java™ class or list of classes to implement online checking

The default online checker class is **sqlj.semantics.JdbcChecker**.

You can specify an online checker class for a particular connection context, as in:

-online@ctxclass2=sqlj.semantics.JdbcChecker

You must specify a user name with the **-user** option for online checking to occur. The **-password**, **-url**, and **-driver** options must be appropriately set as well.

-password

Specifies a password for the user name set with the **-user** option

If you specify the **-user** option, but not the **-password** option, the translator prompts you for the password.

If you are using multiple connection contexts, the setting for **-password** for the default connection context also applies to any connection context that does not have a specific setting.

-ser2class

Set this flag to `true` to convert the generated **.ser** files to **.class** files. This is necessary if you are creating an applet to be run from a browser, such as Netscape 4.0, that does not support loading a serialized object from a resource file.

The original **.ser** file is not saved.

-url

Specifies a JDBC URL for establishing a database connection for online checking (see Database URLs on page 26 and Online checking on page 24)

The URL can include a host name, a port number, and the Informix® database name. The format is:

jdbc:informix-sqli://{<ip-address>| <domain-name>}:<port-number>[/<dbname>]: INFORMIXSERVER=<server-name>[;user=<username>; password=<password>;<name>=<value> [;<name>=<value>]...]

If you are using multiple connection contexts, the setting for **-url** for the default context also applies to any connection context that does not have a specific setting.

You can specify a URL for a particular connection context, as in -url@ctxclass2=....

Any connection context with a URL must also have a user name set for it (using the **-user option**) for online checking to occur.

-user

Enables online checking and specifies the user name with which the translator connects to the database (see Online checking on page 24)

For example, to enable online checking on the default connection context and connect with the user name **fred**, use the following option:

-user=fred

If you are using multiple connection contexts, the setting for **-user** for the default connection context also applies to any connection context that does not have a specific setting.

If you want to enable online checking for the default context, but turn off online checking for another connection-for example *ctxcon2*-you need to specify the **-user** option twice:

-user=fred -user@ctxcon2=

To enable online checking for a particular connection context, specify that context with the user name, as in:

-user@ctxcon3=joyce

The classes of the connection contexts you specify must all be declared in your source code or previously compiled into a **.class** file.

-vm

Specifies a particular Java™ interpreter for the **java ifxsqlj** command to use

You must also include the path to the interpreter. If you do not specify a particular Java™ interpreter using this option, the translator uses **java** as a default.

The **-vm** option must be specified on the command line; you cannot set it in a property file.

Options for the ifxsqlj command

You specify options for the **java ifxsqlj** command either on the command line or in a property file. Command line options are discussed in ifxsqlj command-line options on page 22. Property files are discussed in Format of property files on page 24.

For Boolean options (those that are either on or off), you can set the option simply by specifying the option name; for example, `-linemap`. You can also set the option to `TRUE`, as in `-linemap=true`. To turn off a Boolean option, you must set it to `FALSE`: for example, `-linemap=false`. You can also set Boolean options to `yes` or `no`, or to `1` or `0`.

ifxsqlj command-line options

Options on the command line override any options set in default files. If the same option appears more than once on the command line, the translator uses the final (rightmost) option's value.

Command-line option names are case sensitive.

You can attach prefixes to options to pass the option to the Java™ compiler or to the Java™ interpreter. If you do not use a prefix, the option is passed to the SQLJ translator.

The prefixes are:

-C

Passes compiler options to the Java™ compiler, as shown in the following example:

```
-C-classpath=/user/jdk/bin
```

-J

Passes interpreter options to the Java™ interpreter, as shown in the following example:

```
-J-Duser.language=ja
```

The options available to pass to the interpreter depend on the release and brand of Java™ you are using.

Do not use the **-C** prefix with the **-d** and **-encoding** options; when you specify these SQLJ translator options, they are automatically passed to the Java™ compiler.

ifxsqlj options in property files

You can use property files to supply options to the **java ifxsqlj** command. The default name of a property file is **sqlj.properties**; you can specify a different name by using the **-props** option on the command line (see Basic options for the ifxsqlj command on page 18).

You cannot use a property file to specify:

- The -**props**, -**help**, and -**version** basic options
- The **-vm** advanced option
- Options with the prefix **-J** (for passing options to the Java™ interpreter)

Precedence of ifxsqlj options

The **java ifxsqlj** command checks for the existence of files called **sqlj.properties** in the following directories in the following order:

1. The Java™ home directory
2. Your home directory
3. The current directory

The translator processes each property file it finds and overrides any previously set option if it finds a new setting for that option.

Later entries in the same property file override earlier entries.

Options on the command line override options set by property files.

If you set options on the command line or in a property file specified using the **-props** option, these options override any options set in **sqlj.properties** files.

Format of property files

In a property file, you:

- Specify one option per line.
- Begin a line with the symbol # to denote a comment.

Tip: The translator ignores empty lines.

The syntax for specifying options is the same as shown in Parameter, field, and variable names on page 15, except you replace the initial hyphen with a string followed by a period that indicates to which utility the option is passed.

You can pass options to the SQLJ translator or the Java™ compiler; however, you cannot pass options to the Java™ interpreter from a property file. The strings for specifying utilities are as follows.

Precede an option with...	To pass it to this utility...
sqlj.	SQLJ translator
compile.	Java™ compiler

An example property file looks like this:

```
# Turn on online checking and specify the user to connect with
sqlj.user=joyce
sqlj.password=*******
# JDBC Driver to connect with
sqlj.driver=com.informix.jdbc.IfxDriver
# Database URL
sqlj.url=jdbc:<ipaddr>:<portno>/demo_isqlj:informixserver=<$INFORMIXSERVER>
# Instruct the compiler to output status messages during compile
compile.verbose
```

Online checking

Online checking analyzes the validity of the embedded SQL statements against the database schema (user name, password, and database) you specify.

Online checking performs the following operations:

- Passes SQL data manipulation statements (DML) to the database to verify their syntax and semantics and their validity for the database schema
- Checks stored procedures and functions for overloading
- Runs the checks covered by off-line checking

Off-line checking verifies SQL syntax and usage of Java™ types; there is no connection to a database for off-line checking.

To set up online checking, you use the following options with the **java ifxsqlj** command or set them in a property file: **-user**, **-password**, **-url**, and **-driver**. These options are described in Advanced options for the ifxsqlj command on page 20.

-user and -password options

You enable online checking by setting the **-user** option. The **-user** option also supplies the user name for the database connection to be used for checking. You do not have to specify the same database or user name for online checking as the application uses at runtime.

In the simplest case, you supply a user name with the **-user** option, and online checking is performed using the default connection context, as in:

```
-user = joyce
```

You can supply the password for the user name by using the **-password** option or by combining the password with the user name; for example, `-user = joyce/jcs123` or `-user = joyce -password =jcs123`.

To disable online checking on the command line, set the **-user** option to an empty value (as in `-user=`) or omit the option entirely. To disable online checking in a property file, comment out the line specifying **sqlj.user**.

To enable online checking against a nondefault connection context, you specify the connection context with the user name in the **-user** option. In the following example, the SQLJ translator connects to the database specified in the connection-context object, *conctx*, using the user name **fred**:

```
-user@conctx = fred
```

-url and -driver options

The **-url** option specifies a JDBC URL for establishing a database connection (see Database URLs on page 26).

The **-driver** option specifies a list of JDBC drivers that can be used to interpret JDBC connection URLs for online checking.

Both of these options are shown in Advanced options for the ifxsqlj command on page 20.

The ifxprofp tool

Embedded SQLJ includes the **ifxprofp** tool. The tool **ifxprofp** enables you to print out the information stored in internal resource **.ser** files, for debugging purposes. You invoke the tool as follows:

```
java ifxprofp filename.ser
```

Here is an example of the output of the **ifxprofp** tool:

```
==================================================
printing contents of profile Demo02_SJProfile0
created 918584057644 (2/9/99 10:14 AM)
associated context is sqlj.runtime.ref.DefaultContext
profile loader is sqlj.runtime.profile.DefaultLoader@1f7f1941
contains no customizations
original source file:Demo02.sqlj
contains 8 entries
==================================================
profile Demo02_SJProfile0 entry 0
#sql { CREATE DATABASE demo_sqlj WITH LOG MODE ANSI
```

```
         };
line number:59
PREPARED_STATEMENT executed via EXECUTE_UPDATE
role is STATEMENT
descriptor is null
contains no parameters
result set type is NO_RESULT
result set name is null
contains no result columns
================================================
```

Appendix

This section contains additional reference information.

Embedded SQLJ and database connections

Embedded SQLJ versus JDBC on page 2 describes how Embedded SQLJ programs connect to databases. This appendix provides background information and information about using nondefault connection contexts.

The ConnectionManager class

You use the **ConnectionManager** class to make a connection to a database, as described in Embedded SQLJ versus JDBC on page 2. The **ConnectionManager** class has two methods:

- **newConnection()**
- **initContext()**

The **newConnection()** method creates and returns a new JDBC **Connection** object using the current values of the DRIVER, DBURL, UID, and PWD attributes. If any of the needed attributes is null or a connection cannot be established, an error message is printed to **System.out**, and the program exits.

The **initContext()** method returns the currently installed default context. If the current default context is null, a new default context instance is created and installed using a connection obtained from a call to **getConnection**.

Database URLs

The DBURL data member of the **ConnectionManager** class and the value for the **-url** option that you specify for online checking are database URLs. (For information about online checking, see Online checking on page 24.) Database URLs specify the subprotocol (the database connectivity mechanism), the database or server identifier, and a list of properties.

Your Embedded SQLJ program uses Informix® JDBC Driver to connect to the Informix® database.

Nondefault connection contexts

This section explains how to use nondefault connection contexts. Embedded SQLJ uses a connection-context object to manage the connection to the database in which you want an SQL statement to execute. You can specify different connection-context objects for different SQL statements in the same Embedded SQLJ program, as shown in the sample program **MultiConnect.sqlj** included in this section.

To use a nondefault connection context

1. Define the connection-context class by using an Embedded SQLJ connection statement. The syntax of the connection statement is as follows:

```
#sql [modifiers] context java_class_name;
```

modifiers

A list of Java™ class modifiers: for example, **public**

java_class_name

The name of the Java™ class of the new connection context

2. Create a connection-context object for connecting to the database.
3. Specify the connection-context object in your Embedded SQLJ statement in parentheses following the **#sql** string.

MultiConnect.sqlj sample program

The sample program **MultiConnect.sqlj** creates two databases with one table each, **Orders** and **Items**, and inserts two records in the **Orders** table and corresponding records in the **Items** table. The program prints the order line items for all the orders from both tables, which exist in different databases, by creating separate connection contexts for each database.

You can find the **MultiConnect.sqlj** sample program code in the `$INFORMIXDIR/jdbc/demo/sqlj` directory.

MultiConnect.sqlj calls the methods **executeSQLScript()** and **getConnect()**. These methods are contained in **demoUtil.java**, which follows this program.

Descriptions of sample programs included with HCL Informix® Embedded SQLJ

The following table lists and describes the online sample programs that are included with Informix® Embedded SQLJ.

Demo Program Name

Description

Demo01.sqlj

Demonstrates a simple connection to the database

Demo02.sqlj

Demonstrates a simple SELECT statement and the use of host variables

Demo03.sqlj

Demonstrates the use of a named iterator

Demo04.sqlj

Demonstrates the use of a positional iterator

Demo05.sqlj

Demonstrates interoperability between a JDBC ResultSet object and an SQLJ iterator

Demo06.sqlj

Demonstrates interoperability between a JDBC **Connection** object and an SQLJ connection-context object

The sample programs are located in the `IFXJLOCATION/demo/sqlj` directory (`IFXJLOCATION` refers to the directory where you chose to install Informix® Embedded SQLJ). The README file in the directory explains how to compile and run the programs.

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