

PSQL v13

Java Class Library Guide

Developing Applications Using the PSQL Java Class Library



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About This Manual

This manual contains information on using the Java Class Library to develop PSQL applications.

Who Should Read This Manual

This document is designed for any user who is familiar with PSQL and wants to know how to develop an application using Java Class Library.

This manual does not provide comprehensive usage instructions for the software or instructions for using other database access methods.

Action Corporation would appreciate your comments and suggestions about this manual. As a user of our documentation, you are in a unique position to provide ideas that can have a direct impact on future releases of this and other manuals. If you have comments or suggestions for the product documentation, post your request at the Community Forum on the Actian PSQL website.

Conventions

Unless otherwise noted, command syntax, code, and examples use the following conventions:

CASE	Commands and reserved words typically appear in uppercase letters. Unless the manual states otherwise, you can enter these items using uppercase, lowercase, or both. For example, you can type MYPROG, myprog, or MYprog.
Bold	Words appearing in bold include the following: menu names, dialog box names, commands, options, buttons, statements, and so forth.
Monospaced font	Monospaced font is reserved for words you enter, such as command syntax.
[]	Square brackets enclose optional information, as in [<i>log_name</i>]. If information is not enclosed in square brackets, it is required.
	A vertical bar indicates a choice of information to enter, as in [<i>file_name</i> <i>@file_name</i>].
< >	Angle brackets enclose multiple choices for a required item, as in /D=<5 6 7>.
variable	Words appearing in italics are variables that you must replace with appropriate values, as in <i>file_name</i> .
...	An ellipsis following information indicates you can repeat the information more than one time, as in [<i>parameter</i> ...].
::=	The symbol ::= means one item is defined in terms of another. For example, a::=b means the item <i>a</i> is defined in terms of <i>b</i> .

Introduction to the PSQL Java Interface

An Interface for Java Applications

The PSQL Java interface is an object-oriented addition to the classic Btrieve API.

The following topics introduce the interface and its basic use:

- [The PSQL Java Interface](#)
- [How to Set Up your Environment](#)
- [Running the Video Store Java Sample Application](#)
- [Viewing the Source of the Java Video Store Application](#)
- [Developer Resources at PSQL](#)
- [Where Do I Go From Here?](#)

For detailed information on developing for the Java interface in PSQL, see [Programming with the Java Class Library](#).

The PSQL Java Interface

The PSQL Java Classes are an interface to the MicroKernel Engine.

Java Class Library and MicroKernel Engine

The PSQL Relational Engine allows the users to reference databases with column level granularity. On the other hand, the MicroKernel Engine is concerned only with files, records, and indexes, and the application programs themselves are responsible for field-level access within the data buffer returned by a Btrieve API call.

In a SQL database, column-level information is available in the data dictionary stored in the data dictionary files.



Note Btrieve has been using the "file/record/field" terminology. However, in this section we use table, row and column instead when we describe classes that can be used in conjunction with databases that have PSQL dictionaries.

The purpose of this API is not only to provide language binding to object-oriented languages, like Java and C++, but also to furnish a logical structure that fits into object-oriented applications.

The design of the object-oriented API addresses the following goals:

- Providing Btrieve application developers a set of abstractions.
- Ensuring ease of use.
- Hiding the platform-dependent byte-orders.
- Enabling developers to use all features of the Btrieve system.
- Ensuring that the performance of the MicroKernel Engine is not jeopardized.

Shortly after the introduction of Java, a database interface, Java Database Connectivity (JDBC) was introduced. JDBC is gaining more and more popularity among database developers. The design of the new PSQL Java API uses the JDBC API as a model and applies many of the ideas and the methodology used in JDBC. However, some new concepts had to be introduced because JDBC was designed to support SQL and generally the relational model, whereas this API set supports the transactional Btrieve.

As was mentioned previously, if a Btrieve application accesses a data file that belongs to a SQL database, the new API calls can use the column descriptions stored in the dictionary of the database. In the case of Btrieve data files that are not part of any SQL database, the new API provides other means to access these files.

Database Concepts

A set of Btrieve data files that do not belong to any SQL database still form a database if some application programs tie them together in a logical sense. Such databases are referred to as *loosely-coupled* databases. A loosely-coupled database has no database dictionary. On the other hand, SQL databases will be referred to as *tightly-coupled* databases. A tightly-coupled database does have a persistent database dictionary.

The PSQL Java interface can operate at a high or low level depending on which classes you use.

Tightly-Coupled Databases

The high-level portion of the Java interface hides many of the implementation details that Btrieve programmers have dealt with formerly, such as position blocks, data buffers, and so on.

Loosely-Coupled Databases

A user who currently has a loosely coupled database and wants to take full advantage of the column-level support of the new API must choose one of the following options:

- 1** Create a database dictionary for the loosely coupled database by using the PSQL Control Center. In effect, the database is turned into a tightly coupled database before using the new API.
- 2** Create a new persistent dictionary and define tables, columns, and so on for each Btrieve file in an application program by using the new API. In this case, the database is turned programmatically into a tightly coupled database.

How to Set Up your Environment

This section contains information about proper configuration for use of the PSQL Java interface.

- [Supported JDKs](#)
- [CLASSPATH Environment Variable](#)

Supported JDKs

The PSQL Java interface supports JDKs 1.4 and higher.

CLASSPATH Environment Variable

The PSQL SDK configuration needs the CLASSPATH variable to point to the PSQL classes.

The sample CLASSPATH assumes that PSQL was installed to *file_path*\PSQL. The Java Class Library SDK is installed to *file_path*\PSQL\SDK\JCL. For default locations of PSQL files, see [Where are the PSQL files installed?](#) in *Getting Started With PSQL*.

You should update your CLASSPATH environment variable as follows:

```
SET CLASSPATH=.; file_path\PSQL\bin\psql.jar;  
file_path\PSQL\SDK\JCL\Samples\PVideo\pvideoj.jar;  
file_path\PSQL\SDK\JCL\Samples\PVideo;
```

where *file_path* equals the installation location of PSQL.

Windows CLASSPATH

If you receive an error that a certain PSQL class file cannot be found, your user CLASSPATH variable in the Control Panel may be overriding the system CLASSPATH variable that contains the PSQL paths.

To verify your Windows setup (and correct if necessary):

- 1 Click **Start**, point to **Settings**, and then **Control Panel**.
- 2 Double-click **System**.
- 3 Select the **Environment** tab.
- 4 Your PSQL paths are contained in the system variable. Under **User Variables**, see if CLASSPATH is present. If it is not, no action is required. If it is, prepend %CLASSPATH%; to your user variable.

Running the Video Store Java Sample Application

The Video Store sample applications demonstrates some of the capabilities of the PSQL Java interface.

►► **To run the Sample application**

- 1 Open your PSQL SDK Java Pvideo folder. Assuming you installed to the default location, this would be *file_path*\SDK\jcl\samples\pvideo.

For default locations of PSQL files, see [Where are the PSQL files installed?](#) in *Getting Started With PSQL*.

- 2 Double-click the PVIDEOJ.BAT icon.

The following application windows displays:

Figure 1 PSQL Sample Video Application Main Window - Java



Viewing the Source of the Java Video Store Application

The Java source files for the PSQL video store sample application are contained in a Java Archive file. You can extract these files to get a working example of the PSQL Java interface connecting to Btrieve tables.

The following procedure assumes that the JDK is installed and its BIN directory is in the path:

▶▶ To unpack the Java source files

1 At a command prompt, enter:

```
cd \psql\sdk\jcl\samples\pvideo
```

2 Next enter the JAR command:

```
jar -xvf source.zip
```

The source is extracted to the current directory and subdirectories below `psql\sdk\jcl\samples\pvideo`.

For default locations of PSQL files, see [Where are the PSQL files installed?](#) in *Getting Started With PSQL*.

For more information on Java Archive files, see <http://java.sun.com/docs/books/tutorial/index.html>.

Developer Resources at PSQL

The following resources are available to assist you in developing applications using the Java interface.

Website Resources

Resource	Online Location
PSQL Developer Zone	See the Actian PSQL website
Oracle Java website	http://www.oracle.com/technetwork/java/
Oracle Java tutorials	http://docs.oracle.com/javase/tutorial/

Javadocs Reference

The javadocs that accompany the Java Class Library provide a reference for the classes and methods used in JCL-based applications.

▶▶ To load the javadocs reference for Java Class Library

- 1 Locate the folder to which you installed JCL.zip. For example, if you unpacked the zip to C:\sdk, open the C:\sdk\jcl\doc\javadoc folder.
- 2 Open `index.html` using a web browser.

Where Do I Go From Here?

You should now have a good conceptual knowledge of what is included in the PSQL Java interface and have a properly configured environment. The next chapter shows you how to use the Java interface to create database applications.

Programming with the Java Class Library

The following topics provide instructions and details for programming Java in PSQL:

- [PSQL Java Interface Class Structure](#)
- [Overview of Major Classes and Methods](#)
- [Sequence of Steps for a Java Application](#)
- [First Steps with the Java Class Library](#)
- [Java Data Type Issues](#)
- [Sample Database Files](#)
- [Additional Java Samples](#)

PSQL Java Interface Class Structure

This topic describes the classes for the PSQL Java interface.

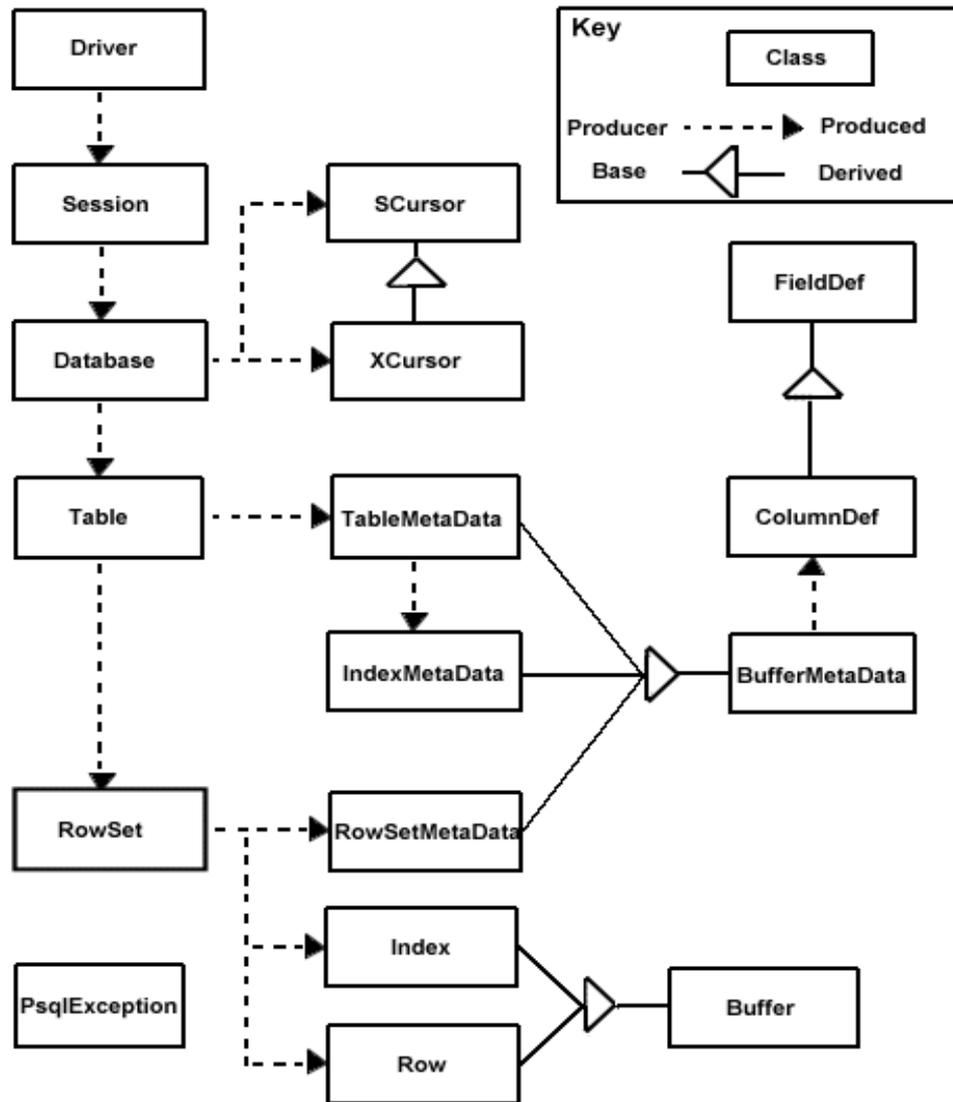
Applying the “factory” pattern, almost all classes (with the exception of `Driver`, `Timestamp`, `FieldDef` and `PsqlException`) can only be produced through methods of another class (or other classes). In the description of classes, under the label `Constructors` no constructors are listed when no public constructors are available.

The PSQL Java interface has a special class, `PsqlException` to handle error conditions occurring when methods of the API are invoked. `PsqlException` extends the `java.lang.Exception`. Each method of the PSQL Java classes throws `PsqlException` and for brevity, the following clause is left out from the method definitions:

```
throws PsqlException
```

Figure 2 shows all classes and their relationship.

Figure 2 Java API Class Structure



The classes of the PSQL Java Interface can be divided into three groups:

- [General Classes](#)
- [Rowset Family Classes](#)
- [Cursor Family Classes](#)

General Classes

The following classes belong to General Classes group:

- Driver
- Session
- Database
- Timestamp

- SQLException

These classes can be used both for tightly coupled and loosely coupled databases.

Rowset Family Classes

The following classes belong to the Rowset Family Classes group:

- Table
- Rowset
- Buffer
- Row
- Index
- DBMetaData
- TableMetaData
- RowSetMetaData
- ColumnDef
- IndexMetaData.

These classes make use of the metadata found in the dictionary of a PSQL database and, therefore, can be applied only for tightly coupled databases.

Cursor Family Classes

This is the low-level portion of the PSQL Java Interface. If you use this portion of the interface, you must handle position blocks, data buffers, and other elements of programming that are typical of the Btrieve API.



Note You must use this family of the Java interface if your Btrieve files do not have DDFs. You can use the PSQL Control Center utility to create DDF files for your data. See *PSQL User's Guide* for more information.

The following classes belong to Cursor Family Classes group:

- SCursor
- XCursor
- FieldDef

These classes do not use any meta data, they directly support the “classic” Btrieve operations (for example, through a BTRV method). Therefore, they are applied typically for loosely coupled databases. However, they can also be used to access data files that store tables of a tightly coupled database. (Although, it is more convenient to use the “rowset family” in the latter case.)

Overview of Major Classes and Methods

The following are the principal classes and methods involved in a basic Java application.

Principal Classes and Methods	Used for
Driver establishSession killAllSessions	<ul style="list-style-type: none"> Establishing one or more sessions. Stopping all Sessions
Session connectToDatabase startTransaction commitTransaction abortTransaction	<ul style="list-style-type: none"> Connecting to Databases Handling transactions
Database getTable getTableNames createxCursor	<ul style="list-style-type: none"> Obtaining Table names and Tables Creating an xCursor to perform low-level operations if needed.
Table getTableMetaData createRowSet	<ul style="list-style-type: none"> Creating a RowSet, which is a view into the table data. Obtaining metadata information about tables.
TableMetaData getIndexNames	<ul style="list-style-type: none"> Obtaining the Indexes from a Table.
RowSet createRow insertRow deleteRow updateRow getNext getByIndex reset	<ul style="list-style-type: none"> Obtaining part of a table Updating Row information
RowSetMetaData AddColumns DropColumns AddFirstTerm SetAccessPath SetDirection	<ul style="list-style-type: none"> Adding and Dropping Columns Performing "WHERE" clause functionality Changing direction of navigation
Row getString setString getFloat setFloat	<ul style="list-style-type: none"> Actual Updating of Data obtained through RowSets.

There are other classes and methods that you can view in the *PSQL Java Class Library Reference*, but these are the classes you will use most often in your application.

The structure of the Java interface classes is flat; there is no inheritance in these classes.

DRIVER

Driver establishes Sessions. You can use Driver to instantiate as many Session objects as needed. You can also use the KillallSessions method to stop the application, as it will clean up socket connections, database connections, open files, and system resources.

SESSION

Sessions use the connection to the driver and allow you to connect to databases using URIs and start and end transactions. Each session receives a unique Btrieve client ID. Unless your application specifically needs multiple Btrieve client IDs, you can generally use one Session for the entire application. You can reset the Session and the Btrieve client by calling Session.close(). For more information about client IDs, see [Btrieve Clients](#) in *PSQL Programmer's Guide* and [License Models](#) in *PSQL User's Guide*.

DATABASE

Objects instantiated using this class are the database itself. Methods in this class allow the developer to, in the case of tightly coupled databases, get the table names, tables and so forth. In the case of the loosely coupled database, the developer can access familiar Btrieve-like APIs including extended operations.

TABLE

An instance of this class represents a table as an object. Using table objects, you can create row sets and get meta data information about tables.

ROWSET

RowSet is an extremely important class. It is used to access the rows of the associated table. In addition, rows can be inserted, updated, and deleted through methods of this class.

An instance of this class represents a set of rows that is derived from the base table. One other way to look at it: a RowSet is a virtual table (a view) generated from a physically stored table.



Note This object can be constructed only through the createRowSet method of Table.

A row set could include all rows or a subset of rows of the base table. A number of methods in RowSetMetaData (e.g.addFirstTerm, addAndTerm, and so forth) is available to provide the terms of a restriction criterion that determines which rows from the base table are included into the row set.

A row set could include all columns or any number of selected columns of the base row. When a RowSet object is created by Table.createRowSet, it is initialized according to the value of noColumns specified explicitly or implicitly in the call. If noColumns is specified as *true*, then no column is included into the row set and the application can selectively include the columns into the row set by calling RowSetMetaData.addColumn. If noColumns is specified a false or it is not included as an argument then the created RowSet includes all columns of the table.

The applications normally do not have to open and close the row sets. The associated data files are opened at the construction time of the RowSet objects and the data files are closed when either the application explicitly calls RowSet.close or as a result of closing a higher-level associated object (Table, Database, etc).

The elements of a row set can be accessed through Row objects. There multiple options are available to retrieve the rows.

For important additional information about row sets, see *PSQL Java Class Library Reference*.

ROW

An instance of this class represents a row buffer for a row in a RowSet. The Class Row enables access to rows and to column values within a row. It can be used to retrieve rows, update, or delete rows and to build rows for insertion.

This class has no methods of its own, but the methods inherited from Buffer can be used to get/set values of columns in the row buffer.

Sequence of Steps for a Java Application

The following sequence of steps are typical of an application or applet. The first two steps are the same for both tightly coupled and for loosely coupled databases:

- 1 Establish an instance of `Session` that is used as the execution environment. (A `Driver` object does not have to be instantiated because `Driver` is a static class.) It is also possible for an application/applet to create multiple sessions.
- 2 Get a `Database` object for the database by invoking `Session.connectToDatabase()` specifying a URI. See *PSQL Programmer's Guide* for more information on database URIs. It is also possible to get multiple `Database` objects in a session, one for each database to be accessed.

Now choose either [Case 1: The application is accessing tables of a tightly coupled database](#). (Btrieve database uses a DDF) or [Case 2: The application is accessing data files of a loosely coupled database \(or data files that store tables of a tightly coupled database in the "classic" way\)](#).

Case 1: The application is accessing tables of a tightly coupled database.

- 3 Optionally, get the names of tables in the database (if they are not known for the application) by invoking `Database.getTableNames`.
- 4 Get a `Table` object for each table to be worked on by invoking `Database.getTable`.
- 5 Optionally, get a `TableMetaData` object for each table if the application has to get the column names and/or index names from the dictionary.
- 6 Create at least one `RowSet` object for each table to be processed in the application. `RowSet` objects are used to retrieve and modify data. A row set can be created including all or none of columns of the table (see more in step 7).

An application creates more than one `RowSet` for a table if it wants to process the table in some parallel fashion while maintaining multiple cursors (positioning) when navigating through the table. A `RowSet` object for a given table can be used for the entire duration of the application. That is, it can be used for retrievals by different indexes, by different conditions, and so forth.

- 7 For a given row set
 - a. Get a `RowSetMetaData` object for the row set.
 - b. Add needed columns to the definition if the row set was created with no columns included.
 - c. Change the default characteristics (direction, access path, and so forth) of the row set if necessary.
 - d. Define a selection criterion (`addFirstTerm`, `addAndTerm`, etc) if a row set should include only some selected rows of the base table.
 - e. Invoke `RowSet.getNext` method to retrieve `Row` objects. Optionally, invoke other methods of `RowSet` (`getByIndex`, `getbyPercent`, `insertRow`, `updateRow`, and so forth).
 - f. Invoke methods of `Row` (`getString`, `setString`, `getInt`, and so forth) to get/set values of columns in a row.



Note Steps a–d are optional and in some applications may not be needed for some row sets.

Case 2: The application is accessing data files of a loosely coupled database (or data files that store tables of a tightly coupled database in the "classic" way).

3. Create an SCursor or an XCursor object for each data file the application plans to work on. XCursor is needed only if any extended get/step operation will be executed on the file. Optionally, the application can get multiple cursor objects for the same file if it wants to process the file in some parallel fashion maintaining multiple positions at the same time.
- 4 Execute "classic" Btrieve operations (open, get/step, insert, etc) using SCursor.BTRV.



Note The BTRV method can be used also on XCursor because XCursor extends SCursor.

- 5 Optionally, define some FieldDef objects for data fields, use these field objects to set selection criterion (XCursor.addFirstTerm, etc) and define extraction list and use the methods like getNextExtended to execute extended operations.
- 6 Invoke methods like getDString, setKString, getDInt4, and so forth, to get/set values of fields in the private data and key buffers of SCursor (XCursor) objects.

The sections that follow explain these overview steps in more detail.

First Steps with the Java Class Library

To build your first Java Btrieve application:

- 1 [Verify your Environment is Correct](#)
- 2 [Create your Database and Tables](#)
- 3 [Connect to a PSQL Database](#)
- 4 [Obtain the Tables and Create Rowsets](#)
- 5 [Navigate the Rows in a Row Set](#)
- 6 [Restrict or Filter the Data](#)
- 7 [Insert, Update, or Delete Rows](#)
- 8 [Combine Operations into a Transaction](#)
- 9 [Store and Retrieve Binary Large Objects](#)

Verify your Environment is Correct

You should make sure your environment is set up correctly as described in [How to Set Up your Environment](#).

In addition, make sure that “psql.jar” is in your CLASSPATH environment variable. The installation procedure should have performed this step for you. To access the classes in the PSQL Java interface class library, you must import the package in your Java source files.

```
import PSQL.database.*;
```

Create your Database and Tables

Currently, the PSQL Java interface class library does not support the creation of databases and database tables. Use the PSQL Control Center utility to perform these tasks. Once the database Data Dictionary Files (DDFs) and data files have been created, you can use the Java API classes to populate and access the tables.

For more information on the PSQL Control Center and creating tables, see *PSQL User's Guide*.

Connect to a PSQL Database

There are two options for connecting to a PSQL database. Either connect directly to the engine or connect using the I*net Data Server.

To connect to a database using a URI

- 1 Get a Session object from the Driver.

```
Session session = Driver.establishSession();
```

- 2 Use the Session object to connect to the database. Specify a URI to connect to the database. At a minimum, this URI should contain `btrv:///dbname`.

```
Database db = session.connectToDatabase("btrv:///demodata");
```

or

```
Database db = session.connectToDatabase("btrv://user@host/
demodata?pwd=password");
```

See *Advanced Operations Guide* for more information on database security and URIs.

Obtain the Tables and Create Rowsets

▶▶ Retrieving a table from the database

```
Table table = db.getTable("MyTable");
```

where “MyTable” is the name of the database table. The table name is case sensitive.

You can also get a list of the database’s table names.

```
String [] names = db.getTableNames();
```

▶▶ To access a Table object’s properties

Once you have a Table object, you can obtain information about the columns and indexes from its TableMetaData object.

```
TableMetaData tmd = table.getTableMetaData();
```

Some examples:

```
// Get the number of columns.
int num_columns = tmd.getColumnCount();
// Get the data type for column 0
int data_type = tmd.getColumnDef(0).getType();
// Get the length in characters for the column 0
int col_length = tmd.getColumnDef(0).getOffset();
```

▶▶ To access a Table object’s rows

To access a Table’s rows, you need a RowSet object which can only be created by a Table object.

```
RowSet rowset = table.createRowSet();
```

You can create multiple RowSet objects from the same table. RowSet objects are used to retrieve a table’s rows, insert new rows, and delete and update existing rows. To iterate through all the table’s rows, create a RowSet object and call getNext() until an PsqLEOFException occurs.

```
try {
while(true)
Row row = rowset.getNext();
}
catch(PsqLEOFException ex) {
// No more rows
}
```

▶▶ To access a RowSet object’s properties

Once you have a RowSet object, you can obtain information about the RowSet from its RowSetMetaData.

```
RowSetMetaData rsm� = rowset.getRowSetMetaData();
```

Consult the methods of the RowSetMetaData class in *PSQL Java Class Library Reference* for more details.

Navigate the Rows in a Row Set

As previously shown, you can iterate through the row set's rows by repeatedly calling the "getNext" method. You can iterate backwards by changing the "direction" property of the row set's RowSetMetaData object.

```
rsmd.setDirection(Const.BTR_BACKWARDS);
```

After setting this property, the behavior of the "getNext" method becomes "getPrevious."



Note You can "reset" the currency of the row set at any time to be before the first or after the last row (as shown in the following procedures). This is an efficient way to retrieve the first row or last row without having to iterate through the entire row set.

▶▶ To retrieve the first row in the row set

- 1 Set the direction to forwards. This is the default.

```
rsmd.setDirection(Const.BTR_FORWARDS);
```

- 2 Set the row set's currency to before the 1st row.

```
rowset.reset();
```

- 3 Retrieve the first row.

```
Row first = rowset.getNext();
```

▶▶ To retrieve the last row in a row set

- 1 Set the direction to backwards.

```
rsmd.setDirection(Const.BTR_BACKWARDS);
```

- 2 Set the row set's currency to after the last row.

```
rowset.reset();
```

- 3 Retrieve the last row.

```
Row last = rowset.getNext();
```

▶▶ To access a Row object's column data

Row objects inherit a multitude of accessor/mutator methods from the Buffer class. These methods allow you to set/get column data to/from a Row object's buffer.

- 1 For example, to retrieve the data in column 0 as a String, do one of the following.

```
String str = row.getString(0);
```

or

```
String str = row.getString("ColumnName");
```

where "ColumnName" is the name defined in the data dictionary for column 0. Column names are case sensitive.

- 2 Now, to set the data for column 0, you use one of the setString methods.

```
row.setString(0, "MyColumnData");
```

or

```
row.setString("ColumnName", "MyColumnData");
```

- 3 Consult the methods of the Buffer class in *PSQL Java Interface Reference* for more details.

Restrict or Filter the Data

▶ **To restrict/filter rows in a row set**

To restrict/filter the rows in a row set, you have to use the RowSetMetaData's "addFirstTerm," "addOrTerm," and "addAndTerm." For example, if the first column of a table contains integer data and you want all the rows where the first column's value is greater than 25, do the following.

- 1 Get the row set's RowSetMetaData.

```
RowSetMetaData rsmd = rowset.getRowSetMetaData();
```

- 2 Get the ColumnDef for first column, column number 0.

```
ColumnDef cmd = rsmd.getColumnDef(0);
```

- 3 Reset the row set's currency to the beginning.

```
rowset.reset();
```

- 4 Add the first term.

```
rowset.addFirstTerm(cmd, Const.BTR_GR, "23");
```

- 5 Call getNext() to get the first row where column 0 is greater than 23.

```
Row row = rowset.getNext();
```

You can add additional terms with the RowSetMetaData's "addOrTerm" and "addAndTerm." These methods allow you to build up more complex filtering conditions similar to a SQL "WHERE" clause.

▶ **To select columns from a row set**

You can specify a subset of the columns to retrieve, similar to the SQL "select" statement, by using the RowSetMetaData methods, "addColumnns" and "dropColumnns." By default, a row set will retrieve all the column data unless the row set was created with the "noColumnns" parameter set to "true."

```
RowSet rowset = table.createRowSet(true);
```

In this case, no columns will be retrieved. Alternatively, after creating the row set, you can drop all or some of the columns.

```
RowSetMetaData rsmd = rowset.getRowSetMetaData();
rsmd.dropAllColumns();
```

Now you can add the set of columns you're interested in to the row set.

```
rsmd.addColumnns("LastName", "FirstName");
```

You can add columns to the row set by column names or by column numbers. See the various "addColumnns" and "dropColumnns" methods of the "RowSetMetaData" class in the *PSQL Java Interface Reference* documentation for more details.

If you access column data in the rows by column number, be aware that the column numbers will be affected by the new ordering produced by "addColumnns" and "dropColumnns" methods. For example, if

“FirstName” was originally column number 3 in the row set, after dropping all the columns and then adding “LastName” and “FirstName,” the “FirstName” column number will be 1.

►► To retrieve a row by index

You can retrieve a row by using a defined index along with a comparison operator. For instance, if an index, “Last_Name” has been created on the “LastName” column for a hypothetical table, you can do the following to find a row with a “LastName” equal to “Smith.”

- 1 Using the row set’s RowSetMetaData object, set the access path to use index “Last_Name.”

```
rsmd.setAccessPath("Last_Name");
```

- 2 Create an index object using the index name. You can use the index number instead of the name.

```
Index index = rowset.createIndex("Last_Name");
```

- 3 Set the “LastName” column data for the index.

```
index.setString("LastName", "Smith");
```

- 4 Get the first row with LastName == Smith.

```
try {  
    Row row = rowset.getByIndex(Const.BTR_EQ, index);  
}
```

- 5 Catch any exceptions that occur.

```
catch(PsqlOperationException ex) {  
  
    // If the error code == 4, then no row with LastName  
    // == Smith exists. This could be considered  
    // normal operation.  
  
    // If the status code is not 4, the operation failed  
    // for some other reason than “not found.”  
  
    if (ex.getErrorCode() != 4)  
        throw(ex);  
}
```

If the index allows duplicate key values, the first row which satisfies the comparison operator will be returned. The returned row becomes the current row, allowing you to retrieve the next logical row, based on the index, with the row set’s “getNext” method.

You can get the list of index names from the table’s TableMetaData object.

```
String [] index_names = table.getTableMetaData().getIndexNames();
```

Be aware that an index is not required to have a name. In that case, you should use the index number instead. Index numbers are zero based.

Insert, Update, or Delete Rows

▶▶ To insert a new row

- 1 First create a new Row object.

```
Row row = rowset.createRow();
```

- 2 Set the column data for the row.

```
// Set column 0 data
```

```
row.setString(0, "Column0String");
```

```
// Set column 1 data
```

```
row.setInt(1, 45);
```

```
// Update column 2 data
```

```
row.setDouble(2, 99.99);
```

- 3 Now insert the row.

```
rowset.insertRow(row);
```

This newly inserted row becomes the current row of the row set. If you do not want the row set's currency to be changed by the insertion, you can use the overloaded version of "insertRow" that takes a boolean argument indicating no currency change(NCC).

```
rowset.insertRow(row, true);
```

The row set's current row will be unchanged.

▶▶ To update a row/record

- 1 First retrieve the row by calling one of the row set's retrieval methods, "getNext," "getByIndex," and so forth.

```
Row row = rowset.getNext();
```

- 2 Make the changes to the column data for the row.

```
// Update column 1
```

```
row.setInt(1, 45);
```

- 3 Now update the row.

```
rowset.updateRow(row);
```

Like "insertRow," the newly updated row becomes the current row of the row set unless "no currency changed" is indicated, as shown following.

```
rowset.updateRow(row, true);
```

▶▶ To delete a row/record

- 1 First retrieve the row by calling one of the row set's retrieval methods, "getNext," "getByIndex," and so forth.

```
Row row = rowset.getNext();
```

- 2 Then delete the row.

```
rowset.deleteRow(row);
```

The row to be deleted does not have to be the “current” row i.e. the row returned from the last retrieval operation. If it is not the current row, the “deleteRow” method will make the deleted row the “current” row before deleting it. After the deletion, a call to “getNext” will return the row following the deleted row.

Combine Operations into a Transaction

Transactions allow you to combine a series of operations into a single operation that will either be committed or aborted.

▶▶ To make a set of operations a transaction

You can make a set of operations a transaction by using the transaction methods of the Session class.

Here is an example of a transaction:

1 Start the transaction

```
try {  
    session.startTransaction(BTR_CONCURRENT_TRANS);
```

2 Perform some operations that you want to rollback if a failure occurs.

```
    // insert one or more operations here
```

3 Attempt to commit the transaction.

```
    session.commitTransaction(); }  
    catch(PsqlException ex)
```

4 If an error is detected, abort the transaction.

```
    {    // An error occurred.  
        session.abortTransaction(); }
```

Transactions can be “exclusive” or “concurrent.” See the *PSQL Programmer's Guide* for more information about transactions.

Store and Retrieve Binary Large Objects

The setObject() and getObject() methods can be used to store and retrieve Java objects that implement the java.io.Serializable interface. The setBinaryStream() and getBinaryStream() methods can be used to store and retrieve binary data using Java InputStreams. If we have a "simple" object Employees with the following interface:

```
public class Employee implements java.io.Serializable  
public int    getID();           //Gets the Employee ID  
public void   setID(int ID);    //Sets the Employee ID  
public String getName();        //Gets the Employee Name  
public void   setName(String name); //Sets Employee Name  
public String getManagerName(); //Gets the Manager Name  
public void   setManagerName(); //Sets the Manager Name
```

...and we have a file that we wish to read at C:\Employees\Java Duke\report.txt, we can instantiate an Employee object, set its state with the mutator methods, and store it into the database in the Employee_Data column as well as storing the file in the Manager_Report column:

```
// Already performed usual setup
```

```

// (Driver.establishSession, and so forth)
// and instantiated an Employee object
// named employeeObject.
employeeObject.setName("Java Duke");
employeeObject.setID(123456789);
employeeObject.setManagerName("Big Boss");

FileInputStream managerReport = null;
try
{
    managerReport = new FileInputStream(C:\Employees\Java Duke\report.txt);
}
catch(IOException ioe)
{
    //Handle the exception.
}

//Set the column values for the row,
// assuming that a RowSet object
//(rowset) has already been created.

Row employeeRow = rowset.createRow();

//Set the ID column of the database.
employeeRow.setInt("ID", employeeObject.getID());

//Set the Employee object into the row.
try
{
    employeeRow.setObject("Employee_Data", employeeObject);
}
catch(PsqlIOException pioe)
{
    //Handle the exception.
}

//Set the manager's report into the row.
employeeRow.setBinaryStream("Manager_Report", managerReport);

//Insert the row.
rowset.insertRow(employeeRow);

//Now we can retrieve this row from the database

RowSetMetaData rsmd = rowset.getRowSetMetaData();
ColumnDef cdef = rsmd.getColumnDef("ID");
rsmd.addFirstTerm(cdef, Const.BTR_EQ, "123456789");
Row rowRetrieved = rowset.getNext();

//After the row is retrieved, we can
// perform the getObject and
// getBinaryStream methods on the row in
// order to retrieve the desired data.

try
{
    Employee employeeRetrieved =
        (Employee)rowRetrieved.getObject("Employee_Data");
}

```

```
}  
catch(PsqlException pe) //This method throws both  
                        // PsqlIOException  
{                          //and PsqlClassNotFoundException  
    //Handle the exception.  
}  
  
InputStream reportRetrieved =  
    rowRetrieved.getBinaryStream("Manager_Report");  
  
// These objects have now been reconstituted.  
// You can invoke the methods that have been  
// defined for either the object itself or  
// its parents as you normally would.  
  
String managerName = employeeRetrieved.getManagerName();  
  
// You probably wouldn't normally want  
// to process the entire file.  
// in one chunk, but you could  
// if you have the resources.  
byte file[] = new byte[reportRetrieved.available()];  
reportRetrieved.read(file);
```

For more information, see [Binary Large Object Support](#).

Java Data Type Issues

This section contains information that may be of use to the PSQL Java programmer:

Binary Large Object Support

Support has been added to the Java Class Library to handle Binary Large Objects or BLOBs. BLOBs represent large (up to 4 Gigabytes) binary data, and are represented as LONGVARBINARY data types in the PSQL engine. The Java Class Library supports these data types through these methods (which are found in the PSQL.database.Row class):

```
public void setObject(int columnNumber, Serializable object),
public void setObject(String columnName, Serializable object),
public Serializable getObject(int columnNumber),
public Serializable getObject(String columnName),

public InputStream getBinaryStream(int columnNumber),
public InputStream getBinaryStream(String columnName),
public void setBinaryStream(int columnNumber, InputStream inStream),
public void setBinaryStream(String columnName, InputStream inStream)
```

where columnNumber = the zero based sequence number of a column in the row buffer. columnName = the name of a column in the row buffer. object = a serializable Java object to store into the database. inStream = a Java InputStream object used to stream bytes into the database.

The methods above can be split into two categories: those that operate on Serialized Java objects and those that operate on Java InputStream objects. Each of these categories will be discussed further in the following sections. In the following sections, examples will be assuming that a table named Employees has been created with the following schema:



Note Employee_Data and Manager_Report have the "not null" specification in their definitions because the Java Class Library does not yet support the True Null feature found in PSQL 2000 and later versions.

```
table Employees (SS_Num ubigint primary key,
  Employee_Data longvarbinary not null,
  Manager_Report longvarbinary not null)
```

Data inserted into a "one byte integer column" with the SQL Interface cannot be retrieved with the Java Interface

The PSQL database engines interpret one byte integers as having possible values from 0 to 255. Java interprets its byte type as signed quantities with possible values from -128 to 127.

Because of this difference in interpretation, your code must perform the procedure described here so that data is not misinterpreted.

▶▶ **To convert single byte integers between Java's interpretation and that of the PSQL Database engine**

```
int theOneByteInt = 0;
PSQL.database.Row row = _rowset.getNext();
theOneByteInt = row.getBytes("OneByte") & 0x00FF;
listCourses.add(theOneByteInt + " ");
```



Note All Java data types are signed.

For more information on Java data types and other Java language information, please see <http://java.sun.com/docs/books/tutorial/index.html>.

Sample Database Files

You can use the sample database files provided with the SDK to write Java applications. If you damage the database files because of faulty programming, you can restore them from a backup directory installed with the SDK.

► To restore the sample database files

- 1 Before restoring, close any programs that have the database files open, such as the sample application or your development environment.

- 2 Assuming you installed to the default location of `file_path\PSQL\SDK`, open the following folder:

```
file_path\psql\sdk\jcl\samples\pvideo\pvideodb\dbbackup
```

For default locations of PSQL files, see [Where are the PSQL files installed?](#) in *Getting Started with PSQL*.

- 3 Copy the files located in that directory to the next higher level folder, which in the case of step 1 is:

```
file_path\psql\sdk\jcl\samples\pvideo\pvideodb\
```

Additional Java Samples

There are additional samples included with the Java API. One sample demonstrates joining two tables provided in the SDK package. Another is a simple connection to the DEMODATA database. The final one demonstrates object serialization.

These samples are located in the following directories, (assuming you installed to the default location):

```
file_path\psql\sdk\jcl\samples\join
```

```
file_path\psql\sdk\jcl\samples\helloworld\
```

```
file_path\psql\sdk\jcl\samples\serialization
```

For default locations of PSQL files, see [Where are the PSQL files installed?](#) in *Getting Started with PSQL*. For additional PSQL Java information and to obtain future samples, see the PSQL website.