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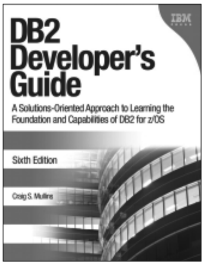

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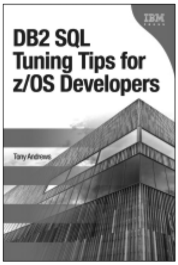

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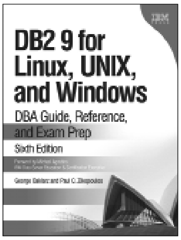
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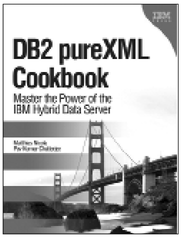

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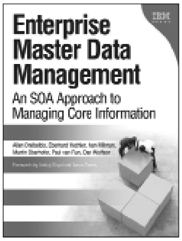

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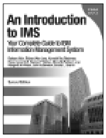

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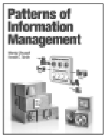

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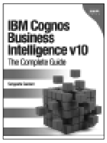

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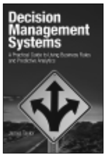

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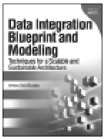

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Understanding DB2 in a Big Data World

Raul F. Chong

Clara Liu

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I would like to thank my wife Jin, and my two daughters Meylin and Isabelle,
for their understanding, patience, support, and love.
The many weekends and nights spent writing this book meant many sacrifices,
and quality family time lost.
But you all kept me going to complete this book!
I would also like to thank my parents, in-laws,
and siblings for their constant support and love.

Raul F. Chong

I didn't think I would write another book after completing
my fourth one a couple years ago.
I would like to sincerely thank Raul for his encouragement (and convincing)
to become THE co-author of this book.
It is indeed a proud achievement to find five books (so far)
listed when my name is "googled."
I want to dedicate this book to my lovely family: Heison, Kristen, Ansel,
my parents, and my in-laws.
I thank you for your support on giving me private time to work on the chapters
over weekends and late nights.
We missed our annual Ride for Heart event this year, didn't we?
Finally, congratulations to the entire DB2 for LUW team. We did it again!

Clara Liu

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Foreword

To meet the rapidly growing demand for information, IT infrastructures must not only work faster to provide analytics, they must also work smarter with new database technology created for the era of Big Data. DB2® 10.5 with BLU Acceleration offers businesses a faster, easier and significantly more affordable approach to analytics.

This book describes the increasing interest and demand for Big Data, and introduces big data technologies such as IBM® InfoSphere® Streams, IBM InfoSphere BigInsights™, and IBM InfoSphere Data Explorer. The authors highlight the value of DB2 for data warehouse simplification.

In the last two editions, the authors received great feedback about the visual illustrations throughout the book. With this third edition of the Understanding DB2 series, this book continues to keep the visual learning style with clear explanations for every chapter. Each chapter introduces a topic with a "big picture". Figures are used extensively and explained thoroughly. The "big pictures" are excellent for beginners to understand the concept and see how each component complements and interacts with others. They are also excellent references for database professionals at intermediate levels.

After "visually" learning the concepts in the chapters, the full case studies that follow will illustrate how to put theory into practice in real life scenarios. There are concept review questions to help you prepare for your DB2 certification exams. This provides a complete introduction as well as practical guide with study material.

This book has been fully updated with DB2 10.1 and 10.5 functions and features. New topics include introducing BLU Acceleration, Adaptive Compression, multi-temperature data management, the newly simplified DB2 portfolio, the complementary tool - IBM Data Studio, and many other new capabilities.

The authors have effectively compiled valuable information into this book that has been collected through their experience of working in the DB2 development lab as well as from working with many DB2 customers and partners globally. As with the previous editions, it will continue to earn a place on the must-read list for every DB2 professional. Enjoy the book!

Judy Huber
Vice President, Distributed Data Servers and Data Warehousing
Director, IBM Canada Laboratory

Preface

We are living in exciting times where data is being heralded as the new gold. The confluence of Big Data Technologies and Cloud Computing is enabling us to analyze vast amounts of data in ways never done before, and allowing the discovery of new information that is impacting everyone's lives. But for those in the Information Technology (IT) field, keeping up with the skills to be successful on the job is becoming more and more challenging. Understanding new algorithms, new programming paradigms, and new technologies in general require significant time commitment. Although you cannot avoid the time investment needed on your own education, choosing books written in a clear, concise, and visual manner can help you get the most of your investment. This book was designed with this in mind, to minimize the time, money, and effort required to learn DB2 for Linux®, UNIX®, and Windows®. The book visually introduces and discusses the latest version of DB2, DB2 10.5. This version introduces and important feature, BLU acceleration technology, which is particularly important in the big data world.

Who Should Read This Book?

This book is intended for anyone who works with data, and specifically databases, such as database administrators (DBAs), application developers, system administrators, and consultants. This book is a great introduction to DB2, whether you have used it before or you are a beginner. It is also a good study guide for anyone preparing for the IBM DB2 10 Certification exams 610 (DB2 10.1 Fundamentals), or 611 (DB2 10.1 Database Administrator for Linux, UNIX and Windows).

This book will save you time and effort because the topics are presented in a clear and concise manner, and we use figures, examples, case studies, and review questions to reinforce the material as it is presented. The book is different from many others on the subject because of the following.

- Visual learning. The book relies on visual learning as its base. Each chapter starts with a "big picture" to introduce the topics to be discussed in that chapter. Numerous graphics are used throughout the chapters to explain concepts in detail. We feel that figures allow for fast, easy learning and longer retention of the material. If you forget some of the concepts discussed in the book or just need a quick refresher, you will not need to read the entire chapter again. You can simply look at the figures quickly to refresh your memory. For your convenience, some of the most important figures are provided in color on the book's Web site (www.ibmpressbooks.com/title/9780133461909). These figures in color can further improve your learning experience.

- Clear explanations. We have encountered many situations when reading other books where paragraphs need to be read two, three, or even more times to grasp what they are describing. In this book we have made every effort possible to provide clear explanations so that you can understand the information quickly and easily.
- Examples, examples, examples. The book provides many examples and case studies that reinforce the topics discussed in each chapter. Some of the examples have been taken from real life experiences that the authors have had while working with DB2 customers.
- Sample exam questions. All chapters end with review questions that are similar to the questions on the DB2 Certification exams. These questions are intended to ensure that you understand the concepts discussed in each chapter before proceeding, and as a study guide for the IBM Certification exams. Appendix A contains the answers with explanations.

Getting Started

If you are new to DB2 and would like to get the most out of this book, we suggest you start reading from the beginning and continuing with the chapters in order. If you are new to DB2 but are in a hurry to get a quick understanding of the product, you can jump to Chapter 2, "DB2 at a Glance: The Big Picture." Reading this chapter will introduce you to the main concepts of DB2. You can then go to other chapters to read for further details. If you are new to DB2 but have knowledge of Oracle database products, you can review first Appendix C, "A Comparison of DB2 and Oracle Terminology."

If you would like to follow the examples provided with the book, you need to install DB2. Chapter 3, "Installing DB2," gives you the details to handle this task.

A Word of Advice

In this book we use figures extensively to introduce and examine DB2 concepts. Although some of the figures may look complex, don't be overwhelmed by first impressions! The text that accompanies them explains the concepts in detail. If you look back at the figure after reading the description, you will be surprised by how much clearer it is.

This book only discusses DB2 for Linux, UNIX, and Windows, so when we use the term DB2, we are referring to DB2 on those platforms. DB2 for i®, DB2 for z/OS®, and DB2 for VSE and VM are mentioned only when presenting methods that you can use to access these databases from an application written on Linux, UNIX, or Windows. When DB2 for i®, DB2 for z/OS®, and DB2 for VSE and VM are discussed, we refer to them explicitly.

This book was written prior to the official release of DB2 10.5. The authors used a beta copy of the product to obtain screen shots, and perform their tests. It is possible that by the time this book is published, and the product is officially released, some features and screenshots may have changed slightly.

Conventions

Many examples of SQL statements, XPath/XQuery statements, DB2 commands, and operating system commands are included throughout the book. SQL statement keywords are written in uppercase. For example: Use the `SELECT` statement to retrieve data from a DB2 database.

XPath and XQuery statements are case sensitive—for example: /employee/DEPT/Id

DB2 commands are shown in lowercase mono—for example: The `list applications` command lists the applications connected to your databases.

You can issue many DB2 commands from the Command Line Processor (CLP) utility, which accepts the commands in both uppercase and lowercase. In UNIX operating systems, program names are case-sensitive, so be careful to enter the program name using the proper case. For instance, on UNIX, `db2` must be entered in lowercase. (See Chapter 2, "DB2 at a Glance: The Big Picture," for a detailed discussion of this.)

Keywords are written in uppercase, unless the keyword is part of a command statement or syntax, or the particular program language uses lowercase.

Database object names used in our examples are shown in italic. For example: The *COUNTRY* table has a *City* column.

Italic is also used for variable names in the syntax of a command or statement. If the variable name has more than one word, it is joined with an underscore. For example: `CREATE SEQUENCE` *`sequence_name`*.

In code listings, some code lines are too long to fit the width of the page. When a code line wraps to another line, you will see a code continuation character (➥) at the beginning of the runover line:

```
Number of pooled fenced processes         (FENCED_POOL) =
➥AUTOMATIC(MAX_COORDAGENTS)
```

Where a concept of a function is new in DB2 10.1 or DB2 10.5, we signify this with an icon as follows:

V10

Note that the DB2 certification exams only include material of DB2 version 10.1, not version 10.5

Contacting the Authors

We are interested in any feedback that you have about this book. Please contact us with your opinions and inquiries at udb2book@ca.ibm.com.

Depending on the volume of inquiries, we may be unable to respond to every technical question but we'll do our best. The DB2 forum at https://www.ibm.com/developerworks/community/forums/html/forum?id=11111111-0000-0000-0000-000000000842 is another great way to get assistance from IBM employees and the DB2 user community.

What's New

This book, though with a different title, is an update of the book *Understanding DB2 – Learning Visually with Examples* (2nd Edition), which received great reviews. Though our intention was to keep the same title and same depth in each topic, the size of the book became an issue. As more features are added into the DB2 product, more pages are required to describe them. Rather than reduce the depth of each topic, we decided to split the book. *DB2 Essentials* covers the core topics every DB2 professional should know at the beginner-to-intermediate level. More advanced concepts have been left for another book, which at the time of this writing is in the planning stage.

Since the time the second edition of *Understanding DB2: Learning Visually with Examples* was published, there have been four releases or versions of DB2 for Linux, UNIX, and Windows in that time: DB2 9.7, DB2 9.8, DB2 10.1, and now DB2 10.5; this section highlights what's new with each of them.

The core of DB2 and its functionality remains mostly the same as in previous versions; therefore, some chapters required minimal updates. On the other hand, some other chapters such as Chapter 4, "Using Database Tools and Utilities," required substantial changes since most DB2 GUI Tools were deprecated with DB2 9.7, and then discontinued with DB2 10.1 and replaced by IBM Data Studio.

To indicate where something has changed from the previous version of the book, or was added in DB2 10.1 or DB2 10.5, we have used the icon shown below. This is particularly useful for those who have bought the second edition of the *Understanding DB2* book and quickly want to identify what's new.

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As you will see next, there is only one main feature introduced in DB2 10.5 (BLU acceleration technology) that we discuss in this book; therefore we did not use different icons to distinguish changes or additions between version 10 and version 10.5.

The following sections will briefly introduce the changes or additions in each of these new versions of DB2.

DB2 9.7

DB2 9.7 introduced many features to help administrators and developers of other relational database products migrate their databases and applications to DB2. For example, with DB2 9.7 a migration from an Oracle database to DB2 that would take months in the past, could now be performed in a few hours or days. This was possible because DB2 9.7 introduced several data types, and support for non-standard SQL statements used in Oracle. In addition, the CLPPlus tool was introduced which has a very similar interface and behavior to Oracle's SQL*Plus. Moreover, Oracle's PL/SQL language often used in stored procedures could be easily understood in DB2; therefore Oracle's stored procedures could run with minimal or no modification in DB2. Appendix C, "A Comparison of DB2 and Oracle Terminology," has a section with more information about this. Other improvements in this release included compression, pureXML®, and security enhancements.

DB2 9.8

DB2 9.8 introduced pureScale® technology, a solution architected based on DB2 on the mainframe data-sharing technology. With pureScale, different DB2 servers share the same data in a cluster environment. DB2 servers can be added to the cluster as the data grows, allowing for scalability, but also, extreme availability. In this book we discuss the basic concepts of pureScale.

DB2 10.1

DB2 10.1 introduced many features and enhancements in different areas. Most of these enhancements are discussed in detail in the book:

- Adaptive compression, for deep compression using dictionaries at the page and table levels.
- Time Travel Query, which allows users to query data in the past, the present or the future.
- Multi-temperature data management, ideal for data warehousing environments where data is classified based on how often it is accessed; thus, assigning the most frequently used data (hot data) to faster devices, and the least frequently used data (cold data) to slower devices.
- Row and Column Access Control (RCAC), which provides security granularity at both, row and column levels.

DB2 10.5

DB2 10.5 introduces new packaging of the product to fit different needs at different price points. One single image is created for most editions, as opposed to one different image per edition. This means that to upgrade from one edition to the other, you don't need to uninstall the previous edition of DB2, simply apply the license of the new edition, and any feature specific to the new edition would be unlocked. This is particularly helpful in environments where the company's IT policy required safety procedures in place for new installations of a product. With this approach, there is no new installation required.

Probably the key feature of DB2 10.5 is BLU Acceleration technology, a revolutionary approach of storing data rows in columnar fashion. This is ideal for data warehousing environments, and allows for performance improvements in order of magnitude for analytic workloads. BLU Acceleration is a technology that enables users to work with big data as it dramatically helps with performance. It is also remarkable the ease in which this technology can be implemented by users. All complexities are hidden from regular users who don't even need to create indexes.

One common denominator in all the new features and changes made to DB2 in these four new versions or releases is that many of the new features and functions were developed to make your life easier!

Acknowledgments

Raul and Clara would like to thank Cristian Molaro and Kshitij Kohli for their extensive technical review of the book. Their suggestions and corrections were invaluable.

Steven Stansel, Susan Visser, and Mary Beth Ray provided guidance and invaluable help throughout the whole process of planning, writing, and publishing the book. Without their help, this book would never have been completed as smoothly as it has been.

About the Authors

Raul F. Chong is a Senior DB2, Big Data and Cloud Program Manager and Technical Evangelist based at the IBM Canada Laboratory. He leads the development and design of several offerings for the Information Management (IM) brand of IBM, with the goal of increasing awareness and growing communities around IBM IM products, such as IBM InfoSphere® BigInsights™, IBM InfoSphere Streams, DB2 database software, IBM Data Studio, InfoSphere Data Architect, and pureQuery® technology. As part of the IM Cloud Computing Center of Competence at the Toronto Lab, Raul leads the development and deployment of projects by the community using DB2 on the Cloud, such as bigdatauniversity.com, and db2oncampus.org. As a technical evangelist, Raul travels worldwide delivering presentations and workshops targeting customers, IBM business partners and the Academia. Raul develops and leads the development of collateral material such as articles, books, videos, courses, and DVDs that help educate users in IBM IM products. He has also participated actively in the development of training material and offerings of IBM IM Certification programs. Raul joined IBM in 1997 and has worked as a DB2 consultant, DB2 technical support specialist, and DB2 Information Developer. Raul has summarized many of his DB2 experiences through the years in the first and second editions of the book Understanding DB2—Learning Visually with Examples for which he is the lead author. He has also co-authored the book DB2 SQL PL Essential Guide for DB2 UDB on Linux, UNIX, Windows, i5/OS, and z/OS (ISBN 0131477005), and other books that are part of the DB2 on Campus book series. In his spare time, Raul enjoys playing with his two little daughters. Raul is fluent in Spanish as he was born and raised in Peru, but he keeps some of the Chinese traditions from his grandparents. He also enjoys reading history and archeology books.

Clara Liu was recently appointed to be the Program Manager of IBM Cross Brand Technical Initiatives. She manages leading edge strategic projects across IBM brands. Her prior management role was with the DB2 Planning team. Her previous consulting experience gave her an insight and solid understanding of customers' needs. Based on market demand, competition pressure, and objectives of maximizing return of investment, she drives software enhancements into the product with the right balance between leading edge technology and business needs. In many DB2, Warehouse, PureData™ Systems versions and releases, Clara held key responsibilities such as planning product enhancements, managing product offer portfolio and license entitlement, making software available on fulfillment systems for customers, and planning for smooth migration paths for customers when products reach end of life. Over the years, she delivered many product hands-on and video demonstrations with her team. Those are great assets for the IBM Sales and Marketing team and customers who want to 'see' and 'play' with the technologies. Due to the board involvement in numerous phases of the database product life cycle, Clara has established great networking within the development organization as well as across the business teams. As a mother of two, Clara had coauthored five books (including this one), all focusing in her technical expertise, DB2 for Linux, UNIX and Windows.

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CHAPTER 4

Using Database Tools and Utilities

How do you work with DB2? How do you issue SQL and/or XQuery statements and enter DB2 commands? Are there graphical tools that can make your administration tasks easier? This chapter provides the answers to all of these questions. DB2 provides a wide range of tools, both graphical and command-driven, to help you work with DB2.

In this chapter, you learn about

- DB2 command line tools
- IBM Data Studio
- IBM Data Studio Web Console
- Set up tools
- DB2 information tools
- DB2 problem determination tools

Database Tools: The Big Picture

DB2 comes with a comprehensive and complimentary set of tools for you to perform basic database administration and development tasks. Figure 4.1 shows a high level overview of tools available with DB2. They are categorized into command line tools, graphical tools, and other tools to assist you with setup. In most cases you can perform the same DB2 commands, SQL statements, and XQuery statements using the command line and graphical tools.

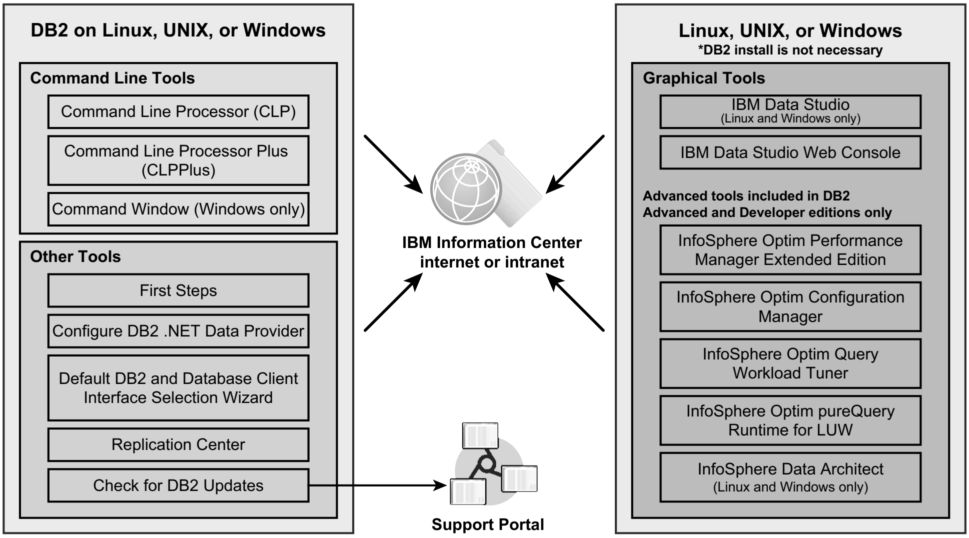
DB2 on Linux, UNIX, or Windows
Command Line Tools
Command Line Processor (CLP)
Command Line Processor Plus (CLPPlus)
Command Window (Windows only)
Other Tools
First Steps
Configure DB2 .NET Data Provider
Default DB2 and Database Client Interface Selection Wizard
Replication Center
Check for DB2 Updates
IBM Information Center internet or intranet
Support Portal
Linux, UNIX, or Windows
*DB2 install is not necessary
Graphical Tools
IBM Data Studio
(Linux and Windows only)
IBM Data Studio Web Console
Advanced tools included in DB2 Advanced and Developer editions only
InfoSphere Optim Performance Manager Extended Edition
InfoSphere Optim Configuration Manager
InfoSphere Optim Query Workload Tuner
InfoSphere Optim pureQuery Runtime for LUW
InfoSphere Data Architect
(Linux and Windows only)

Figure 4.1 Database tools the big picture

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NOTE

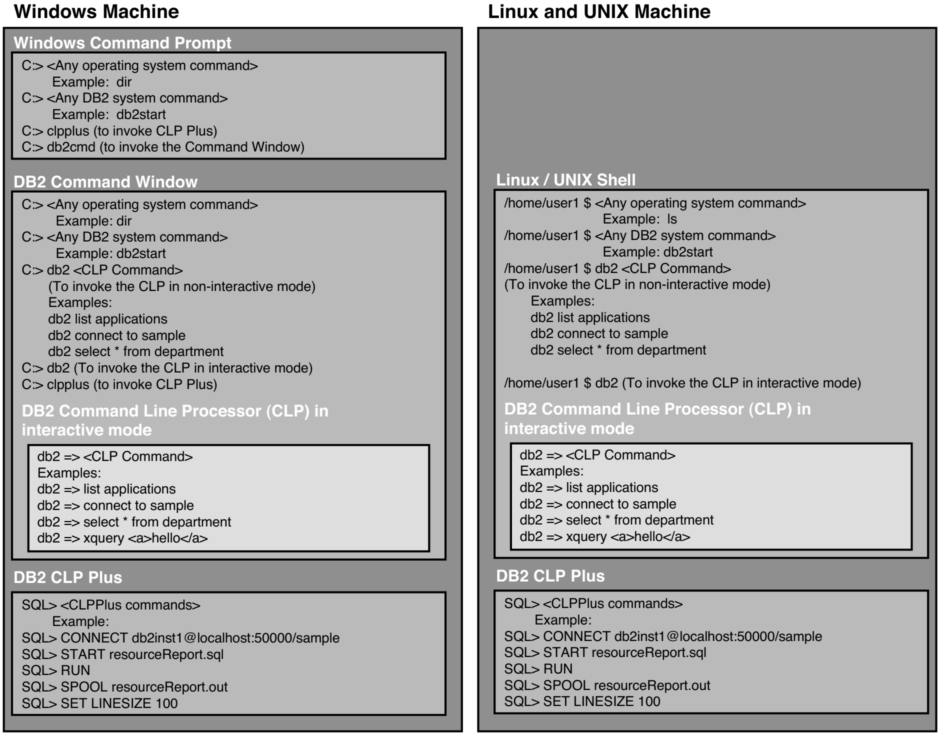
The Control Center tools and all related components such as wizards and advisors were discontinued in DB2 10. IBM Data Studio can be used to manage DB2 environment and DB2 data-centric applications. IBM Data Studio comes with every DB2 edition.

The Command-Line Tools

All DB2 operations are invoked by DB2 commands, SQL statements, or XQuery statements. For example, to back up a database, you use the `BACKUP DATABASE` command. To create a table, you use the `CREATE TABLE` SQL statement. To parse an XML document you use the `FLWOR` expression. All of these commands, SQL statements, and XQuery statements can be entered using the command-line tools.

The command-line tools consist of the Command Line Processor (CLP), the Command Line Processor Plus (CLP Plus), and the Command Window (Windows platform only). Because they are command-driven, you must have some knowledge of DB2 commands and SQL statements to use them. Figure 4.2 demonstrates the relationship between them. Compare each line in the Windows machine versus the Linux/UNIX machine. The equivalent line in each machine has been aligned in the figure.

> **NOTE**
>
> In this chapter, we use the generic term **DB2 commands** to refer to DB2 system commands, DB2 CLP, and DB2 CLP Plus commands. When a section is only applicable to a given type of command, it is indicated. Refer to section "SQL Statements, XQuery Statements, and DB2 Commands," for an explanation about the differences between these commands.



Windows Machine

Windows Command Prompt

```
C:> <Any operating system command>
      Example:  dir
C:> <Any DB2 system command>
      Example:  db2start
C:> clpplus (to invoke CLP Plus)
C:> db2cmd (to invoke the Command Window)
```

DB2 Command Window

```
C:> <Any operating system command>
       Example: dir
C:> <Any DB2 system command>
       Example: db2start
C:> db2 <CLP Command>
      (To invoke the CLP in non-interactive mode)
      Examples:
      db2 list applications
      db2 connect to sample
      db2 select * from department
C:> db2 (To invoke the CLP in interactive mode)
C:> clpplus (to invoke CLP Plus)
```

DB2 Command Line Processor (CLP) in interactive mode

```
db2 => <CLP Command>
Examples:
db2 => list applications
db2 => connect to sample
db2 => select * from department
db2 => xquery <a>hello</a>
```

DB2 CLP Plus

```
SQL> <CLPPlus commands>
      Example:
SQL> CONNECT db2inst1@localhost:50000/sample
SQL> START resourceReport.sql
SQL> RUN
SQL> SPOOL resourceReport.out
SQL> SET LINESIZE 100
```

Linux and UNIX Machine

Linux / UNIX Shell

```
/home/user1 $ <Any operating system command>
                  Example:  ls
/home/user1 $ <Any DB2 system command>
                  Example: db2start
/home/user1 $ db2 <CLP Command>
(To invoke the CLP in non-interactive mode)
      Examples:
      db2 list applications
      db2 connect to sample
      db2 select * from department

/home/user1 $ db2 (To invoke the CLP in interactive mode)
```

DB2 Command Line Processor (CLP) in interactive mode

```
db2 => <CLP Command>
Examples:
db2 => list applications
db2 => connect to sample
db2 => select * from department
db2 => xquery <a>hello</a>
```

DB2 CLP Plus

```
SQL> <CLPPlus commands>
      Example:
SQL> CONNECT db2inst1@localhost:50000/sample
SQL> START resourceReport.sql
SQL> RUN
SQL> SPOOL resourceReport.out
SQL> SET LINESIZE 100
```

Figure 4.2 The CLP, CLP Plus, and the DB2 Command Window

The DB2 Command Window

The DB2 Command Window is only available on Windows; this is due to some architecture differences in Windows versus Linux and UNIX. If you are familiar with the Linux and UNIX platforms, you can think of the Command Window on Windows as the Linux/UNIX shell. Figure 4.2 illustrates this: The commands and statements inside the DB2 Command Window box to the left of the figure are equivalent to the ones inside the Linux/UNIX shell box on the right.

To start the Command Window, click **Start** > **Programs** > **IBM DB2** > **DB2COPY1 (Default)** > **Command Window**. Alternatively, to invoke the Command Window from a

Windows command prompt, issue the command `db2cmd`. This command spawns another window that displays `DB2 CLP` in the title bar. Note that the Command Window looks like any Windows command prompt except for this title bar.

From the Windows command prompt, you can perform operating system commands and DB2 system commands but not DB2 CLP commands, DB2 CLPPlus commands, SQL statements, or XQuery statements. However, you can perform all of these from a DB2 Command Window.

Refer to the DB2 Information Center, under Database administration > Interfaces > Commands, for a complete list of different types of commands. Figure 4.2 shows a few examples. From the Windows command prompt you can execute the following:

Operating system commands:	`dir`
DB2 system commands:	`db2start`

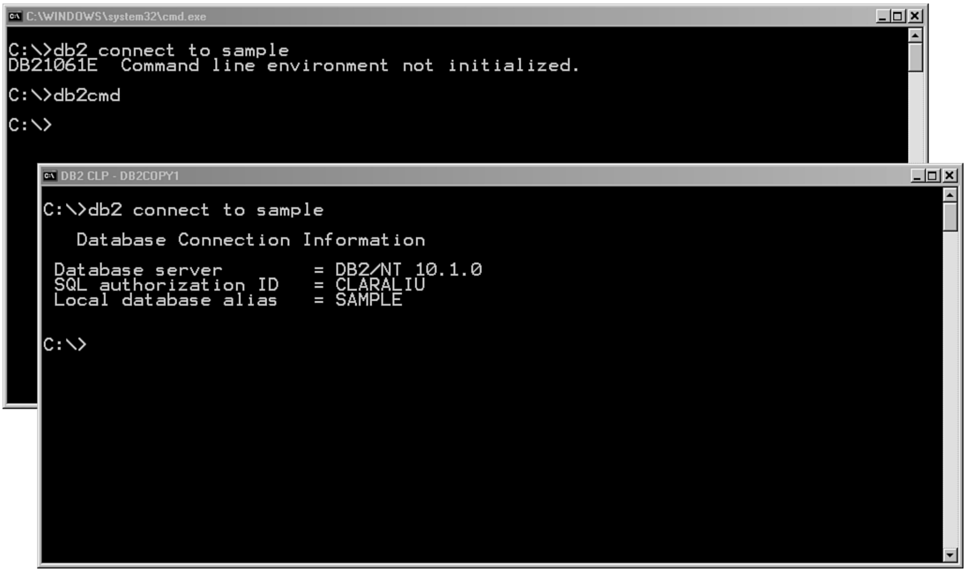
In the DB2 Command Window, you can perform these commands as well as DB2 CLP commands and SQL statements:

DB2 CLP commands:	`db2 list applications`
SQL statements:	`db2 SELECT * FROM department`
XQuery statements:	`db2 "xquery <a>hello</a>"`

If you try to execute a CLP command, SQL statement, or XQuery statement from a Windows command prompt, you receive the following error as illustrated in Figure 4.3.

```
DB21061E Command line environment not initialized
```

In the figure, you also see how the same statement works from the DB2 Command Window after it is invoked with the `db2cmd` command.



```
C:\>db2 connect to sample
DB21061E  Command line environment not initialized.

C:\>db2cmd

C:\>
```

```
C:\>db2 connect to sample

   Database Connection Information

 Database server        = DB2/NT 10.1.0
 SQL authorization ID   = CLARALIU
 Local database alias   = SAMPLE

C:\>
```

Figure 4.3 Invoking the DB2 Command Window from a Windows command prompt

The DB2 Command Line Processor

The DB2 Command Line Processor (CLP) is an application written in the C language that contains embedded SQL. It provides you with a text-based interface to the DB2 engine that lets you issue CLP commands, SQL statements, and XQuery statements. The CLP executable is called `db2`, and it is stored under the DB2_install_directory/sqllib/bin directory.

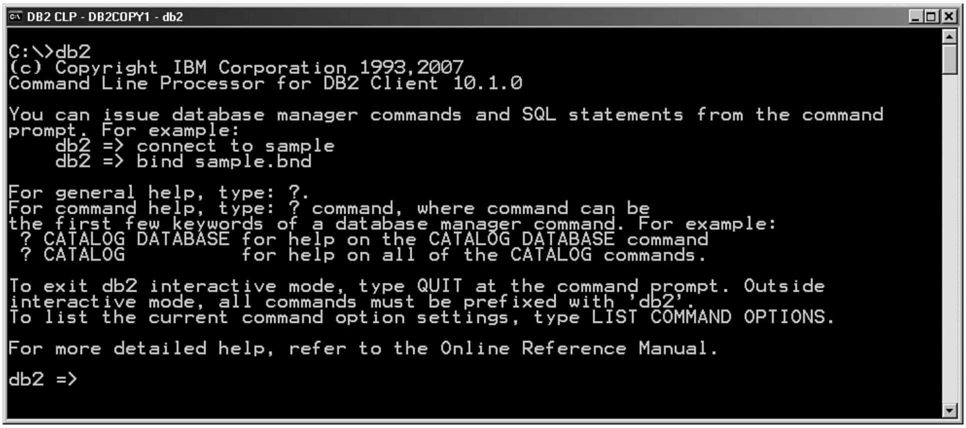
> **NOTE**
>
> We recommend you learn how to use the Command Line Processor, as it is the common tool available with all DB2 versions and clients.

Methods to Work with the CLP

There are three ways to issue a DB2 command or SQL statement with the CLP: interactive mode, noninteractive mode, and noninteractive mode using a file as input. These methods are discussed in the following sections.

Method 1: Interactive Mode

You start the CLP in interactive mode by clicking **Start > Programs > IBM DB2 > DB2COPY1 (Default) > Command Line Processor**. Alternatively, from the Command Window or Linux/UNIX shell, you start the CLP in interactive mode by entering `db2` and pressing **Enter**, as shown in Figure 4.4.



```
C:\>db2
(c) Copyright IBM Corporation 1993,2007
Command Line Processor for DB2 Client 10.1.0

You can issue database manager commands and SQL statements from the command
prompt. For example:
    db2 => connect to sample
    db2 => bind sample.bnd

For general help, type: ?.
For command help, type: ? command, where command can be
the first few keywords of a database manager command. For example:
 ? CATALOG DATABASE for help on the CATALOG DATABASE command
 ? CATALOG          for help on all of the CATALOG commands.

To exit db2 interactive mode, type QUIT at the command prompt. Outside
interactive mode, all commands must be prefixed with 'db2'.
To list the current command option settings, type LIST COMMAND OPTIONS.

For more detailed help, refer to the Online Reference Manual.

db2 =>
```

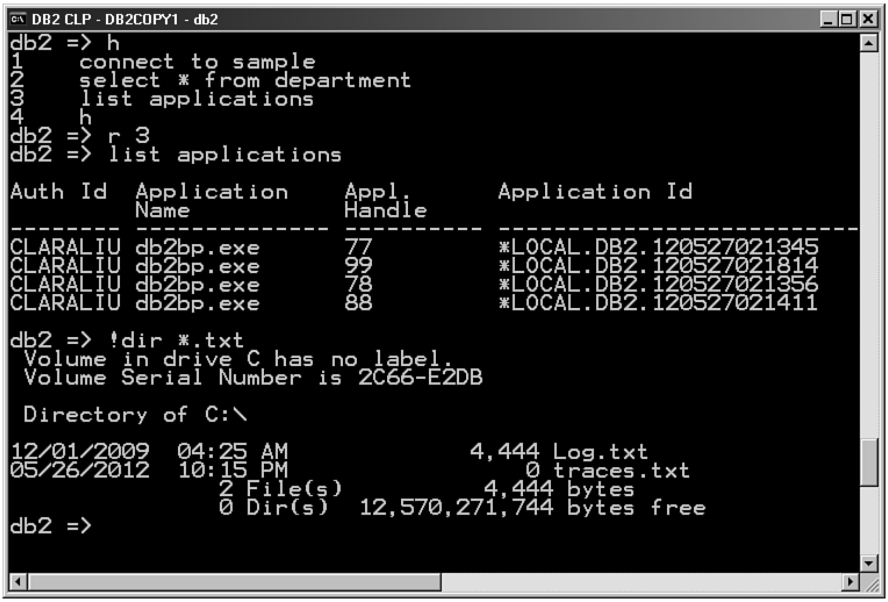
Figure 4.4 The Command Line Processor in interactive mode

After you invoke the CLP in interactive mode, a few messages appear on the screen, and then your command prompt changes to `db2 =>`. This prompt indicates that you are in interactive mode and you can type any DB2 CLP command, SQL statement, or XQuery statement.

Table 4.1 lists some common CLP interactive mode commands. The underlined letter in the command shows the shortcut that you can use to invoke the command. Figure 4.5 shows a few examples of the commands in Table 4.1 in action.

Table 4.1 Useful CLP Commands for Working with the CLP in Interactive Mode

Command	Explanation	Example
`history`	Lists the last 20 commands entered and prefixes each with a number. The maximum number of commands kept in memory can be customized with the DB2 registry variable DB2_CLP_HISTSIZE (see Chapter 5 for information about DB2 registry variables).	`History`
`runcmd <n>`	Re-executes command number *n* from the list given by the `history` command. If *n* is not specified (or *n* = -1), the previous command is invoked.	To re-execute the third command in the history list: `r 3`
`edit <n>`	Edits the command number *n* using an editor defined by the DB2 registry variable DB2_CLP_EDITOR. If not set, this uses the vi editor on Linux/UNIX and Notepad on Windows.	To edit the fifth command in the history list: `e 5`
Exclamation mark (`!`)	This is the escape character that enables you to issue operating system commands from within the CLP interactive mode.	`!dir`



```
db2 => h
1    connect to sample
2    select * from department
3    list applications
4    h
db2 => r 3
db2 => list applications

Auth Id  Application    Appl.      Application Id
         Name           Handle
-------- -------------- ---------- ----------------------------
CLARALIU db2bp.exe      77         *LOCAL.DB2.120527021345
CLARALIU db2bp.exe      99         *LOCAL.DB2.120527021814
CLARALIU db2bp.exe      78         *LOCAL.DB2.120527021356
CLARALIU db2bp.exe      88         *LOCAL.DB2.120527021411

db2 => !dir *.txt
 Volume in drive C has no label.
 Volume Serial Number is 2C66-E2DB

 Directory of C:\

12/01/2009  04:25 AM             4,444 Log.txt
05/26/2012  10:15 PM                 0 traces.txt
               2 File(s)          4,444 bytes
               0 Dir(s)  12,570,271,744 bytes free
db2 =>
```

Figure 4.5 Examples of CLP commands in interactive mode

Method 2: Noninteractive Mode

Working with the CLP in noninteractive mode is equivalent to working with the DB2 Command Window (on Windows) or the Linux/UNIX shell. If you start the CLP in interactive mode, entering the `quit` command takes you to the CLP in noninteractive mode. In this mode you need to prefix the CLP command or SQL statement with `db2`, which calls the `db2` executable. Otherwise, you receive an error. For example

```
db2 connect to sample
db2 list applications all
db2 select * from employee
db2 "xquery <name>Raul</name>"
```

Using this method you can execute operating system commands in addition to DB2 commands, SQL statements, and XQuery statements from the same window or session.

In practice, many DB2 users prefer to work in the CLP noninteractive mode environment because they can use some shortcut key strokes, such as pressing the up arrow key to repeat the last commands on Windows or taking advantage of operating system mechanisms like piping the output of the CLP to the `more` command on Linux and UNIX to display the output in portions.

Every time you issue the `db2` executable, a "CLP session" is created where a front-end process is invoked. This takes the rest of the statement as input and then closes the process. For example, you issue the following command:

```
db2 list db directory
```

`db2` invokes a CLP front-end process that takes `list db directory` as input. After the CLP digests this command, it implicitly issues the `quit` command to end the CLP front-end process. The front-end and back-end processes are discussed in more detail later in this chapter. Figure 4.6 shows the CLP in noninteractive mode.

When invoking the CLP in noninteractive mode, enclosing the CLP command, SQL statement, or XQuery statement double quotes (`"`) might be required if these contain special characters that the operating system interprets as wildcard characters. This is especially important on Linux and UNIX platforms. If double quotes are not used, the error message that DB2 reports vary depending on where the wildcard character is used in the statement. For example, you issue this statement:

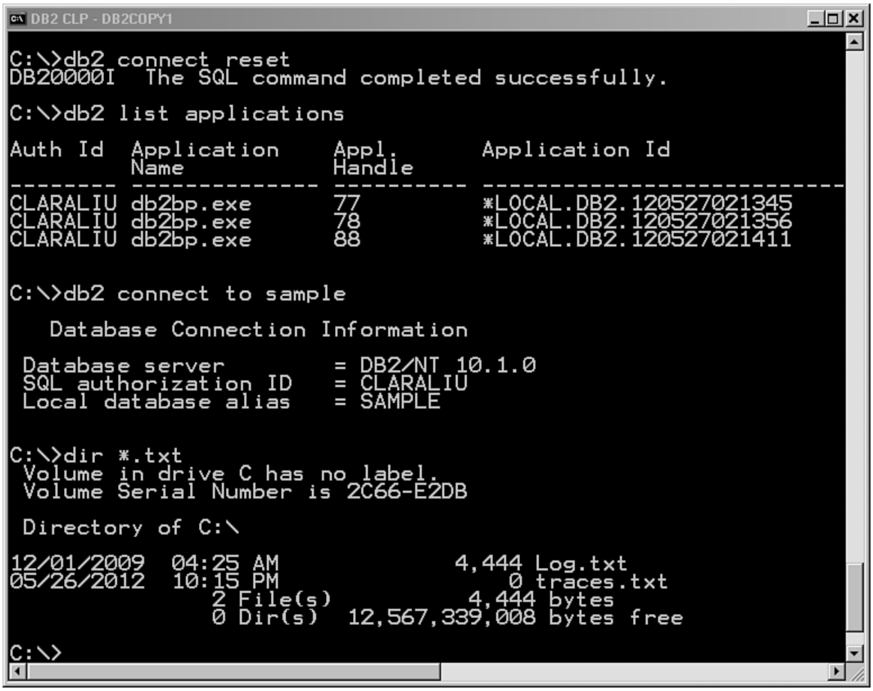
```
db2 select * from employee
```

You *might* receive the following error message because the asterisk (*) is a wildcard character:

```
SQL0104N An unexpected token "*" was found following "select "
```

To avoid parsing errors, use double quotes as shown here:

```
db2 "select * from employee"
```



```
C:\>db2 connect reset
DB20000I  The SQL command completed successfully.

C:\>db2 list applications

Auth Id  Application    Appl.      Application Id
         Name           Handle
-------- -------------- ---------- ----------------------------
CLARALIU db2bp.exe      77         *LOCAL.DB2.120527021345
CLARALIU db2bp.exe      78         *LOCAL.DB2.120527021356
CLARALIU db2bp.exe      88         *LOCAL.DB2.120527021411


C:\>db2 connect to sample

   Database Connection Information

 Database server        = DB2/NT 10.1.0
 SQL authorization ID   = CLARALIU
 Local database alias   = SAMPLE


C:\>dir *.txt
 Volume in drive C has no label.
 Volume Serial Number is 2C66-E2DB

 Directory of C:\

12/01/2009  04:25 AM             4,444 Log.txt
05/26/2012  10:15 PM                 0 traces.txt
               2 File(s)          4,444 bytes
               0 Dir(s)  12,567,339,008 bytes free

C:\>
```

Figure 4.6 The Command Line Processor in noninteractive mode

A more deceiving example occurs when you use the greater than (>) character. Here is an example:

```
db2 select lastname from employee where salary > 10000
```

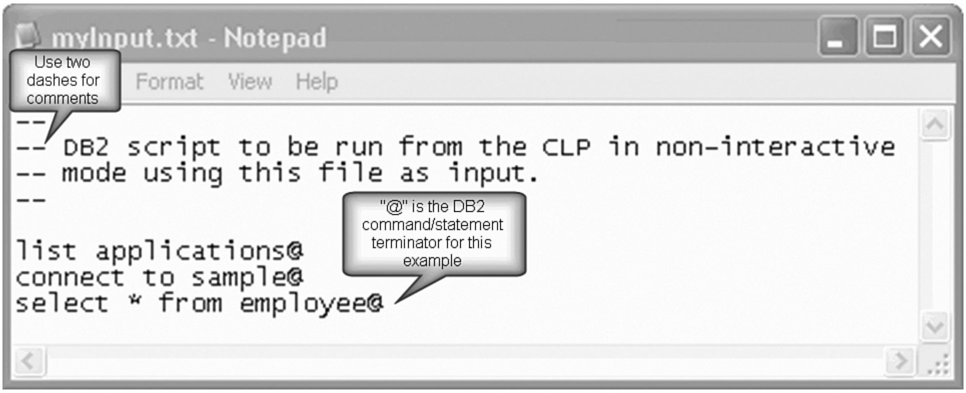
The command is first parsed by the operating system, which interprets `> 10000` as the redirection of the output to the file *10000*. After executing the statement just given, your current directory has a new file with the name *10000* containing a DB2 syntax error message because only `select lastname from employee where salary` was passed to DB2. Again, to resolve this problem, make sure to enclose the statement in double quotes.

```
db2 "select lastname from employee where salary > 10000"
```

This is particularly important as well when working with XQuery because XML documents use tags enclosed in angle brackets (< and >), which the operating system interprets completely differently.

Method 3: Noninteractive Mode Using a File as Input

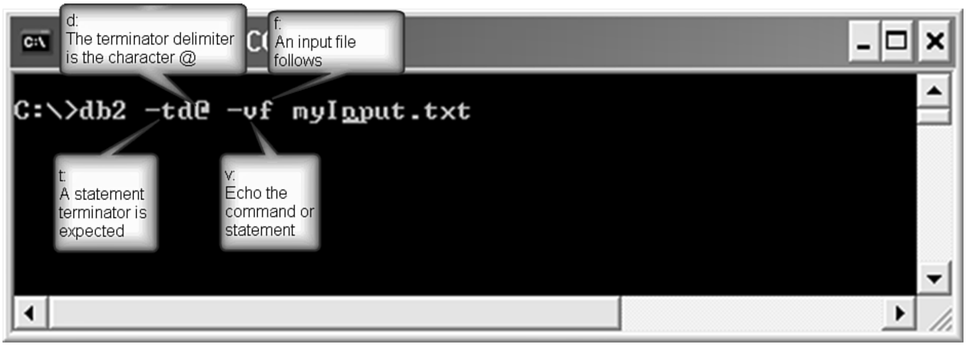
The CLP can use a file containing one or more CLP commands or SQL statements and process them one after the other. This is ideal to develop DB2 database scripts. For example, Figure 4.7 shows the contents of the file *myInput.txt*, which we use as input to the CLP.


myInput.txt - Notepad
Format View Help
Use two dashes for comments
"@" is the DB2 command/statement terminator for this example

```
--
-- DB2 script to be run from the CLP in non-interactive
-- mode using this file as input.
--

list applications@
connect to sample@
select * from employee@
```

Figure 4.7 Input file to be used by the CLP

To execute this DB2 script file, the `-f` command option (for *file*) followed by the file name is required to indicate to the CLP that this file contains the input. (CLP command options are described in detail in the next section.) If the input file contains a statement terminator character, the `-t` command option (for *terminator*) is required to indicate a terminator character is present. By default, the statement terminator is a semicolon (`;`). If you want to use a different terminator, the `-dcharacter` option (for *delimiter*) indicates which delimiter character is being used as the terminator. Use the `-v` option (for *verbose*) to echo the command you are executing. Figure 4.8 provides an example of invoking the CLP using these command options.


d:
The terminator delimiter is the character @
f:
An input file follows
t:
A statement terminator is expected
v:
Echo the command or statement

```
C:\>db2 -td@ -vf myInput.txt
```

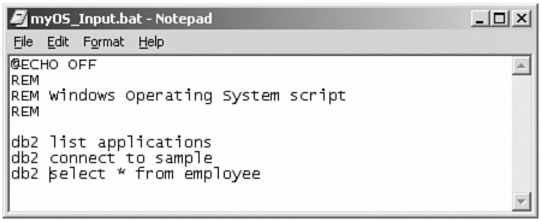
Figure 4.8 Invoking the CLP in noninteractive mode using a file as input

NOTE

The input file must be a text file. Be aware that invisible characters can cause DB2 CLP fail to process the file. If using the Notepad application on Windows, for example, saving the text file with Unicode encoding rather than ANSI encoding causes the following error:

```
DB21007E End of file reached while reading the command.
```

If you prefix each of the CLP commands with db2 (the CLP executable) in a file and remove the terminator characters, you are effectively converting this file into an operating system script rather than a DB2 script. Depending on the operating system, you might have to make additional modifications. For example, on Windows, you need to use rem for comments. You might also need to change the file name so that the *.bat* extension is used. Figure 4.9 shows this for the file *myOS_Input.bat*.



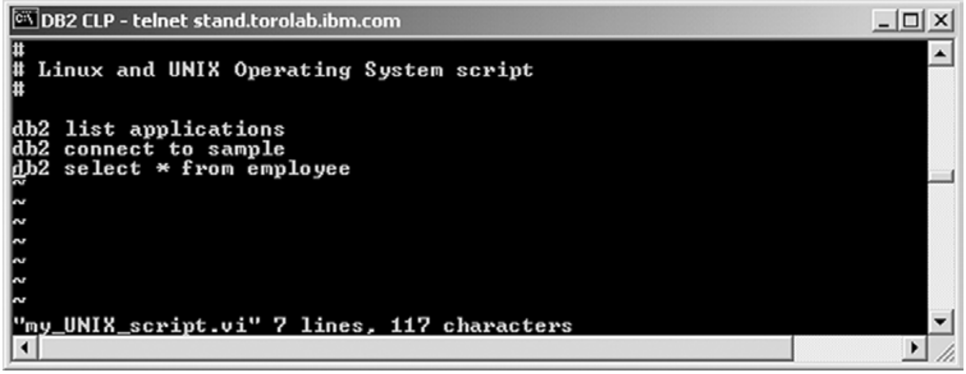
```
@ECHO OFF
REM
REM Windows Operating System script
REM

db2 list applications
db2 connect to sample
db2 select * from employee
```

Figure 4.9 Invoking DB2 CLP commands and SQL statements in a Windows script file

On Linux and UNIX platforms, use the pound sign (#) for comments. You might also need to change the permissions of the file so that it is executable. Typically you can use this command to change the file permissions:

```
chmod +x myOS_Input.txt
```

Figure 4.10 shows the same script for a Linux or UNIX platform.



```
#
# Linux and UNIX Operating System script
#

db2 list applications
db2 connect to sample
db2 select * from employee
~
~
~
~
~
~
~
"my_UNIX_script.vi" 7 lines, 117 characters
```

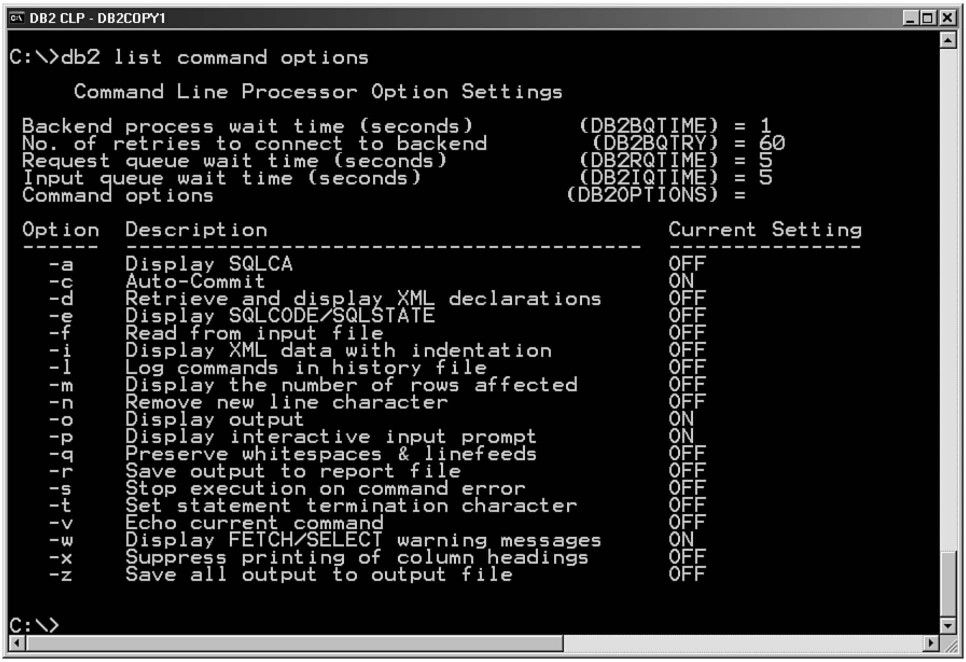
Figure 4.10 Invoking DB2 CLP commands and SQL statements in a Linux/UNIX script file

Note

DB2 scripts do not accept parameters, but operating system scripts do. In other words, if you need to invoke your scripts with parameters, you need to use operating system scripts.

CLP Command Options

The CLP is just another program designed to interact with DB2. Like many other programs, the CLP has been designed to accept several parameter options. The CLP command `list command options` displays the available CLP command option parameters (see Figure 4.11).



```
C:\>db2 list command options

     Command Line Processor Option Settings

 Backend process wait time (seconds)        (DB2BQTIME) = 1
 No. of retries to connect to backend        (DB2BQTRY) = 60
 Request queue wait time (seconds)          (DB2RQTIME) = 5
 Input queue wait time (seconds)            (DB2IQTIME) = 5
 Command options                           (DB2OPTIONS) =

 Option  Description                               Current Setting
 ------  ----------------------------------------  ---------------
   -a    Display SQLCA                             OFF
   -c    Auto-Commit                               ON
   -d    Retrieve and display XML declarations     OFF
   -e    Display SQLCODE/SQLSTATE                  OFF
   -f    Read from input file                      OFF
   -i    Display XML data with indentation         OFF
   -l    Log commands in history file              OFF
   -m    Display the number of rows affected       OFF
   -n    Remove new line character                 OFF
   -o    Display output                            ON
   -p    Display interactive input prompt          ON
   -q    Preserve whitespaces & linefeeds          OFF
   -r    Save output to report file                OFF
   -s    Stop execution on command error           OFF
   -t    Set statement termination character       OFF
   -v    Echo current command                      OFF
   -w    Display FETCH/SELECT warning messages     ON
   -x    Suppress printing of column headings      OFF
   -z    Save all output to output file            OFF

C:\>
```

Figure 4.11 CLP command options

To turn on an option, use a dash (-) in the command line. To turn off an option, use a plus symbol (+). Some options are on (or off) by default. For example, to enable auto-commit, invoke the CLP as follows.

```
db2 -c insert into employee (firstnme) values ('Raul')
```

After you execute this command, a `COMMIT` statement is automatically issued because auto-commit is enabled. (As you can see in Figure 4.11, the Auto-Commit option was already on by default, so including `-c` in this example is not necessary.)

To disable auto-commit, invoke the CLP as follows.

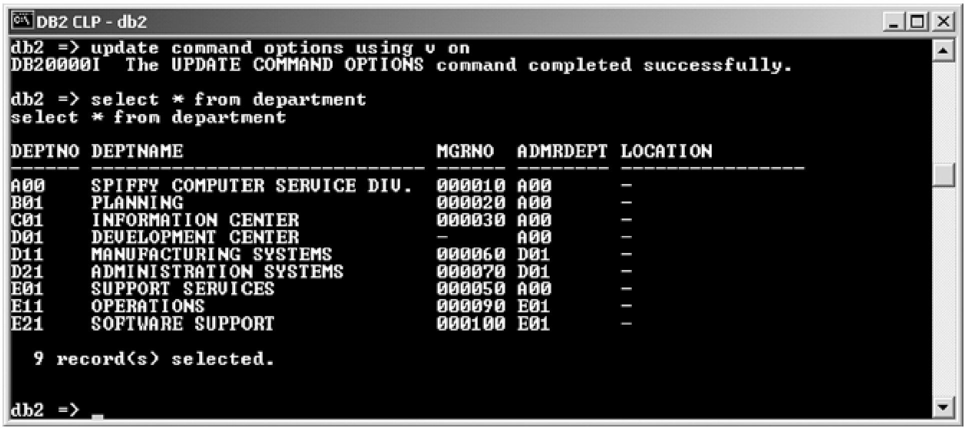
```
db2 +c insert into employee (firstnme) values ('Raul')
```

Note that specifying a command option in the `db2` command applies only to that session of the CLP. Issuing the `db2` command without an option uses the default command option values, or the ones contained in the `DB2OPTIONS` registry variable, which we discuss later in this section.

You can also change a command option when working with the CLP in interactive mode using the following command:

```
update command options using option1 value1 option2 value2 ...
```

Figure 4.12 shows an example where the `v` option (verbose) is used. This option causes the command or statement to be repeated or echoed when executed as discussed earlier. In Figure 4.12, note that the `SELECT * FROM department` statement is echoed.



```
db2 => update command options using v on
DB20000I  The UPDATE COMMAND OPTIONS command completed successfully.

db2 => select * from department
select * from department

DEPTNO DEPTNAME                      MGRNO  ADMRDEPT LOCATION
------ ----------------------------- ------ -------- ----------------
A00    SPIFFY COMPUTER SERVICE DIV.  000010 A00      -
B01    PLANNING                      000020 A00      -
C01    INFORMATION CENTER            000030 A00      -
D01    DEVELOPMENT CENTER            -      A00      -
D11    MANUFACTURING SYSTEMS         000060 D01      -
D21    ADMINISTRATION SYSTEMS        000070 D01      -
E01    SUPPORT SERVICES              000050 A00      -
E11    OPERATIONS                    000090 E01      -
E21    SOFTWARE SUPPORT              000100 E01      -

  9 record(s) selected.

db2 => _
```

Figure 4.12 The CLP in interactive mode

If you would like the changes to your CLP options to be effective across all your CLP sessions, you can set the `DB2OPTIONS` registry variable with the desired options. In the command shown next, the `DB2OPTIONS` registry variable is set so that any command executed is echoed (`-v` option), and the output is spooled in the file *myfile.log* (`-z myfile.log` option). The changes take effect immediately for the current session and for any other new CLP sessions you start.

```
db2set db2options="-v -z myfile.log"
```

To reset the values to the default, issue this command:

```
db2set db2options=
```

To displays all defined values for the current instance:

```
db2set -all
```

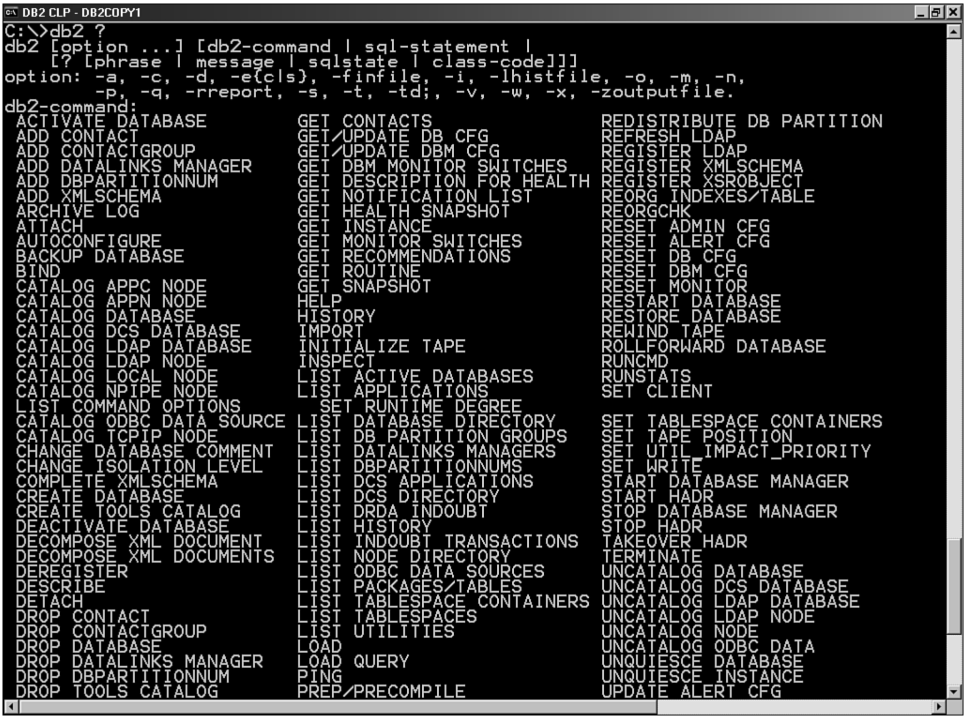
DB2 registry variables are explained in detail in Chapter 5, "Understanding the DB2 Environment, DB2 Instances, and Databases."

Obtaining Help Information from the CLP

One of the most useful CLP commands is the help command represented by a question mark (`?`). This command provides help on SQL error codes (SQLCODE), DB2 messages, and CLP command syntax. For example

```
db2 ? SQL0104N
db2 ? DB21004E
db2 ? list applications
```

In addition, using the help command by itself displays the entire list of CLP commands, as shown in Figure 4.13.



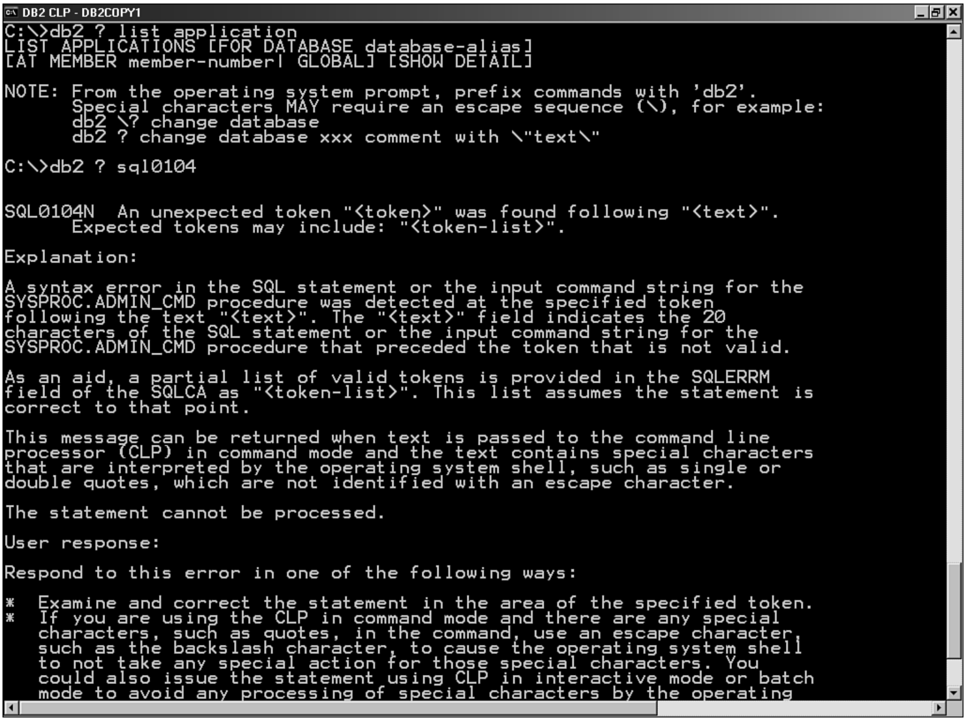
```
C:\>db2 ?
db2 [option ...] [db2-command | sql-statement |
    [? [phrase | message | sqlstate | class-code]]]
option: -a, -c, -d, -e{c|s}, -finfile, -i, -lhistfile, -o, -m, -n,
        -p, -q, -rreport, -s, -t, -td;, -v, -w, -x, -zoutputfile.
db2-command:
 ACTIVATE DATABASE         GET CONTACTS               REDISTRIBUTE DB PARTITION
 ADD CONTACT               GET/UPDATE DB CFG          REFRESH LDAP
 ADD CONTACTGROUP          GET/UPDATE DBM CFG         REGISTER LDAP
 ADD DATALINKS MANAGER     GET DBM MONITOR SWITCHES   REGISTER XMLSCHEMA
 ADD DBPARTITIONNUM        GET DESCRIPTION FOR HEALTH REGISTER XSROBJECT
 ADD XMLSCHEMA             GET NOTIFICATION LIST      REORG INDEXES/TABLE
 ARCHIVE LOG               GET HEALTH SNAPSHOT        REORGCHK
 ATTACH                    GET INSTANCE               RESET ADMIN CFG
 AUTOCONFIGURE             GET MONITOR SWITCHES       RESET ALERT CFG
 BACKUP DATABASE           GET RECOMMENDATIONS        RESET DB CFG
 BIND                      GET ROUTINE                RESET DBM CFG
 CATALOG APPC NODE         GET SNAPSHOT               RESET MONITOR
 CATALOG APPN NODE         HELP                       RESTART DATABASE
 CATALOG DATABASE          HISTORY                    RESTORE DATABASE
 CATALOG DCS DATABASE      IMPORT                     REWIND TAPE
 CATALOG LDAP DATABASE     INITIALIZE TAPE            ROLLFORWARD DATABASE
 CATALOG LDAP NODE         INSPECT                    RUNCMD
 CATALOG LOCAL NODE        LIST ACTIVE DATABASES      RUNSTATS
 CATALOG NPIPE NODE        LIST APPLICATIONS          SET CLIENT
 LIST COMMAND OPTIONS        SET RUNTIME DEGREE
 CATALOG ODBC DATA SOURCE LIST DATABASE DIRECTORY     SET TABLESPACE CONTAINERS
 CATALOG TCPIP NODE        LIST DB PARTITION GROUPS   SET TAPE POSITION
 CHANGE DATABASE COMMENT   LIST DATALINKS MANAGERS    SET UTIL_IMPACT_PRIORITY
 CHANGE ISOLATION LEVEL    LIST DBPARTITIONNUMS       SET WRITE
 COMPLETE XMLSCHEMA        LIST DCS APPLICATIONS      START DATABASE MANAGER
 CREATE DATABASE           LIST DCS DIRECTORY         START HADR
 CREATE TOOLS CATALOG      LIST DRDA INDOUBT          STOP DATABASE MANAGER
 DEACTIVATE DATABASE       LIST HISTORY               STOP HADR
 DECOMPOSE XML DOCUMENT    LIST INDOUBT TRANSACTIONS  TAKEOVER HADR
 DECOMPOSE XML DOCUMENTS   LIST NODE DIRECTORY        TERMINATE
 DEREGISTER                LIST ODBC DATA SOURCES     UNCATALOG DATABASE
 DESCRIBE                  LIST PACKAGES/TABLES       UNCATALOG DCS DATABASE
 DETACH                    LIST TABLESPACE CONTAINERS UNCATALOG LDAP DATABASE
 DROP CONTACT              LIST TABLESPACES           UNCATALOG LDAP NODE
 DROP CONTACTGROUP         LIST UTILITIES             UNCATALOG NODE
 DROP DATABASE             LOAD                       UNCATALOG ODBC DATA
 DROP DATALINKS MANAGER    LOAD QUERY                 UNQUIESCE DATABASE
 DROP DBPARTITIONNUM       PING                       UNQUIESCE INSTANCE
 DROP TOOLS CATALOG        PREP/PRECOMPILE            UPDATE ALERT CFG
```

Figure 4.13 Output of the command `db2 ?`

Note

The help (?) command can display CLP command syntax, but not SQL statement syntax. Refer to the *DB2 Information Center* for SQL statement syntax.

Figure 4.14 shows more examples of the help (?) command.



```
C:\>db2 ? list application
LIST APPLICATIONS [FOR DATABASE database-alias]
[AT MEMBER member-number| GLOBAL] [SHOW DETAIL]

NOTE: From the operating system prompt, prefix commands with ’db2’.
      Special characters MAY require an escape sequence (\), for example:
      db2 \? change database
      db2 ? change database xxx comment with \"text\"

C:\>db2 ? sql0104


SQL0104N  An unexpected token "<token>" was found following "<text>".
      Expected tokens may include: "<token-list>".

Explanation:

A syntax error in the SQL statement or the input command string for the
SYSPROC.ADMIN_CMD procedure was detected at the specified token
following the text "<text>". The "<text>" field indicates the 20
characters of the SQL statement or the input command string for the
SYSPROC.ADMIN_CMD procedure that preceded the token that is not valid.

As an aid, a partial list of valid tokens is provided in the SQLERRM
field of the SQLCA as "<token-list>". This list assumes the statement is
correct to that point.

This message can be returned when text is passed to the command line
processor (CLP) in command mode and the text contains special characters
that are interpreted by the operating system shell, such as single or
double quotes, which are not identified with an escape character.

The statement cannot be processed.

User response:

Respond to this error in one of the following ways:

*  Examine and correct the statement in the area of the specified token.
*  If you are using the CLP in command mode and there are any special
   characters, such as quotes, in the command, use an escape character,
   such as the backslash character, to cause the operating system shell
   to not take any special action for those special characters. You
   could also issue the statement using CLP in interactive mode or batch
   mode to avoid any processing of special characters by the operating
```

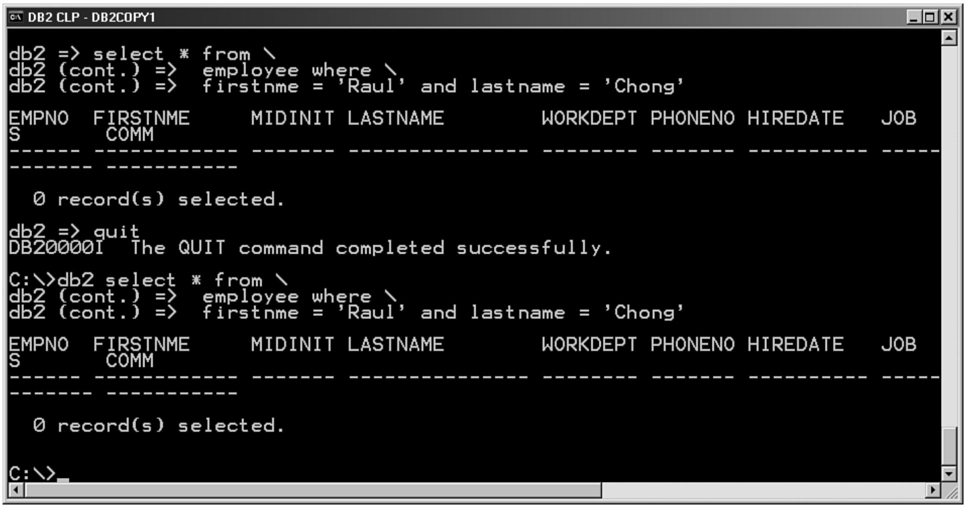
Figure 4.14 The CLP help (?) command

Using Line Continuation

There are two ways to use line continuation from the CLP: with the backslash character and with the delimiter terminator character.

Method 1: Using the Backslash (\) Character

You can use the backslash (\) character in either interactive or noninteractive mode. Figure 4.15 first shows an example of using the interactive mode, followed by an example of using noninteractive.



```
db2 => select * from \
db2 (cont.) =>  employee where \
db2 (cont.) =>  firstnme = 'Raul' and lastname = 'Chong'

EMPNO  FIRSTNME     MIDINIT LASTNAME        WORKDEPT PHONENO HIREDATE   JOB
S       COMM
------ ------------ ------- --------------- -------- ------- ---------- -----
------- -----------

  0 record(s) selected.

db2 => quit
DB20000I  The QUIT command completed successfully.

C:\>db2 select * from \
db2 (cont.) =>  employee where \
db2 (cont.) =>  firstnme = 'Raul' and lastname = 'Chong'

EMPNO  FIRSTNME     MIDINIT LASTNAME        WORKDEPT PHONENO HIREDATE   JOB
S       COMM
------ ------------ ------- --------------- -------- ------- ---------- -----
------- -----------

  0 record(s) selected.

C:\>_
```

Figure 4.15 Line continuation in the CLP using the backslash continuation character

Notice that after entering \ and pressing Enter, the prompt changes to

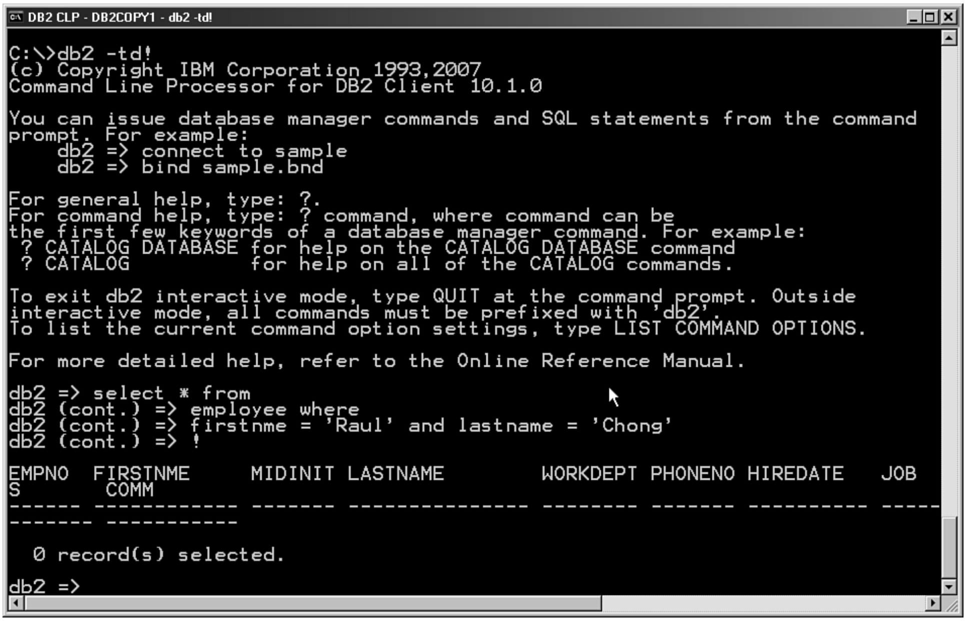
```
db2 (cont.) =>
```

Method 2: Using a Delimiter Terminator Character with the CLP in Interactive Mode

Using this method, the CLP is invoked in interactive mode using the terminator delimiter option. For example

```
db2 -td!
```

After entering this command and pressing Enter, the CLP is invoked in interactive mode. You can wrap commands onto multiple lines until you type the terminator character, which is the exclamation mark (`!`) in the example shown in Figure 4.16.



```
C:\>db2 -td!
(c) Copyright IBM Corporation 1993,2007
Command Line Processor for DB2 Client 10.1.0

You can issue database manager commands and SQL statements from the command
prompt. For example:
    db2 => connect to sample
    db2 => bind sample.bnd

For general help, type: ?.
For command help, type: ? command, where command can be
the first few keywords of a database manager command. For example:
 ? CATALOG DATABASE for help on the CATALOG DATABASE command
 ? CATALOG          for help on all of the CATALOG commands.

To exit db2 interactive mode, type QUIT at the command prompt. Outside
interactive mode, all commands must be prefixed with 'db2'.
To list the current command option settings, type LIST COMMAND OPTIONS.

For more detailed help, refer to the Online Reference Manual.

db2 => select * from
db2 (cont.) => employee where
db2 (cont.) => firstnme = 'Raul' and lastname = 'Chong'
db2 (cont.) => !

EMPNO  FIRSTNME     MIDINIT LASTNAME        WORKDEPT PHONENO HIREDATE   JOB
S       COMM
------ ------------ ------- --------------- -------- ------- ---------- -----
------- -----------

  0 record(s) selected.

db2 =>
```

Figure 4.16 Line continuation in the CLP using a delimiter termination character in interactive mode

Use this method when you have statements that include carriage returns. If you copy and paste one of these statements into the CLP, the carriage returns cause the statement to continue in another line, which is acceptable because the CLP processes the command after the terminator character is entered.

The following statement has one carriage return character after `staff` and one after `Edwards`; therefore, use a delimiter termination character described in method 2 to start the DB2 CLP in interactive mode:

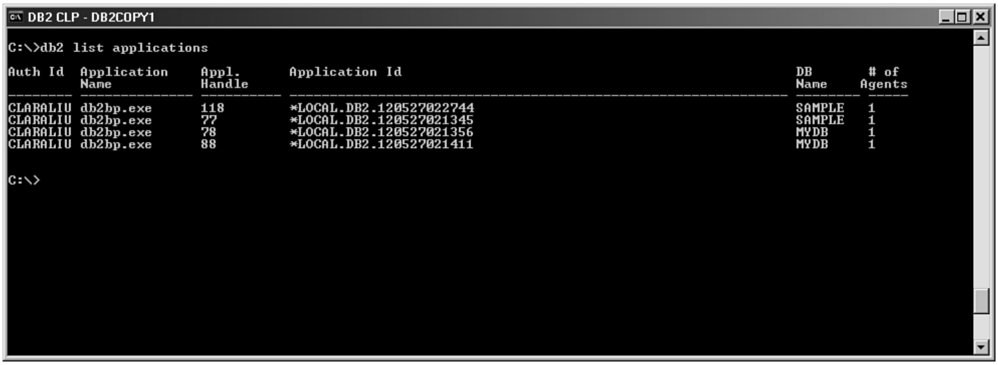
```
select * from staff
where name = 'Edwards'
and job = 'Sales'
```

After you copy and paste the statement into the CLP, enter the terminator character and press Enter to execute it. Remember that the termination character is an exclamation mark (!) in this example.

The CLP Front-End and Back-End Processes

The CLP has both front-end and a back-end processes. The front-end allows you to perform actions without connecting to a database. For example, issuing the command `db2 list db directory` does not require a connection to a database.

The back-end process is needed when you perform actions against a database. It is created when you connect to the database in a CLP session and can be identified by the application name `db2bp`. Figure 4.17 shows the output of the `list applications` command, which shows this thread, indicating a connection to the *SAMPLE* database.



```
C:\>db2 list applications

Auth Id  Application    Appl.      Application Id                                                 DB       # of
         Name           Handle                                                                    Name     Agents
-------- -------------- ---------- -------------------------------------------------------------- -------- -----
CLARALIU db2bp.exe      118        *LOCAL.DB2.120527022744                                        SAMPLE   1
CLARALIU db2bp.exe      77         *LOCAL.DB2.120527021345                                        SAMPLE   1
CLARALIU db2bp.exe      78         *LOCAL.DB2.120527021356                                        MYDB     1
CLARALIU db2bp.exe      88         *LOCAL.DB2.120527021411                                        MYDB     1


C:\>
```

Figure 4.17 The CLP back-end process

To remove the connection to a database, issue the `connect reset` statement, the `terminate` command, or the `disconnect` statement. `Connect reset` and `terminate` work even if the process is in the middle of a unit of work. `Disconnect` only works when there is no active unit of work. Closing a window or session without previously issuing a `terminate` command closes the CLP application and front-end process and removes the connection to the database, but it does not guarantee that the back-end process will be terminated.

NOTE

The `terminate` command is the only one that guarantees the back-end process is indeed terminated. Even if the `list applications` command does not display the *db2bp* back-end process running, use the `terminate` command to be certain.

It is important to make sure that the back-end process is terminated because in some circumstances, a change to a parameter, environment variable, or DB2 registry variable does not take effect until this is performed.

NOTE

We recommend issuing a terminate command before a `db2stop` command. This prevents the back-end process from maintaining an attachment to an instance that is no longer active.

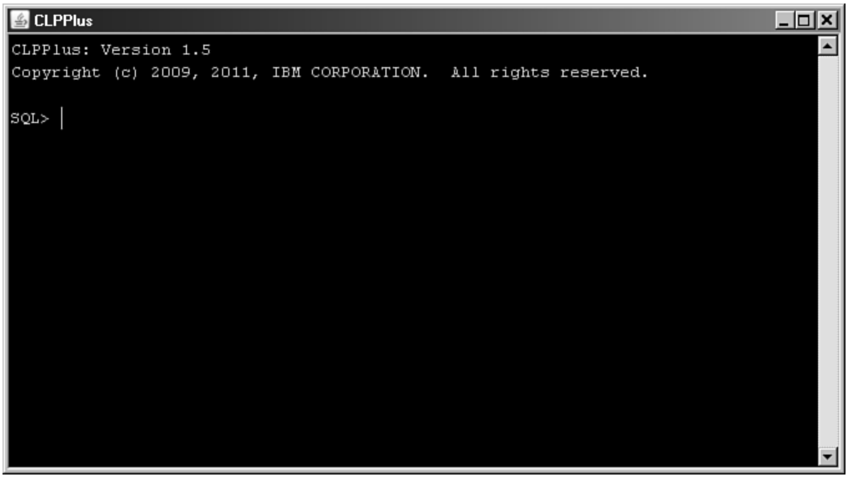
The DB2 Command Line Processor Plus

The DB2 Command Line Processor Plus (CLPPlus) is command-line user interface that enables you to

- Execute Operating system commands
- Execute DB2 system commands
- Develop, edit, and execute SQL statements and XQuery statements
- Compile and run DB2 stored procedures and functions
- Work with scripts and run command-line reports
- Support SQL*Plus scripts that many DBAs and application developers are familiar with

To start the CLPPlus, on Windows 7, click **Start** > **Programs** > **IBM DB2 DB2COPY1 (Default) > Command Line Processor Plus**. Alternatively, issue the command `clpplus` on the Windows command prompt or the Linux and UNIX shell. You get the `SQL>` prompt as shown in Figure 4.18.

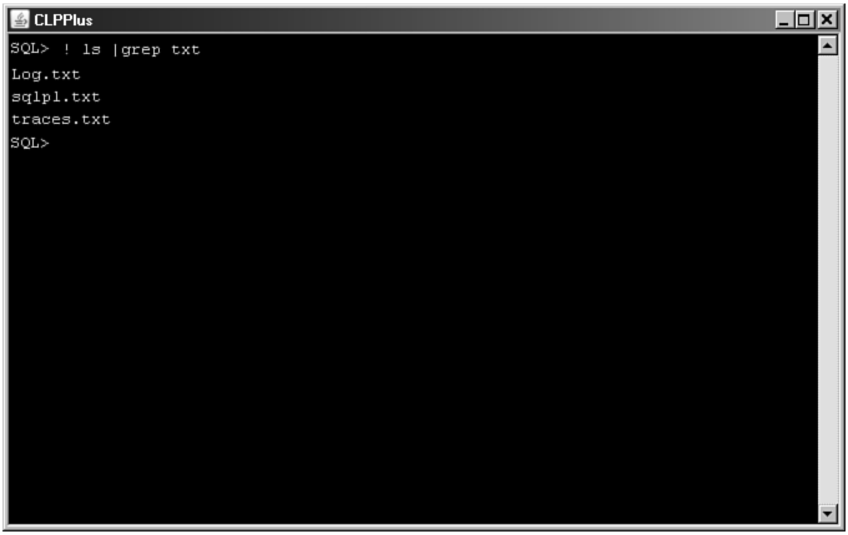
Take a look at the program icon on the top left corner of the CLPPlus window. The icon is a Java application icon. That's right. CLPPlus is a Java application. CLPPlus requires Java 1.5 or later to execute. In DB2 10, Java 1.7 is installed and its path is set up with DB2 installation. If you encounter CLPPlus start-up issue, ensure Java is in your `PATH`.



```
CLPPlus: Version 1.5
Copyright (c) 2009, 2011, IBM CORPORATION.  All rights reserved.

SQL>
```

Figure 4.18 The CLPPlus Window

CLPPlus can run both OS and DB2 commands. To run OS commands, simply use the `!` (exclamation mark) operator. Figure 4.19 illustrates how to use the `ls` and `grep` commands in CLPPlus.



```
SQL> ! ls |grep txt
Log.txt
sqlpl.txt
traces.txt
SQL>
```

Figure 4.19 Use of the `!` operator in CLPPlus

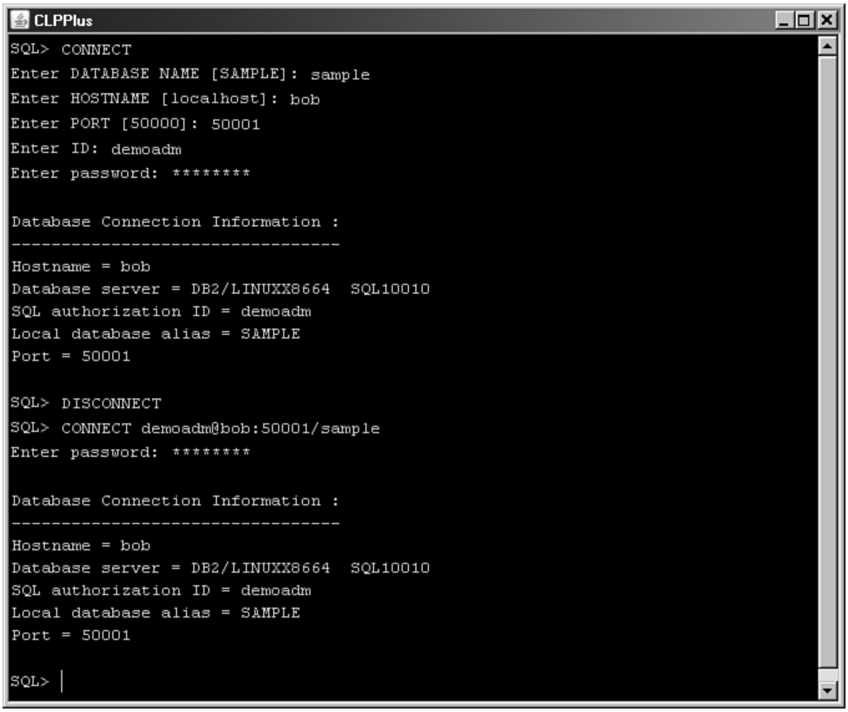
To work with the DB2 database from the CLPPlus, you need to first connect to the database. In Figure 4.20, it shows you two methods to connect to the database in CLPPlus. The first example is simply to enter the `CONNECT` command. CLPPLUS prompts you for the database name, hostname, port number, user ID, and password. You may also enter all these information in the `CONNECT` command as follows.

```
CONNECT demoadm@bob:50001/sample
```

To disconnect from the database, enter `DISCONNECT`.

Note

CLPPlus supports many commands. Refer to the DB2 Information Center for the list of commands and usage example.



```
SQL> CONNECT
Enter DATABASE NAME [SAMPLE]: sample
Enter HOSTNAME [localhost]: bob
Enter PORT [50000]: 50001
Enter ID: demoadm
Enter password: ********

Database Connection Information :
---------------------------------
Hostname = bob
Database server = DB2/LINUXX8664  SQL10010
SQL authorization ID = demoadm
Local database alias = SAMPLE
Port = 50001

SQL> DISCONNECT
SQL> CONNECT demoadm@bob:50001/sample
Enter password: ********

Database Connection Information :
---------------------------------
Hostname = bob
Database server = DB2/LINUXX8664  SQL10010
SQL authorization ID = demoadm
Local database alias = SAMPLE
Port = 50001

SQL> |
```

Figure 4.20 Using the `CONNECT` command in CLPPlus

Working with the SQL Buffer

The **SQL buffer** is an in-memory working area where CLPPlus keeps copies of the most recently entered SQL statements or SQL Procedural Language (SQL PL) block. CLPPlus provides many commands to help manage the SQL buffer.

Let's use an example to demonstrate how to work with the SQL buffer. In Listing 4.1, you can see that a compound statement is used. A **compound statement** is bound by the keywords `BEGIN` and `END` that contain multiple statements. In this example, it uses the `DECLARE` variable statement that is part of SQL PL, a `SET` statement to assign a value to the variable, and an `INSERT` statement. If you are following the example on your system, you need to first create the CUSTOMER_STATISTICS table as shown in Listing 4.2.

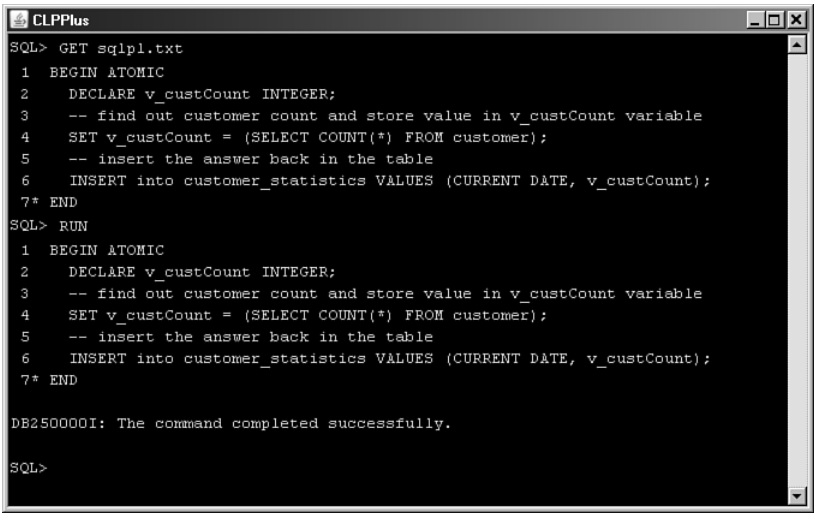
Listing 4.1 Example of a Compound Statement Stored in File sqlpl.txt

```
BEGIN ATOMIC
  DECLARE v_custCount INTEGER;
  -- find out customer count and store value in variable v_custCount
  SET v_custCount = (SELECT COUNT(*) FROM customer);
  -- insert the answer back in the table
  INSERT into customer_statistics
  VALUES (CURRENT DATE, v_custCount);
END
```

Listing 4.2 Sample Table Used in the Compound Statement Example

```
CREATE TABLE CUSTOMER_STATISTICS
     ( RECORD_DATE    DATE
     , CUSTOMER_COUNT INTEGER)
```

The compound statement is stored in the *sqlpl.txt* file. First, load the file into the SQL buffer with the GET command. Then RUN the script (see Figure 4.21).

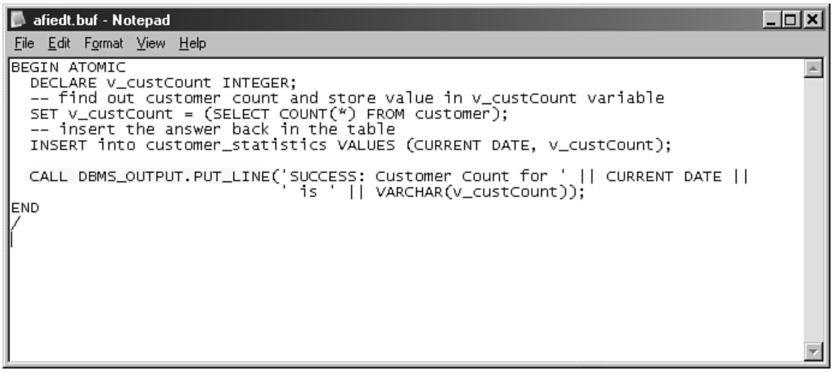


```
SQL> GET sqlpl.txt
 1  BEGIN ATOMIC
 2    DECLARE v_custCount INTEGER;
 3    -- find out customer count and store value in v_custCount variable
 4    SET v_custCount = (SELECT COUNT(*) FROM customer);
 5    -- insert the answer back in the table
 6    INSERT into customer_statistics VALUES (CURRENT DATE, v_custCount);
 7* END
SQL> RUN
 1  BEGIN ATOMIC
 2    DECLARE v_custCount INTEGER;
 3    -- find out customer count and store value in v_custCount variable
 4    SET v_custCount = (SELECT COUNT(*) FROM customer);
 5    -- insert the answer back in the table
 6    INSERT into customer_statistics VALUES (CURRENT DATE, v_custCount);
 7* END

DB250000I: The command completed successfully.

SQL>
```

Figure 4.21 GET and RUN scripts in CLPPlus

After reviewing the output here, you decided to print the customer count returned from the compound statement. You can update the script from the CLPPlus using the EDIT command. The default editor is used. In this example, Notepad is used.

The line CALL DBMS_OUTPUT.PUT_LINE (highlighted in Figure 4.22) is added to print an output comment on the screen after the INSERT statement is executed successfully.

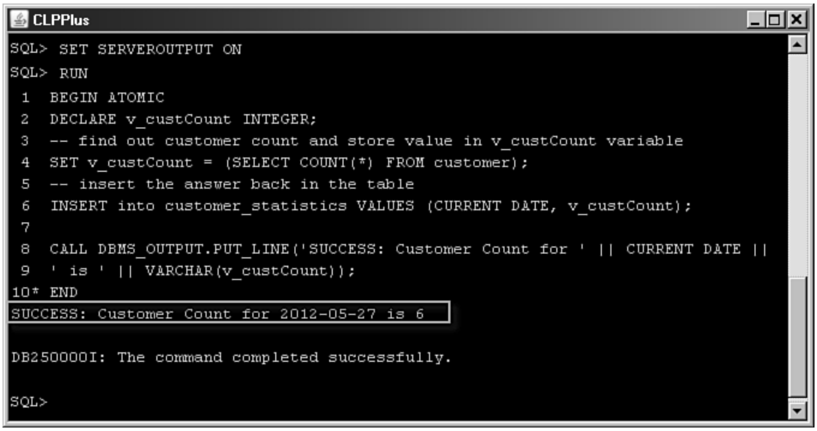


```
BEGIN ATOMIC
  DECLARE v_custCount INTEGER;
  -- find out customer count and store value in v_custCount variable
  SET v_custCount = (SELECT COUNT(*) FROM customer);
  -- insert the answer back in the table
  INSERT into customer_statistics VALUES (CURRENT DATE, v_custCount);

  CALL DBMS_OUTPUT.PUT_LINE('SUCCESS: Customer Count for ' || CURRENT DATE ||
                            ' is ' || VARCHAR(v_custCount));
END
/
```

Figure 4.22 `EDIT` script in CLPPlus

After you save the file and exit the editor, the SQL buffer is updated with the new version of the script.

To display the output comment you just added to the standard output (that is the screen), you need to `SET SERVEROUTPUT ON`. The output from the `DBMS_OUTPUT` message buffer is redirected to the standard output. Then run the script again with the `RUN` command. You now get the customized output as shown in Figure 4.23.

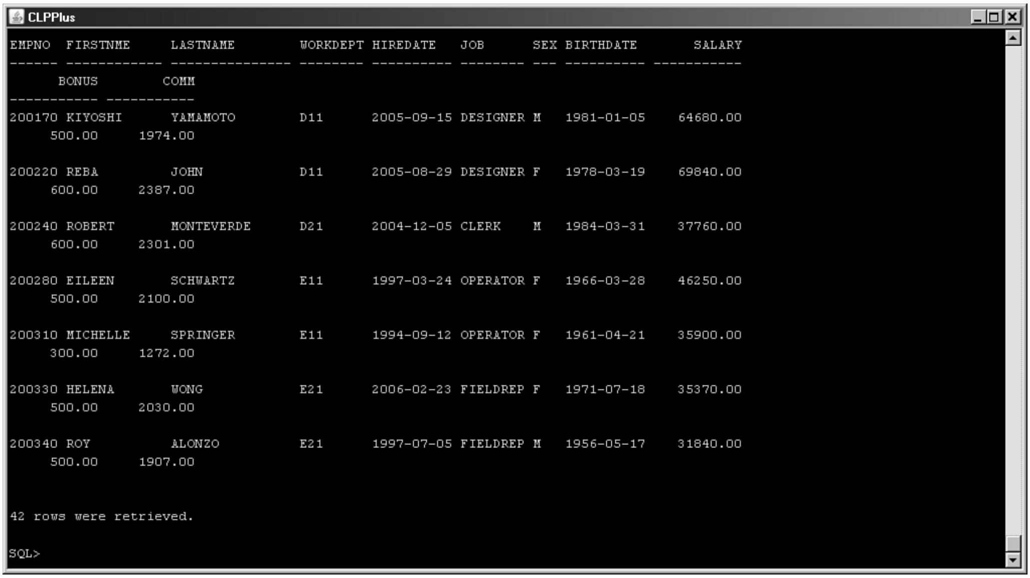


```
SQL> SET SERVEROUTPUT ON
SQL> RUN
 1  BEGIN ATOMIC
 2  DECLARE v_custCount INTEGER;
 3  -- find out customer count and store value in v_custCount variable
 4  SET v_custCount = (SELECT COUNT(*) FROM customer);
 5  -- insert the answer back in the table
 6  INSERT into customer_statistics VALUES (CURRENT DATE, v_custCount);
 7
 8  CALL DBMS_OUTPUT.PUT_LINE('SUCCESS: Customer Count for ' || CURRENT DATE ||
 9  ' is ' || VARCHAR(v_custCount));
10* END
SUCCESS: Customer Count for 2012-05-27 is 6

DB250000I: The command completed successfully.

SQL>
```

Figure 4.23 Output after script is updated

Formatting CLPPlus output

CLPPlus has a lot of options for working with reports. Here is a simple query to display the employee information. As you can see in Figure 4.24, the output is wrapped, and it is hard to read. You can improve the appearance of the report by using some CLPPlus options to format and customize the output of the query.



```
EMPNO  FIRSTNME     LASTNAME        WORKDEPT HIREDATE   JOB      SEX BIRTHDATE       SALARY
------ ------------ --------------- -------- ---------- -------- --- ---------- -----------
      BONUS        COMM
----------- -----------
200170 KIYOSHI      YAMAMOTO        D11      2005-09-15 DESIGNER M   1981-01-05    64680.00
     500.00     1974.00

200220 REBA         JOHN            D11      2005-08-29 DESIGNER F   1978-03-19    69840.00
     600.00     2387.00

200240 ROBERT       MONTEVERDE      D21      2004-12-05 CLERK    M   1984-03-31    37760.00
     600.00     2301.00

200280 EILEEN       SCHWARTZ        E11      1997-03-24 OPERATOR F   1966-03-28    46250.00
     500.00     2100.00

200310 MICHELLE     SPRINGER        E11      1994-09-12 OPERATOR F   1961-04-21    35900.00
     300.00     1272.00

200330 HELENA       WONG            E21      2006-02-23 FIELDREP F   1971-07-18    35370.00
     500.00     2030.00

200340 ROY          ALONZO          E21      1997-07-05 FIELDREP M   1956-05-17    31840.00
     500.00     1907.00


42 rows were retrieved.

SQL>
```

Figure 4.24 Output of query of all employees

A few formatting options are used as described here. See Figure 4.25 for the customized output.

Set the line size to 120 characters for the output the better fit the screen.

```
SET LINESIZE 120
```

Apply formatting rules to the *salary*, *comm*, and *bonus* columns. Add dollar signs in front of the values and add a comma at the unit of thousand:

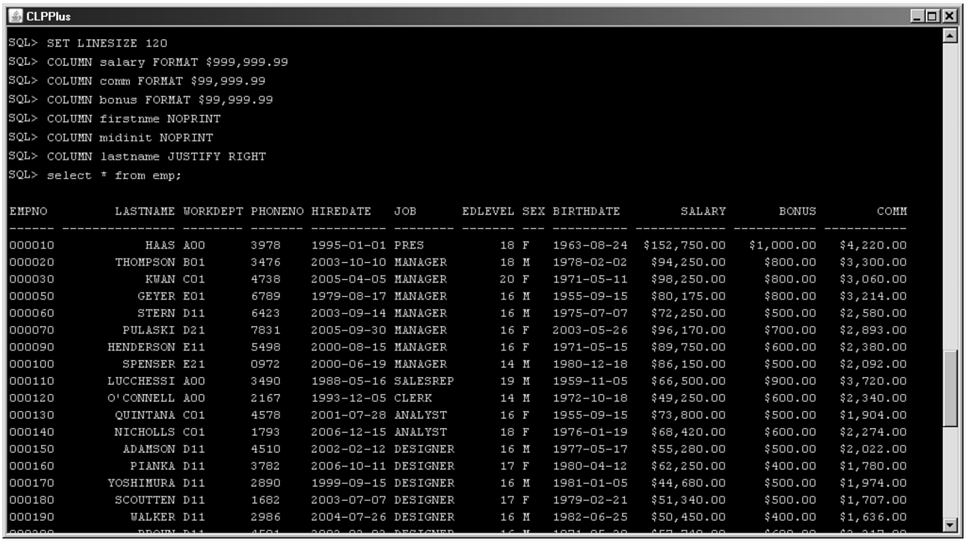
```
COLUMN salary FORMAT $999,999.99
COLUMN comm   FORMAT $99,999.99
COLUMN bonus  FORMAT $99,999.99
```

Do not print the column *firstnnme*:

```
COLUMN firstnme NOPRINT
COLUMN midinit  NOPRINT
```

Display the values of the *lastname* column right-justified:

```
COLUMN lastname JUSTIFY RIGHT
```



```
SQL> SET LINESIZE 120
SQL> COLUMN salary FORMAT $999,999.99
SQL> COLUMN comm FORMAT $99,999.99
SQL> COLUMN bonus FORMAT $99,999.99
SQL> COLUMN firstnme NOPRINT
SQL> COLUMN midinit NOPRINT
SQL> COLUMN lastname JUSTIFY RIGHT
SQL> select * from emp;

EMPNO         LASTNAME WORKDEPT PHONENO HIREDATE   JOB      EDLEVEL SEX BIRTHDATE        SALARY       BONUS        COMM
------ --------------- -------- ------- ---------- -------- ------- --- ---------- ------------ ----------- -----------
000010            HAAS A00      3978    1995-01-01 PRES          18 F   1963-08-24  $152,750.00   $1,000.00   $4,220.00
000020        THOMPSON B01      3476    2003-10-10 MANAGER       18 M   1978-02-02   $94,250.00     $800.00   $3,300.00
000030            KWAN C01      4738    2005-04-05 MANAGER       20 F   1971-05-11   $98,250.00     $800.00   $3,060.00
000050           GEYER E01      6789    1979-08-17 MANAGER       16 M   1955-09-15   $80,175.00     $800.00   $3,214.00
000060           STERN D11      6423    2003-09-14 MANAGER       16 M   1975-07-07   $72,250.00     $500.00   $2,580.00
000070         PULASKI D21      7831    2005-09-30 MANAGER       16 F   2003-05-26   $96,170.00     $700.00   $2,893.00
000090       HENDERSON E11      5498    2000-08-15 MANAGER       16 F   1971-05-15   $89,750.00     $600.00   $2,380.00
000100         SPENSER E21      0972    2000-06-19 MANAGER       14 M   1980-12-18   $86,150.00     $500.00   $2,092.00
000110       LUCCHESSI A00      3490    1988-05-16 SALESREP      19 M   1959-11-05   $66,500.00     $900.00   $3,720.00
000120       O'CONNELL A00      2167    1993-12-05 CLERK         14 M   1972-10-18   $49,250.00     $600.00   $2,340.00
000130        QUINTANA C01      4578    2001-07-28 ANALYST       16 F   1955-09-15   $73,800.00     $500.00   $1,904.00
000140        NICHOLLS C01      1793    2006-12-15 ANALYST       18 F   1976-01-19   $68,420.00     $600.00   $2,274.00
000150         ADAMSON D11      4510    2002-02-12 DESIGNER      16 M   1977-05-17   $55,280.00     $500.00   $2,022.00
000160          PIANKA D11      3782    2006-10-11 DESIGNER      17 F   1980-04-12   $62,250.00     $400.00   $1,780.00
000170       YOSHIMURA D11      2890    1999-09-15 DESIGNER      16 M   1981-01-05   $44,680.00     $500.00   $1,974.00
000180        SCOUTTEN D11      1682    2003-07-07 DESIGNER      17 F   1979-02-21   $51,340.00     $500.00   $1,707.00
000190          WALKER D11      2986    2004-07-26 DESIGNER      16 M   1982-06-25   $50,450.00     $400.00   $1,636.00
```

Figure 4.25 Formatted output of the query

IBM Data Studio

IBM Data Studio is included in every DB2 edition. IBM Data Studio provides a single integrated environment for database administration and application development. You can perform tasks that are related to database modeling and design, developing database applications, administering and managing databases, tuning SQL performance, and monitoring databases all in one single tool. It is an ideal tool that can greatly benefit a team environment with different roles and responsibilities.

IBM Data Studio comes in three favors: full client, administration client, and web console.

The full client includes both the database administrative and the application development capabilities. The development environment is Eclipse-based. This offers a collaborative development environment by integrating with other advanced Eclipse-based tools such as InfoSphere Data Architect and InfoSphere Optim pureQuery Runtime. Note that some of the advanced InfoSphere tools are only included in the DB2 Advanced editions and the DB2 Developer Edition. You can also separately purchase the advanced tools.

The administration client is a subset of the full client. It still provides a wide range of database administrative functionality such as DB2 instance management, object management, data management, and query tuning. Basic application development tasks such as SQL Builder, query formatting, visual explain, debugging, editing, and running DB2 routines are supported. Use the full client for advanced application development features.

The web console, as the name implies, it is a web-based browser interface that provides health monitoring, job management, and connection management.

NOTE

IBM Data Studio also provides collaborative database development tools for DB2 for z/OS, DB2 for i, Informix, and other non-IBM databases. To see a list of IBM Data Studio features by data server, refer to the documentation at http://www.ibm.com/support/docview.wss?uid=swg27022148.

IBM Data Studio Workspace and the Task Launcher

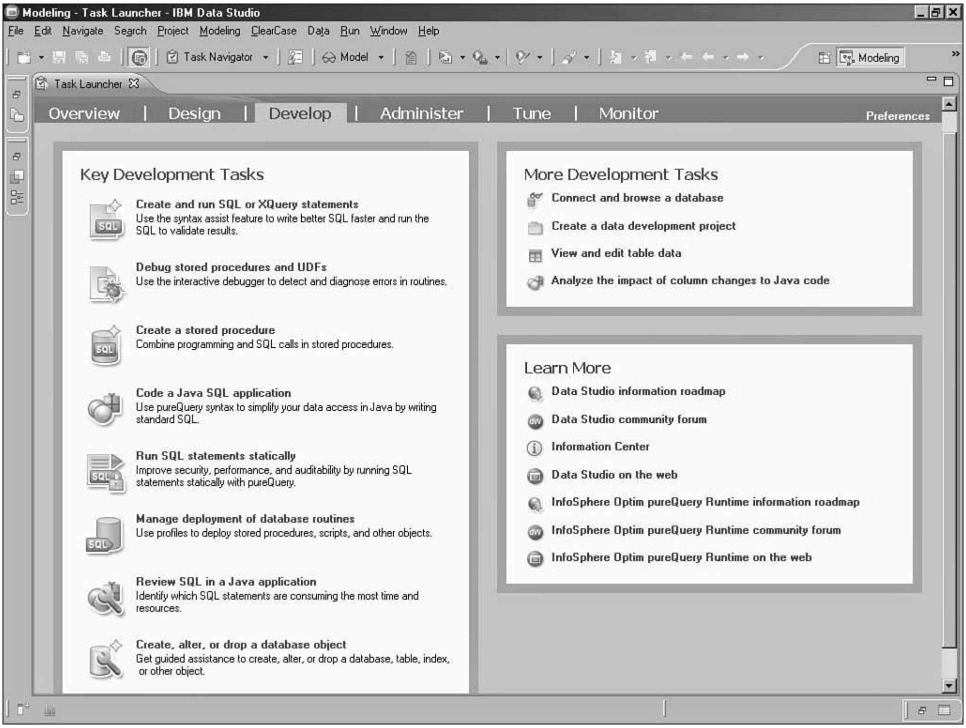
When you have successfully installed the IBM Data Studio, you are asked to provide a workspace name. A **workspace** is a folder that saves your work and projects. It refers to the desktop development environment, which is an Eclipse-based concept.

Task Launcher is displayed, which highlights the following category of tasks:

- Design
- Develop
- Administer
- Tune
- Monitor

Each category is described in more detail in its own tab. Click any tab, and you see the key and primary tasks listed in the box on the left. See Figure 4.26 to get an idea on how to navigate the Task Launcher.

As an example, the figure shows you the Develop tasks. You can find the key development tasks on the left. On the top right, it lists more tasks related to development. On the bottom right, IBM Data Studio provides a few documentation links where you can learn more about development. Where appropriate, it also suggests the advanced tools available in the InfoSphere Optim portfolio that apply to the task you have selected.


Modeling - Task Launcher - IBM Data Studio
File Edit Navigate Search Project Modeling ClearCase Data Run Window Help
Task Navigator
Model
Modeling
Task Launcher
Overview | Design | Develop | Administer | Tune | Monitor
Preferences

Key Development Tasks

Create and run SQL or XQuery statements
Use the syntax assist feature to write better SQL faster and run the SQL to validate results.

Debug stored procedures and UDFs
Use the interactive debugger to detect and diagnose errors in routines.

Create a stored procedure
Combine programming and SQL calls in stored procedures.

Code a Java SQL application
Use pureQuery syntax to simplify your data access in Java by writing standard SQL.

Run SQL statements statically
Improve security, performance, and auditability by running SQL statements statically with pureQuery.

Manage deployment of database routines
Use profiles to deploy stored procedures, scripts, and other objects.

Review SQL in a Java application
Identify which SQL statements are consuming the most time and resources.

Create, alter, or drop a database object
Get guided assistance to create, alter, or drop a database, table, index, or other object.

More Development Tasks

- Connect and browse a database
- Create a data development project
- View and edit table data
- Analyze the impact of column changes to Java code

Learn More

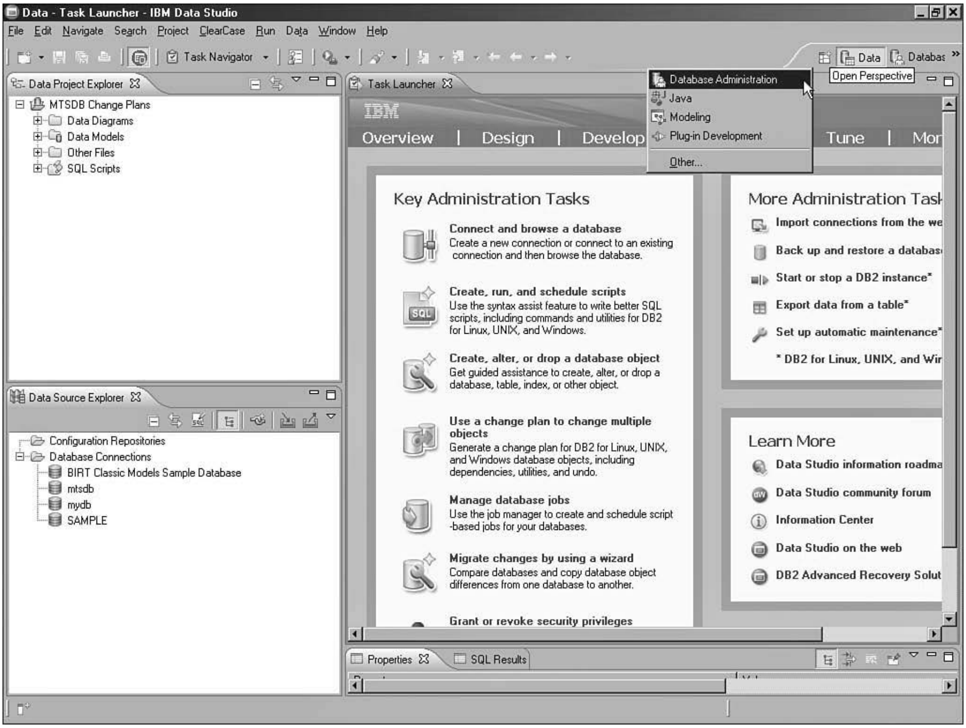
- Data Studio information roadmap
- Data Studio community forum
- Information Center
- Data Studio on the web
- InfoSphere Optim pureQuery Runtime information roadmap
- InfoSphere Optim pureQuery Runtime community forum
- InfoSphere Optim pureQuery Runtime on the web

Figure 4.26 The IBM Data Studio Task Launcher

Connection Profiles

Every task you were to perform against a database requires to first establish a database connection. To connect to a database from IBM Data Studio, open the **Database Administration** perspective. On the top right corner, click the **Open Perspective** icon and select **Database Administration**.

On the **Administration Explorer**, right-click the white space or under the **New** menu, select **New Connection** to a database. From the *New Connection* window, you see that you can use the IBM Data Studio to connect to different IBM data sources, as well as non-IBM data sources. Select the database manager and enter the necessary connection parameters. Figure 4.28 shows an example.



Key Administration Tasks

Connect and browse a database
Create a new connection or connect to an existing connection and then browse the database.

Create, run, and schedule scripts
Use the syntax assist feature to write better SQL scripts, including commands and utilities for DB2 for Linux, UNIX, and Windows.

Create, alter, or drop a database object
Get guided assistance to create, alter, or drop a database, table, index, or other object.

Use a change plan to change multiple objects
Generate a change plan for DB2 for Linux, UNIX, and Windows database objects, including dependencies, utilities, and undo.

Manage database jobs
Use the job manager to create and schedule script -based jobs for your databases.

Migrate changes by using a wizard
Compare databases and copy database object differences from one database to another.

Grant or revoke security privileges

More Administration Tasl

Import connections from the we
Back up and restore a databas
Start or stop a DB2 instance*
Export data from a table*
Set up automatic maintenance*
* DB2 for Linux, UNIX, and Wir

Learn More

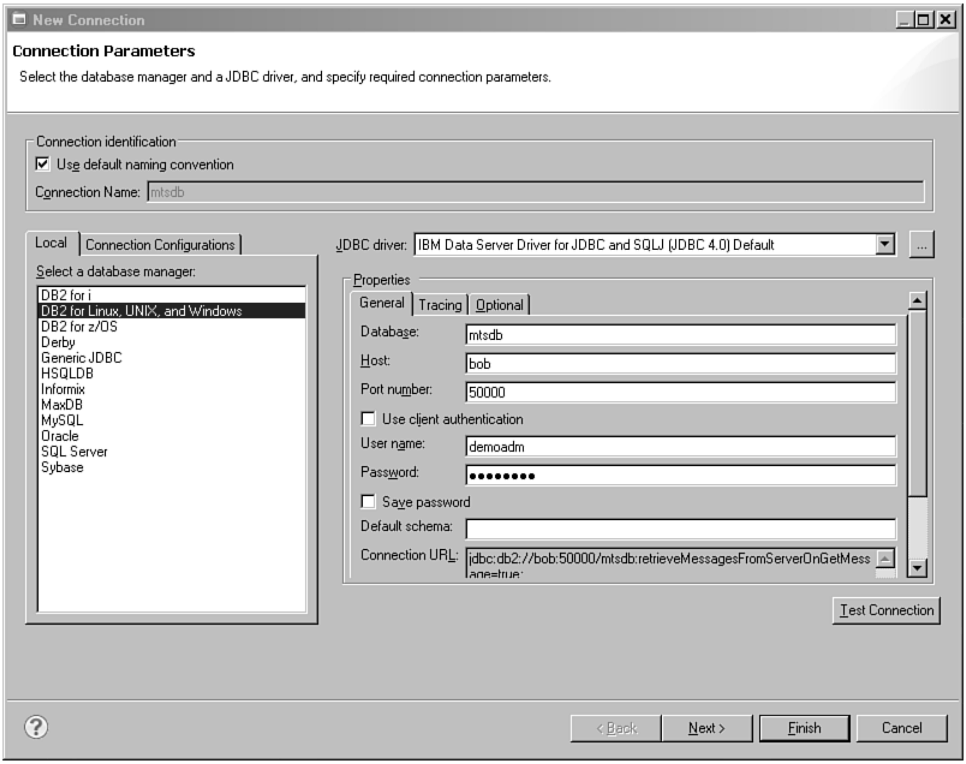
Data Studio information roadma
Data Studio community forum
Information Center
Data Studio on the web
DB2 Advanced Recovery Solut

Figure 4.27 Open the Database Administration perspective

Pull down the JDBC driver drop-down menu, and you can select the type of JDBC driver to use. JDBC type 4 driver is used by default.

Use the **Test Connection** button to ensure the connection information you enter is valid. Click **Finish**.

At this point, you have created a connection profile. Connection profiles contain information about how to connect to a database such as indicating the type of authentication to be used when connecting the database, specifying default schema, and configuring tracing options. Other team members can import the connection profiles to their own IBM Data Studio and be able to deploy a set of consistent connection settings.



New Connection

Connection Parameters

Select the database manager and a JDBC driver, and specify required connection parameters.

Connection identification

☑ Use default naming convention

Connection Name: mtsdb

Select a database manager:

DB2 for i
DB2 for Linux, UNIX, and Windows
DB2 for z/OS
Derby
Generic JDBC
HSQLDB
Informix
MaxDB
MySQL
Oracle
SQL Server
Sybase

JDBC driver: IBM Data Server Driver for JDBC and SQLJ (JDBC 4.0) Default

Properties

Database: mtsdb

Host: bob

Port number: 50000

□ Use client authentication

User name: demoadm

Password: ••••••••

□ Save password

Default schema:

Connection URL: jdbc:db2://bob:50000/mtsdb:retrieveMessagesFromServerOnGetMessage=true;

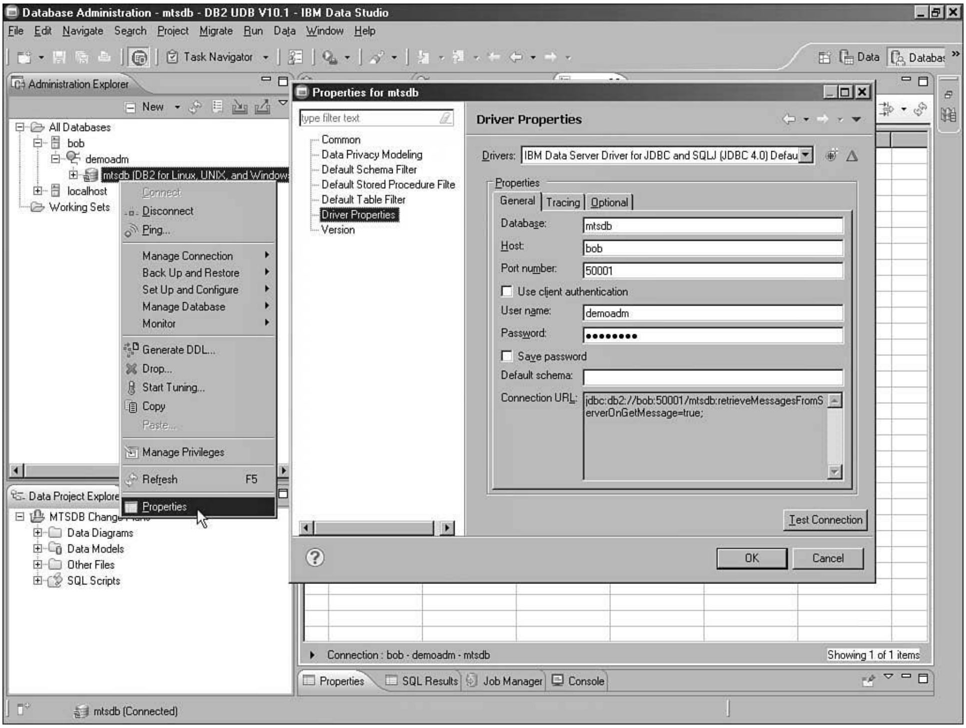
Figure 4.28 Creating a new database connection

To update the connection profile, right-click the database and select **Properties**. Properties for the database are displayed as shown in Figure 4.29.

General Database Administration Tools

There are few other useful administration tasks available in the menu illustrated in Figure 4.29.

The *Manage Connection* function enables you to rename the connection profile, delete the connection profile, change the user ID and password, and duplicate the profile. The *Back Up and Restore* function enables you to setup a database or table space backups. In the appropriate editor, you can specify the type of backup, location of the backup images, and performance options for the backup. Database backup and recovery is discussed in Chapter 10, "Maintaining, Backing Up, and Recovering Data."



Drivers: IBM Data Server Driver for JDBC and SQLJ (JDBC 4.0) Defau

Database: mtsdb

Host: bob

Port number: 50001

☐ Use client authentication

User name: demoadm

Password: ••••••••

☐ Save password

Default schema:

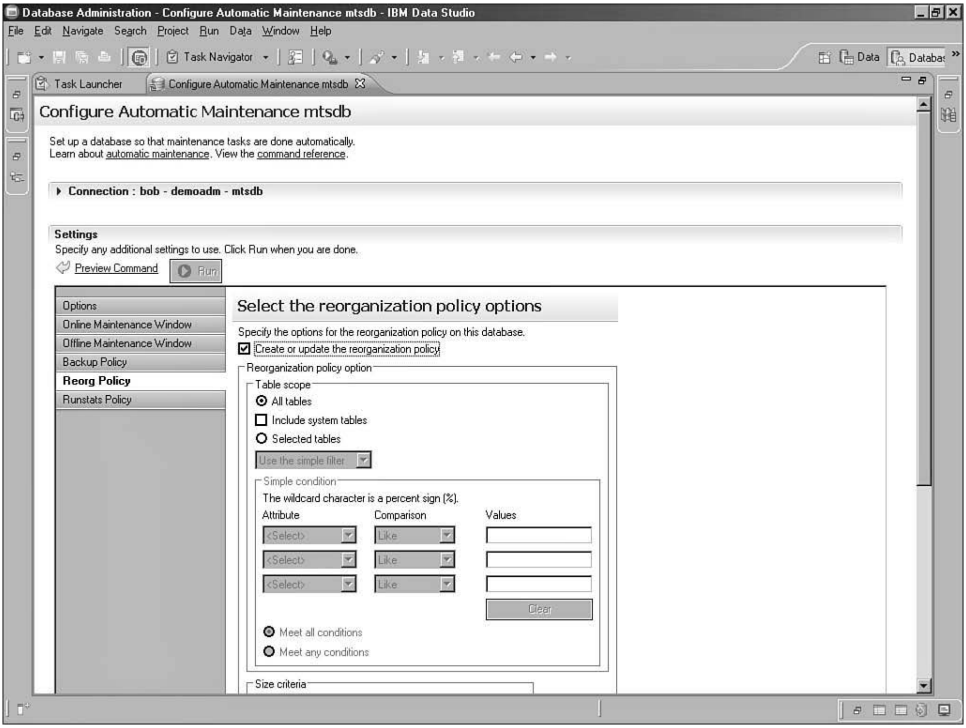
Connection URL: jdbc:db2://bob:50001/mtsdb:retrieveMessagesFromServerOnGetMessage=true;

Figure 4.29 Updating the connection profile

The *Set Up and Configure* function enables you to configure the database. Database configuration and this IBM Data Studio function are covered in detail in Chapter 5. Notice from the menu, you can launch the Configure Automatic Maintenance editor. DB2 provides automatic maintenance capabilities for performing database backups, reorganizing tables and indexes, and updating the database statistics as necessary. The editor enables you customize the automatic maintenance policy (see Figure 4.30).

The *Manage Database* function enables you to start and stop the database. In DB2, that means activating and deactivating the database. Activating a database allocates all the necessary database memory and services or processes required. Deactivating a database releases the memory and stops DB2 services and processes.

The *Monitor* function launches the IBM Data Studio Web Console. Refer to the section, “IBM Data Studio Web Console,” for introduction of the tool.


Database Administration - Configure Automatic Maintenance mtsdb - IBM Data Studio
File Edit Navigate Search Project Run Data Window Help
Task Navigator
Data
Databas
Task Launcher
Configure Automatic Maintenance mtsdb
Preview Command
Run
Options
Online Maintenance Window
Offline Maintenance Window
Backup Policy
Reorg Policy
Runstats Policy
Clear

Configure Automatic Maintenance mtsdb

Set up a database so that maintenance tasks are done automatically.
Learn about automatic maintenance. View the command reference.

Connection : bob - demoadm - mtsdb

Settings

Specify any additional settings to use. Click Run when you are done.

Select the reorganization policy options

Specify the options for the reorganization policy on this database.

☑ Create or update the reorganization policy

Reorganization policy option

Table scope

● All tables

□ Include system tables

○ Selected tables

Use the simple filter

Simple condition

The wildcard character is a percent sign (%).

Attribute	Comparison	Values
<Select>	Like	
<Select>	Like	
<Select>	Like	

● Meet all conditions

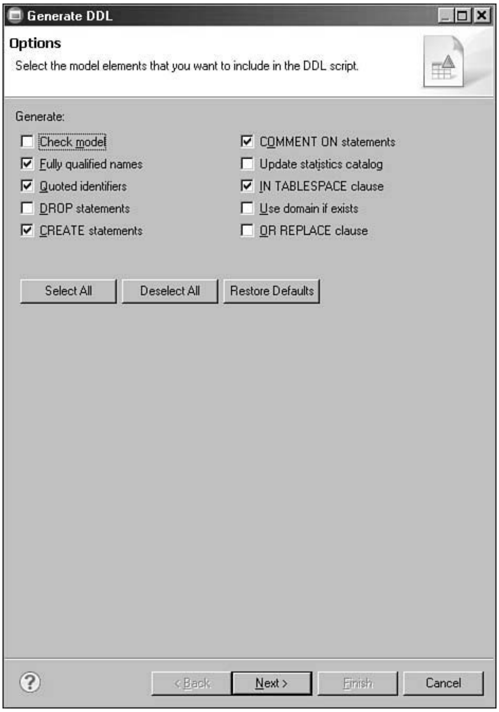
○ Meet any conditions

Size criteria

Figure 4.30 Select the Automatic Maintenance policy options

The *Generate DDL* function uses the DB2 command-based tool `db2look` to extract the Data Definition Language (DDL) statements for the identified database objects or the entire database. This function and tool come handy when you want to mimic a database, a set of database objects, or the database statistics to another database. As a result of the Generate DDL function in IBM Data Studio or the DB2 command `db2look`, you receive a DDL script. The script contains statements to re-create the database objects you have selected. See Figure 4.31 for a reference of the types of statements you can generate using the IBM Data Studio.

For complete options for the DB2 command `db2look`, refer to the DB2 Information Center.



Generate DDL

Options

Select the model elements that you want to include in the DDL script.

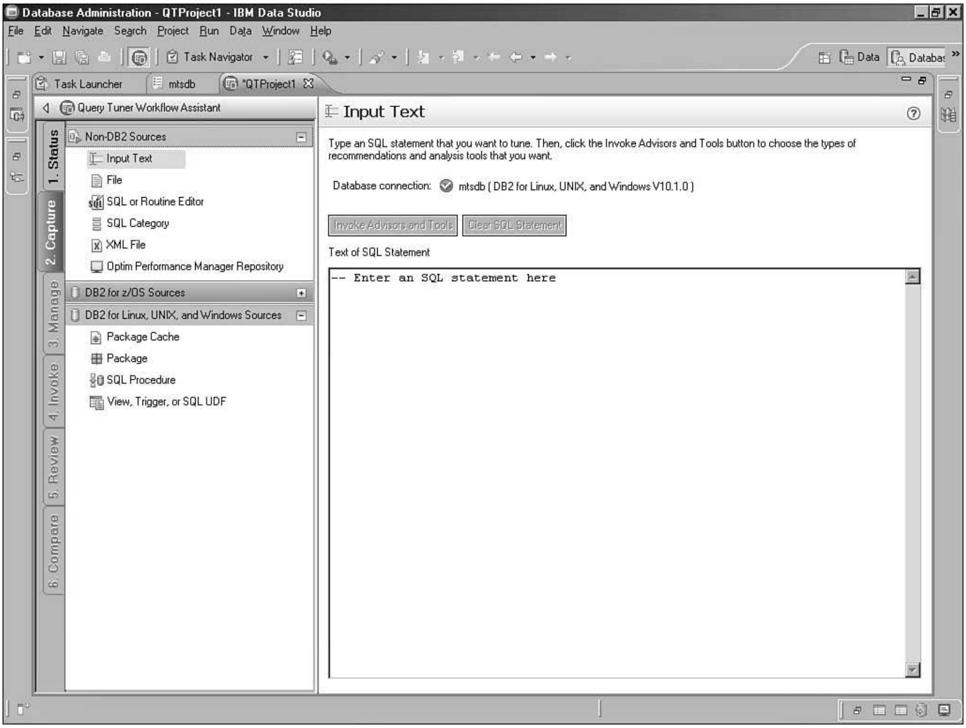
Generate:

☐ Check model
☑ Fully qualified names
☑ Quoted identifiers
☐ DROP statements
☑ CREATE statements
☑ COMMENT ON statements
☐ Update statistics catalog
☑ IN TABLESPACE clause
☐ Use domain if exists
☐ OR REPLACE clause

Figure 4.31 Generate DDL function in the IBM Data Studio

The *Start Tuning* function configures the database to enable query tuning. You might receive a warning indicating that you need to activate the InfoSphere Optim Query Workload Tuner (OQWT) license for advanced tuning capability. Note that IBM DB2 Advanced Enterprise Server Edition comes with OQWT. Follow the instructions to apply the product license or click **Yes** to configure the database server for tuning with the features complementary in the IBM Data Studio.

When the database is configured to use the tuning advisors and tools, you are presented with the Query Tuner Workflow Assistant, as shown in Figure 4.32.


Database Administration - QTProject1 - IBM Data Studio
File Edit Navigate Search Project Run Data Window Help
Task Navigator
Data
Databas
Task Launcher
mtsdb
*QTProject1
Query Tuner Workflow Assistant
1. Status
2. Capture
3. Manage
4. Invoke
5. Review
6. Compare
Non-DB2 Sources
Input Text
File
SQL or Routine Editor
SQL Category
XML File
Optim Performance Manager Repository
DB2 for z/OS Sources
DB2 for Linux, UNIX, and Windows Sources
Package Cache
Package
SQL Procedure
View, Trigger, or SQL UDF
Input Text
Invoke Advisors and Tools
Clear SQL Statement

Type an SQL statement that you want to tune. Then, click the Invoke Advisors and Tools button to choose the types of recommendations and analysis tools that you want.

Database connection: mtsdb (DB2 for Linux, UNIX, and Windows V10.1.0)

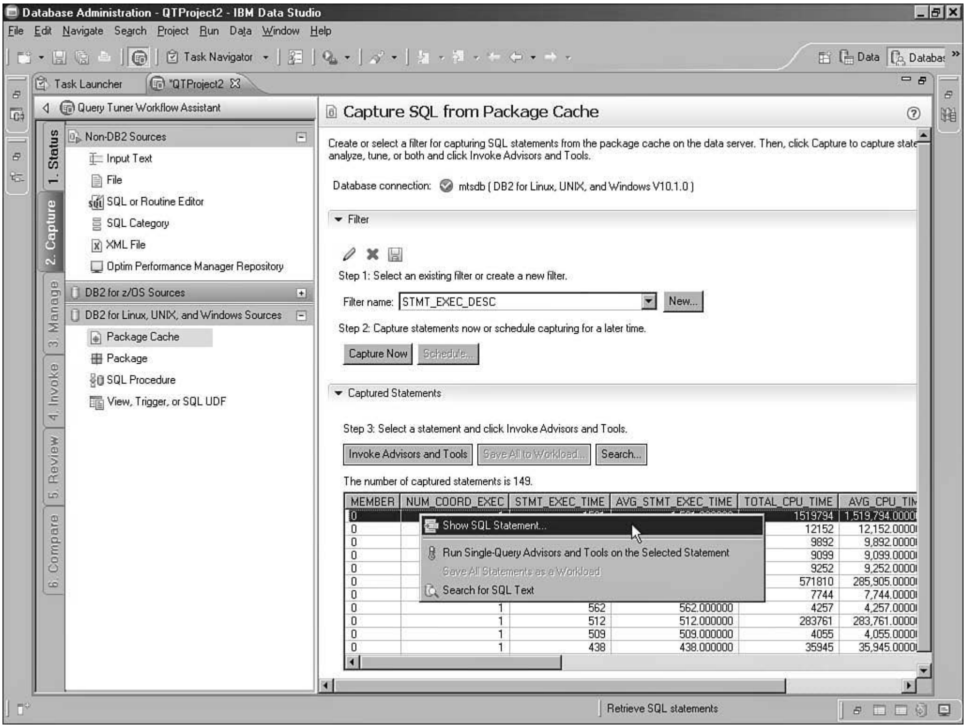
Text of SQL Statement

```
-- Enter an SQL statement here
```

Figure 4.32 The Query Tuner Workflow Assistant

From the *Query Tuner Workflow Assistant*, you can obtain a statement from various sources and tune the statement. In the Capture view, it gives you a list of sources where you can capture the statements. Figure 4.33 shows an example on capturing the SQL statements from the Package Cache. This example captures over 100 statements. Right-click the statement in which you are interested and select **Show SQL statement** or **Run Single-Query Advisors and Tools on the Selected Statement**.

Run the query advisors and tools on the selected statement. You can now enter the Invoke view. The tool collects information and statistics and generates a data access plan (see Figure 4.34).


Database Administration - QTProject2 - IBM Data Studio
File Edit Navigate Search Project Run Data Window Help
Task Navigator
Data
Databas
Task Launcher
*QTProject2
Query Tuner Workflow Assistant
1. Status
2. Capture
3. Manage
4. Invoke
5. Review
6. Compare
Non-DB2 Sources
Input Text
File
SQL or Routine Editor
SQL Category
XML File
Optim Performance Manager Repository
DB2 for z/OS Sources
DB2 for Linux, UNIX, and Windows Sources
Package Cache
Package
SQL Procedure
View, Trigger, or SQL UDF
Show SQL Statement...
Run Single-Query Advisors and Tools on the Selected Statement
Save All Statements as a Workload
Search for SQL Text
Retrieve SQL statements

Capture SQL from Package Cache

Create or select a filter for capturing SQL statements from the package cache on the data server. Then, click Capture to capture state analyze, tune, or both and click Invoke Advisors and Tools.

Database connection: mtsdb (DB2 for Linux, UNIX, and Windows V10.1.0)

Filter

Step 1: Select an existing filter or create a new filter.

Filter name: STMT_EXEC_DESC [New...]

Step 2: Capture statements now or schedule capturing for a later time.

[Capture Now] [Schedule...]

Captured Statements

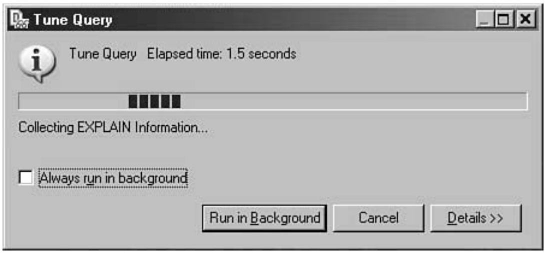
Step 3: Select a statement and click Invoke Advisors and Tools.

[Invoke Advisors and Tools] [Save All to Workload...] [Search...]

The number of captured statements is 149.

MEMBER	NUM_COORD_EXEC	STMT_EXEC_TIME	AVG_STMT_EXEC_TIME	TOTAL_CPU_TIME	AVG_CPU_TIM
0				1519794	1,519,794.0000
0				12152	12,152.0000
0				9892	9,892.0000
0				9099	9,099.0000
0				9252	9,252.0000
0				571810	285,905.0000
0				7744	7,744.0000
0	1	562	562.000000	4257	4,257.0000
0	1	512	512.000000	283761	283,761.0000
0	1	509	509.000000	4055	4,055.0000
0	1	438	438.000000	35945	35,945.0000

Figure 4.33 Capturing SQL statements for tuning



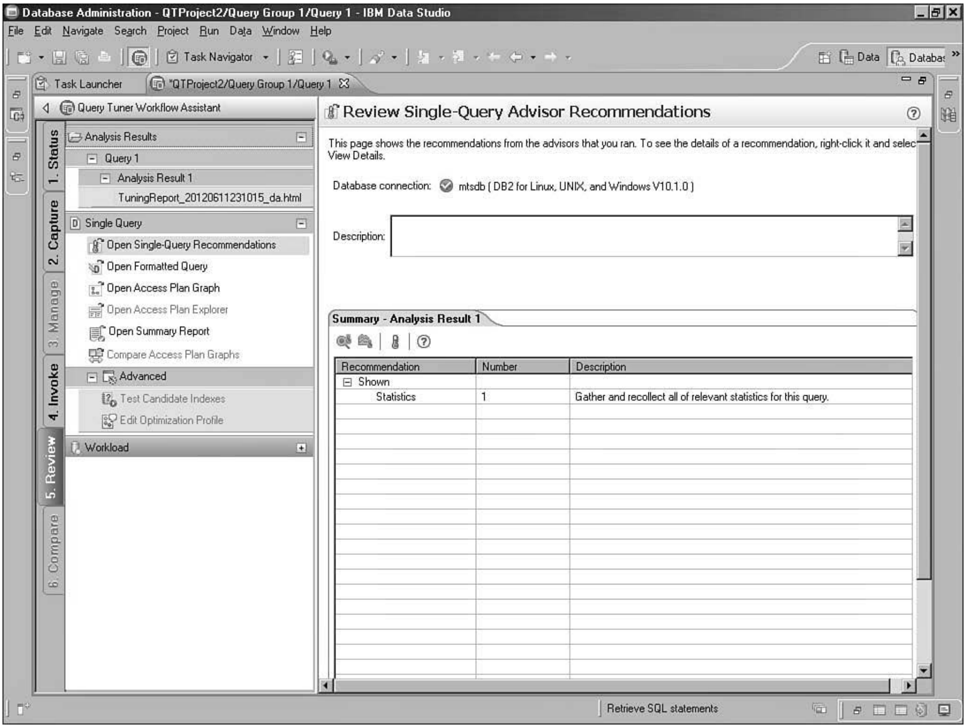
Tune Query Elapsed time: 1.5 seconds

Collecting EXPLAIN Information...

☐ Always run in background

Figure 4.34 Tune query in progress

When the query tuning activities are complete, you are brought to the Review view. It presents you the analysis results and an advisor recommendation, such as the one shown in Figure 4.35. The tool documentation recommends gathering and re-collecting all of relevant statistics of the query.


Database Administration - QTProject2/Query Group 1/Query 1 - IBM Data Studio
File Edit Navigate Search Project Run Data Window Help
Task Navigator
Data
Databa
Task Launcher
*QTProject2/Query Group 1/Query 1
Query Tuner Workflow Assistant
1. Status
2. Capture
3. Manage
4. Invoke
5. Review
6. Compare
Analysis Results
Query 1
Analysis Result 1
TuningReport_20120611231015_da.html
Single Query
Open Single-Query Recommendations
Open Formatted Query
Open Access Plan Graph
Open Access Plan Explorer
Open Summary Report
Compare Access Plan Graphs
Advanced
Test Candidate Indexes
Edit Optimization Profile
Workload
Review Single-Query Advisor Recommendations
Summary - Analysis Result 1
Retrieve SQL statements

This page shows the recommendations from the advisors that you ran. To see the details of a recommendation, right-click it and selec View Details.

Database connection: mtsdb (DB2 for Linux, UNIX, and Windows V10.1.0)

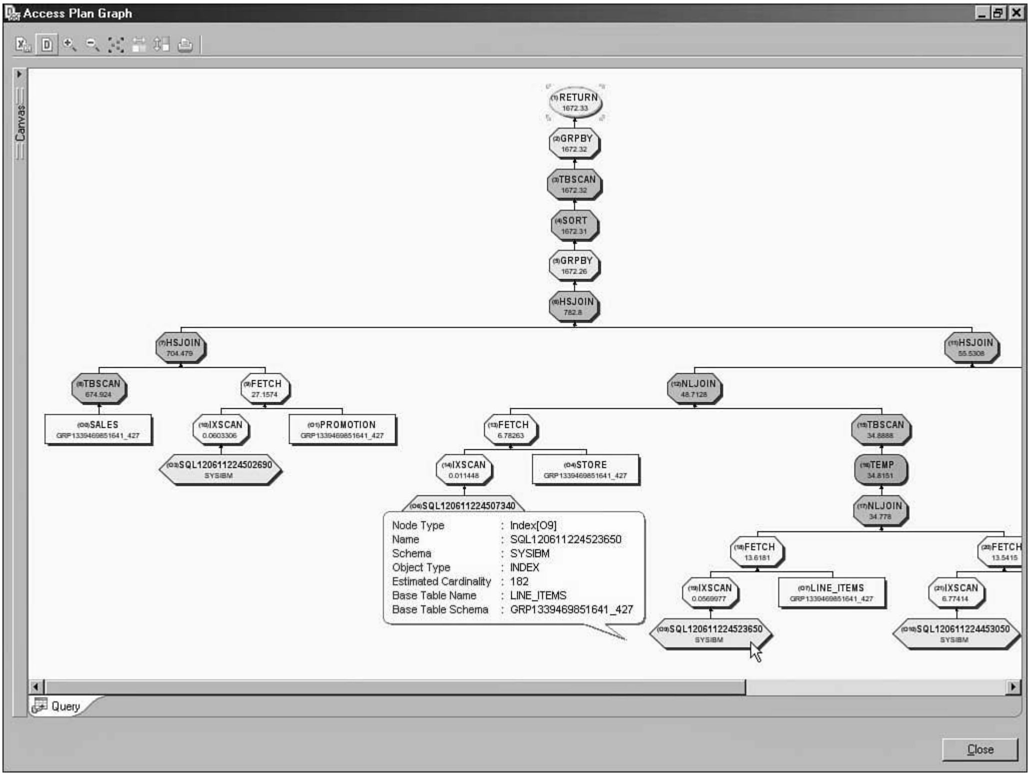
Description:

Recommendation	Number	Description
⊟ Shown		
Statistics	1	Gather and recollect all of relevant statistics for this query.

Figure 4.35 Review the advisor recommendation

You can also review the access plan graph generated by the DB2 explain function (see Figure 4.36 for an example). Remember to save the analysis for future references and compare them if needed.

The *Manage Privileges* function allows you to grant database privileges to the users. Refer to Chapter 8, “Implementing Security,” for details about privileges and database access controls.



```
Node Type               : Index[O9]
Name                    : SQL120611224523650
Schema                  : SYSIBM
Object Type             : INDEX
Estimated Cardinality   : 182
Base Table Name         : LINE_ITEMS
Base Table Schema       : GRP1339469851641_427
```

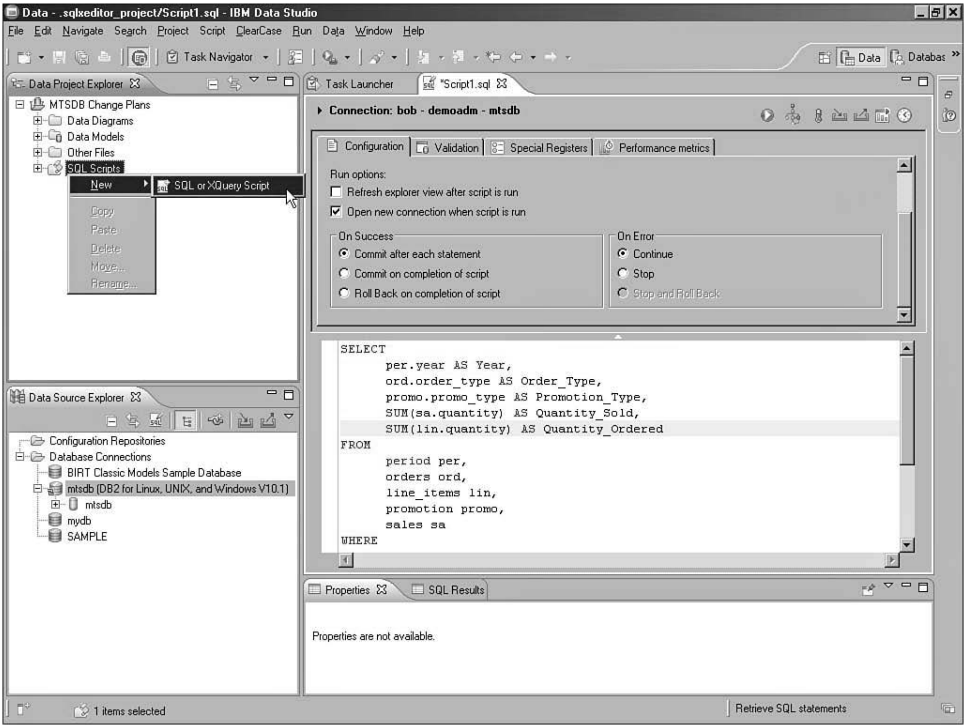
Figure 4.36 Sample access plan graph

General Database Development Tools

IBM Data Studio consolidates the database administration and database development capabilities. From the *Task Launcher – Develop*, you find a list of key development tasks such as creating and running SQL statements, debugging stored procedures, and user-defined functions (UDFs). Each task brings you to a tool that helps you accomplish it.

SQL and XQuery Editor

The SQL and XQuery editor helps you create and run SQL scripts that contain more than one SQL and XQuery statements. To launch the editor, open the **Data Project Explorer**; under SQL Scripts select **New** > **SQL or XQuery Script**. As shown in Figure 4.37, a sample SQL script is entered. You can configure the run options for the script.



Connection: bob - demoadm - mtsdb

Run options:

□ Refresh explorer view after script is run

☑ Open new connection when script is run

On Success

● Commit after each statement

○ Commit on completion of script

○ Roll Back on completion of script

On Error

● Continue

○ Stop

○ Stop and Roll Back

```
SELECT
      per.year AS Year,
      ord.order_type AS Order_Type,
      promo.promo_type AS Promotion_Type,
      SUM(sa.quantity) AS Quantity_Sold,
      SUM(lin.quantity) AS Quantity_Ordered
FROM
      period per,
      orders ord,
      line_items lin,
      promotion promo,
      sales sa
WHERE
```

Properties are not available.

Figure 4.37 SQL and XQuery editor

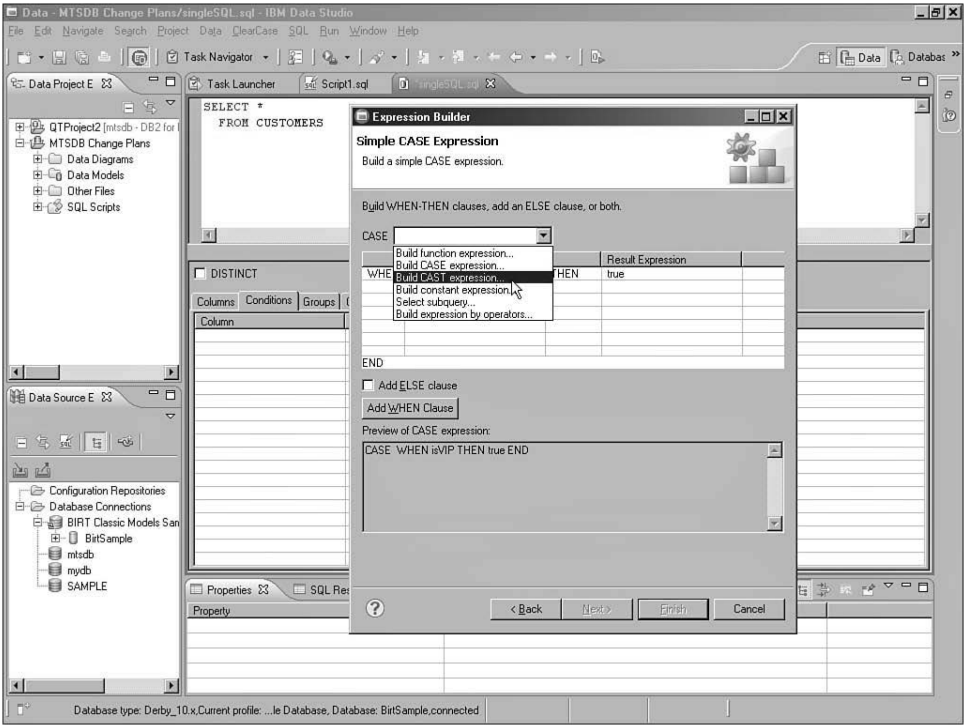
The editor formats the SQL statements nicely and provides syntax highlights for easier reading as you enter the SQL statements. The functionality content assist is also very useful. It lists all the existing schemas in the database so that you can just select one from the drop-down menu. The editor also parses the statement and validates the statement syntax. You can validate the syntax in scripts with multiple database parsers and run scripts against multiple database connections.

SQL Query Builder

The SQL Query Builder enables you to create a single SQL statement, but it does not support XQuery. As the name implies, the tool helps you build an SQL statement. It helps you look at the underlying database schema or build an expression, as shown in Figure 4.38.

NOTE

To get to the SQL Query Builder, click the Data perspective button available at the top right of the window. In the Data Project Explorer view, expand the data profile, right-click the **SQL Scripts** folder, and then click **New** > **SQL or XQuery Script**. This launches the SQL Query Builder.



```
SELECT *
  FROM CUSTOMERS
```

Simple CASE Expression

Build a simple CASE expression.

Build WHEN-THEN clauses, add an ELSE clause, or both.

Preview of CASE expression:

```
CASE  WHEN isVIP THEN true END
```

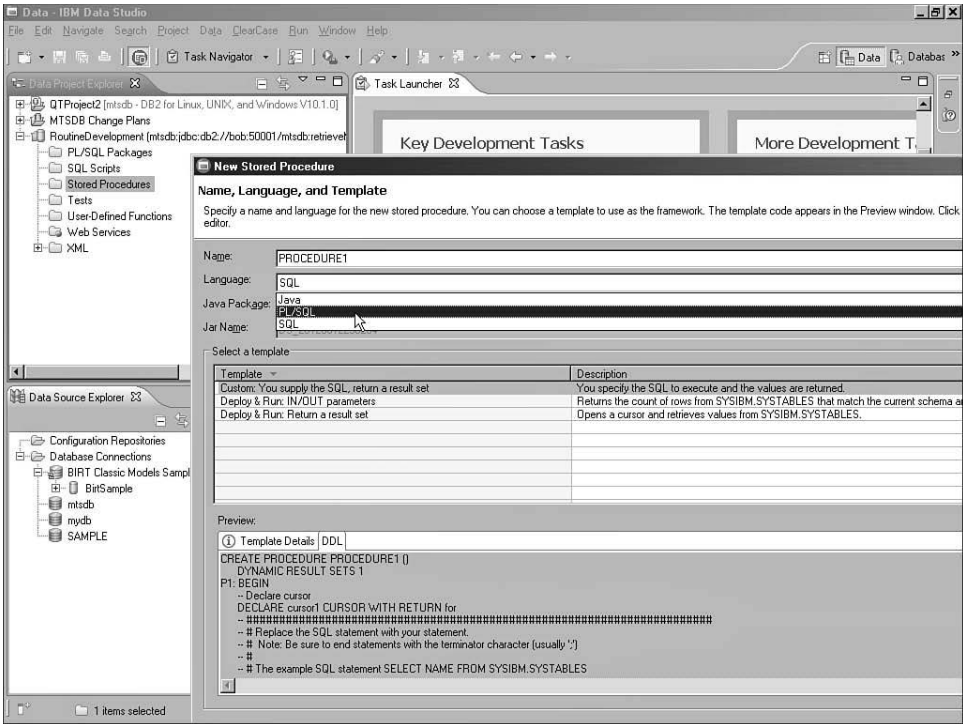
Database type: Derby_10.x,Current profile: ...le Database, Database: BirtSample,connected

Figure 4.38 SQL Query Builder

Database Routines Editor and Debugger

Stored procedures and user-defined functions (UDFs) are database application objects that encapsulate application logic at the database server rather than in application-level code. Use of application objects help reduce overhead of SQL statements and the results that are passed through the network. Stored procedures and UDFs are also called routines. IBM Data Studio supports routines development and debugging.

From the Data Project Explorer, create a new Data Development Project. In the project, you can create various types of database application objects such as stored procedures and UDFs (see Figure 4.39). To debug a routine, right-click the routine and select **Debug**.



Name, Language, and Template

Specify a name and language for the new stored procedure. You can choose a template to use as the framework. The template code appears in the Preview window. Click editor.

Name: PROCEDURE1

Language: SQL

Java Package:

Jar Name:

Template	Description
Custom: You supply the SQL, return a result set	You specify the SQL to execute and the values are returned.
Deploy & Run: IN/OUT parameters	Returns the count of rows from SYSIBM.SYSTABLES that match the current schema a
Deploy & Run: Return a result set	Opens a cursor and retrieves values from SYSIBM.SYSTABLES.

```
CREATE PROCEDURE PROCEDURE1 ()
    DYNAMIC RESULT SETS 1
P1: BEGIN
    -- Declare cursor
    DECLARE cursor1 CURSOR WITH RETURN for
    -- ##########################################################################
    -- # Replace the SQL statement with your statement.
    -- #  Note: Be sure to end statements with the terminator character (usually ';')
    -- #
    -- # The example SQL statement SELECT NAME FROM SYSIBM.SYSTABLES
```

Figure 4.39 Creating a stored procedure

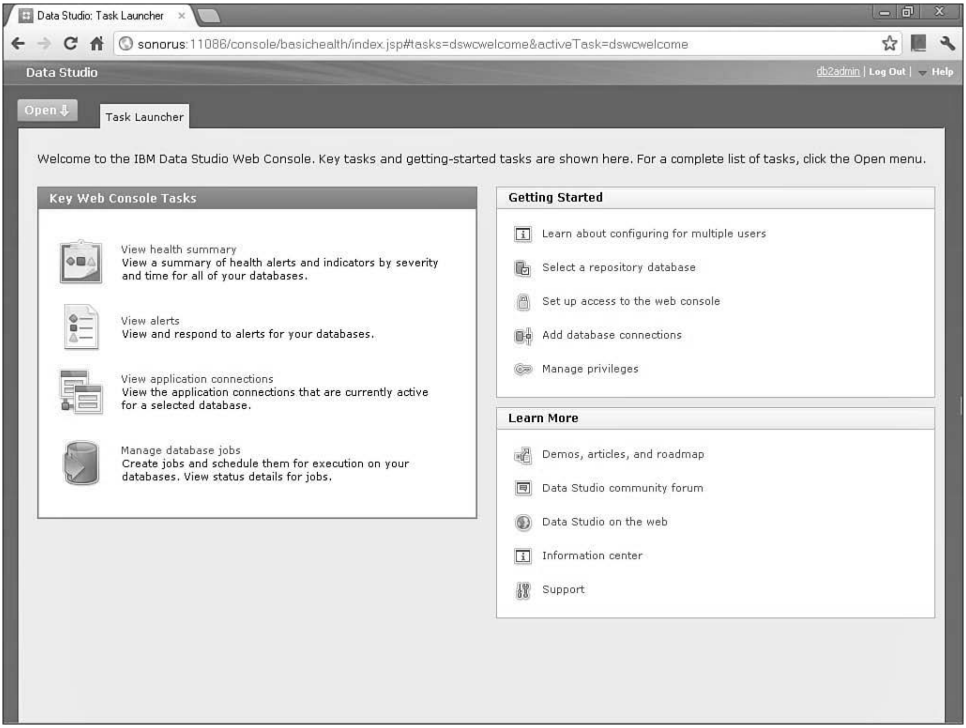
IBM Data Studio Web Console

As a database administrator, it is important to have a good understanding of your database environment. Some of the things you need to know are the kinds of activities that are happening on the system, the data server status, and the database connection status. The IBM Data Studio Web Console provides health monitoring, job management, and connection management for DB2 databases. It can be used in a single-user environment or a multiuser environment to share monitored features and analysis across database servers.

The web console is comprised of a server component and a client component. The server component must be running to monitor database health, issue alerts, and manage scheduled database maintenance jobs. The client component is a web interface used to create and manage jobs and view and analyze alerts.

Shown in Figure 4.40 are the key web console tasks:

- View health summary
- View alerts
- View application connections
- Manage database jobs


Data Studio: Task Launcher
sonorus:11086/console/basichealth/index.jsp#tasks=dswcwelcome&activeTask=dswcwelcome
Data Studio
db2admin | Log Out | Help
Open
Task Launcher

Welcome to the IBM Data Studio Web Console. Key tasks and getting-started tasks are shown here. For a complete list of tasks, click the Open menu.

Key Web Console Tasks

View health summary
View a summary of health alerts and indicators by severity and time for all of your databases.

View alerts
View and respond to alerts for your databases.

View application connections
View the application connections that are currently active for a selected database.

Manage database jobs
Create jobs and schedule them for execution on your databases. View status details for jobs.

Getting Started

- Learn about configuring for multiple users
- Select a repository database
- Set up access to the web console
- Add database connections
- Manage privileges

Learn More

- Demos, articles, and roadmap
- Data Studio community forum
- Data Studio on the web
- Information center
- Support

Figure 4.40 IBM Data Studio Web Console Task Launcher

Set-Up Tools

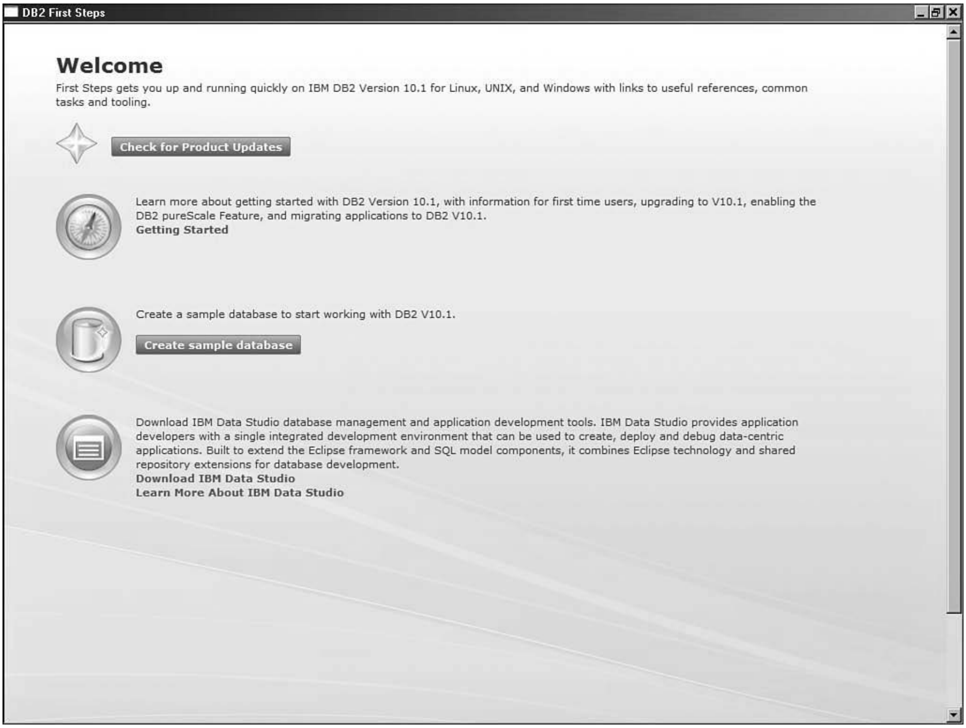
DB2 comes with a number of tools to help you setup the environment. Using these tools, you can create the *SAMPLE* database, which can be used to explore DB2 features. Other tools are Configure DB2 .NET Data Provider, First Steps, Default DB2 and Database Client Interface Selection Wizard, and the Replication Center.

Configure DB2 .NET Data Provider

As its name implies, the Configure DB2 .NET Data Provider tool helps you configure the DB2 .NET Data provider, also known as the IBM Data Server Provider for .NET. There are 32-bit and 64-bit versions of the IBM Data Server Provider for .NET, each supporting the 32-bit and 64-bit versions of the .NET Framework version 2.0, 3.0, 3.5, and 4.0 CLR, respectively.

First Steps

The IBM DB2 First Steps tool is a good starting point for new DB2 users who want to get familiar with the product. It can be launched from the DB2 program menu on Windows or execute the `db2fs` command. Figure 4.41 shows the operations you can perform using this tool.



First Steps gets you up and running quickly on IBM DB2 Version 10.1 for Linux, UNIX, and Windows with links to useful references, common tasks and tooling.

Learn more about getting started with DB2 Version 10.1, with information for first time users, upgrading to V10.1, enabling the DB2 pureScale Feature, and migrating applications to DB2 V10.1.

Create a sample database to start working with DB2 V10.1.

Download IBM Data Studio database management and application development tools. IBM Data Studio provides application developers with a single integrated development environment that can be used to create, deploy and debug data-centric applications. Built to extend the Eclipse framework and SQL model components, it combines Eclipse technology and shared repository extensions for database development.

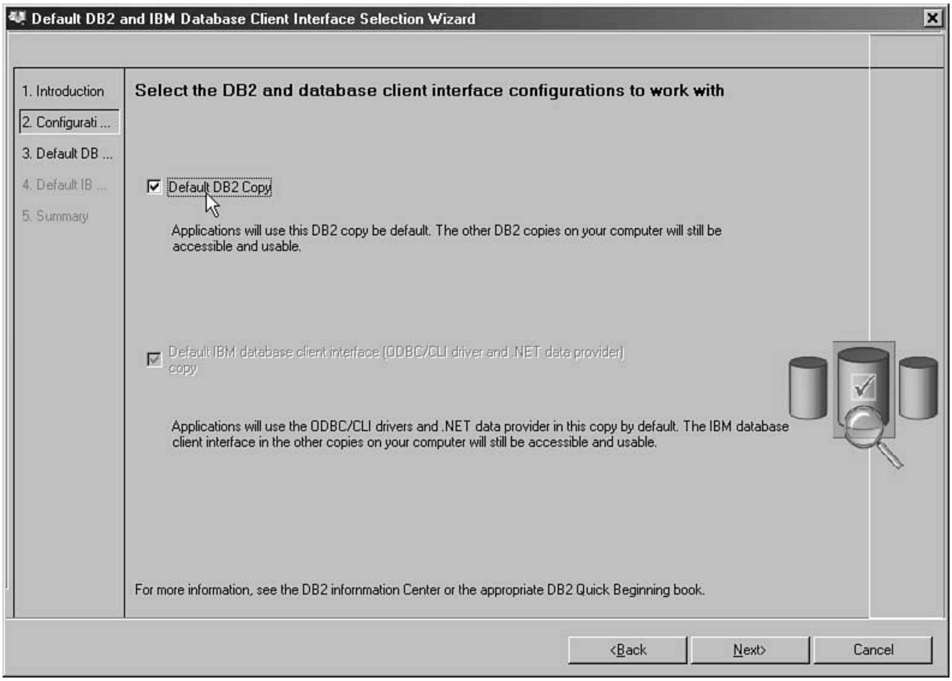
Figure 4.41 The DB2 First Steps

The Create Sample Database button enables you to create a database called *SAMPLE* on your local system. This database is provided with the DB2 product for testing and learning purposes. It comes with a set of predefined tables. You can work with this database just like any other. The equivalent DB2 command to create the *SAMPLE* database is `db2sampl`.

After the database is created, you can create tables using the IBM Data Studio or SQL statements. The SQL statements to create database objects are described in Chapter 7, "Working with Database Objects."

Default DB2 and Database Client Interface Selection Wizard

This tool only applies to Windows platforms. The Default DB2 and Database Client Interface Selection Wizard (available from the DB2 Programs menu) enables you to select or change the default DB2 install copy on your computer when there is one or more DB2 copies on it. Applications use this DB2 install copy by default. This tool can also be used to set the default IBM database client interface (ODBC/CLI driver and .NET provider) copy. You can also launch this wizard by running the `db2swtch.exe` command located in the sqllib\bin directory of your DB2 install copy. Figure 4.42 shows the Default DB2 and Database Client Interface Selection Wizard.



Select the DB2 and database client interface configurations to work with

☑ Default DB2 Copy

Applications will use this DB2 copy be default. The other DB2 copies on your computer will still be accessible and usable.

☑ Default IBM database client interface (ODBC/CLI driver and .NET data provider) copy

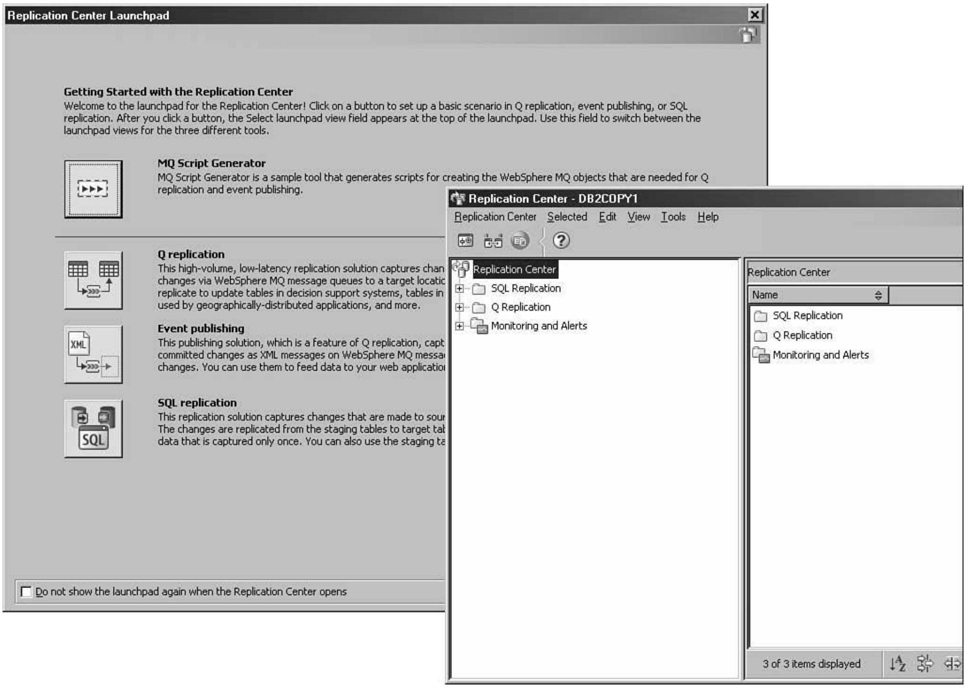
Applications will use the ODBC/CLI drivers and .NET data provider in this copy by default. The IBM database client interface in the other copies on your computer will still be accessible and usable.

For more information, see the DB2 information Center or the appropriate DB2 Quick Beginning book.

Figure 4.42 The Default DB2 and Database Client Interface Selection Wizard

The Replication Center

The Replication Center enables you set up and manage your replication environment. You can easily follow the required steps by using the Replication Center Launchpad. Use DB2 replication when you want to propagate data from one location to another. For example, let's say your users perform transactional queries to your database throughout the day. At the same time, another group of users performs reporting queries to the same database several times a day. When both types of queries are executed at the same time, the performance of your database degrades because the type of workload is different, causing a lot of contention. To solve this problem, you can replicate the database so that one database is used for transactional queries through the day, and the other database, the replicated one, is used for reporting queries. Figure 4.43 shows the Replication Center.



Getting Started with the Replication Center

Welcome to the launchpad for the Replication Center! Click on a button to set up a basic scenario in Q replication, event publishing, or SQL replication. After you click a button, the Select launchpad view field appears at the top of the launchpad. Use this field to switch between the launchpad views for the three different tools.

MQ Script Generator

MQ Script Generator is a sample tool that generates scripts for creating the WebSphere MQ objects that are needed for Q replication and event publishing.

Q replication

This high-volume, low-latency replication solution captures chan
changes via WebSphere MQ message queues to a target locatic
replicate to update tables in decision support systems, tables in
used by geographically-distributed applications, and more.

Event publishing

This publishing solution, which is a feature of Q replication, capt
committed changes as XML messages on WebSphere MQ messa
changes. You can use them to feed data to your web applicatio

SQL replication

This replication solution captures changes that are made to sour
The changes are replicated from the staging tables to target tal
data that is captured only once. You can also use the staging ta

☐ Do not show the launchpad again when the Replication Center opens

Figure 4.43 The Replication Center

Information Tools

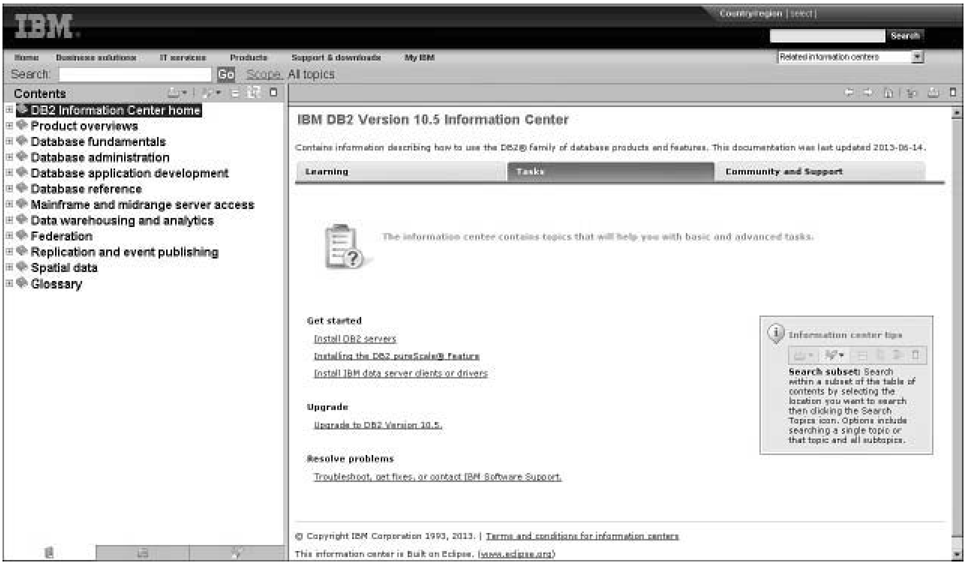
To keep DB2 users informed on current and new product information, IBM offers valuable information via different channels such as webcasts, best practice documentations, and product videos. Additionally, every DB2 edition ships two information tools, namely the DB2 Information Center and the Check for DB2 Update tool.

DB2 Information Center

The DB2 Information Center gives you access to all DB2 documentation. It comes with a fast search engine, enabling you to search on any given topic. The DB2 Information Center can be accessed in three different ways:

- Dynamically through the Internet at http://pic.dhe.ibm.com/infocenter/db2luw/v10r5/index.jsp.
- Locally on the database server after installing the DB2 Information Center from a separate media DVD.
- Through a designated server on your company's intranet. The DB2 Information Center must be installed on that server.

Figure 4.44 shows the Information Center accessed through the Internet. On the left panel there is a list of topics from which you can choose. Each of these topics can be drilled down to subtopics, and selecting a specific subtopic makes the contents panel on the right side display more information. At the top left corner of the Information Center, you find the Search field. Use this field to input any topic or keyword you want to search in the DB2 manuals. Then click the **GO** button.


IBM
Country/region [select]
Search
Home
Business solutions
IT services
Products
Support & downloads
My IBM
Related information centers
Search:
Go
Scope: All topics
Contents
DB2 Information Center home
Product overviews
Database fundamentals
Database administration
Database application development
Database reference
Mainframe and midrange server access
Data warehousing and analytics
Federation
Replication and event publishing
Spatial data
Glossary
Learning
Tasks
Community and Support
Get started
Install DB2 servers
Installing the DB2 pureScale® Feature
Install IBM data server clients or drivers
Upgrade
Upgrade to DB2 Version 10.5.
Resolve problems
Troubleshoot, get fixes, or contact IBM Software Support.
Information center tips

IBM DB2 Version 10.5 Information Center

Contains information describing how to use the DB2® family of database products and features. This documentation was last updated 2013-06-14.

The information center contains topics that will help you with basic and advanced tasks.

Search subset: Search within a subset of the table of contents by selecting the location you want to search then clicking the Search Topics icon. Options include searching a single topic or that topic and all subtopics.

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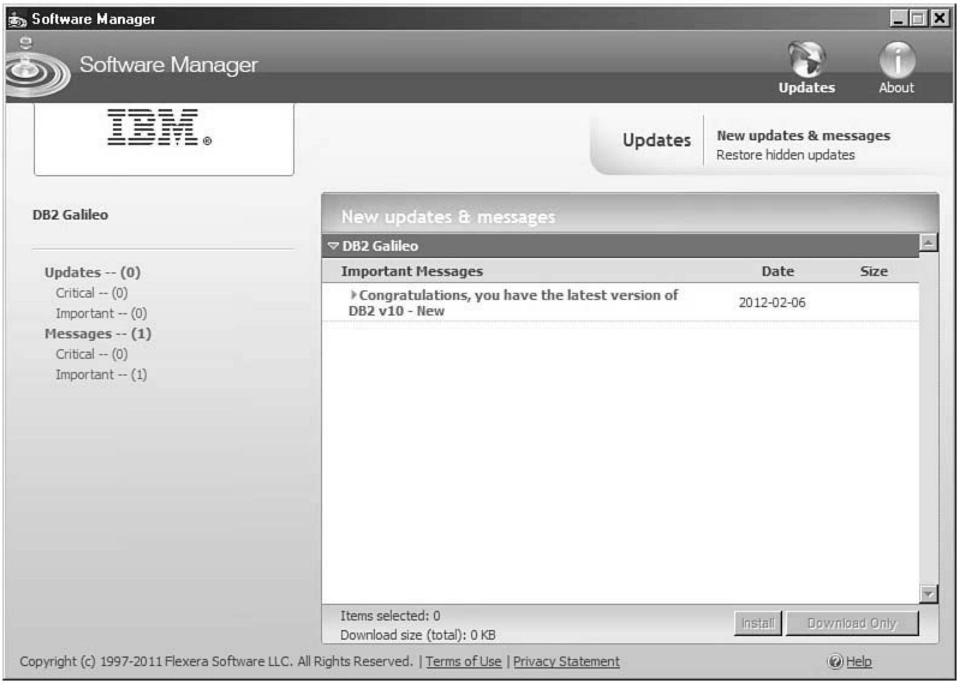
This information center is Built on Eclipse. (www.eclipse.org)

Figure 4.44 The DB2 Information Center

Checking for DB2 Updates

The Information Center website is periodically updated with new documentation; however, if you have installed the Information Center locally, make sure to check for updates regularly. Use the Check For DB2 Updates option in the DB2 menu to launch the InstallShield Update Service, which is shown in Figure 4.45.



DB2 Galileo

Updates -- (0)
Critical -- (0)
Important -- (0)
Messages -- (1)
Critical -- (0)
Important -- (1)

Important Messages	Date	Size
Congratulations, you have the latest version of DB2 v10 - New	2012-02-06	

Items selected: 0
Download size (total): 0 KB

Copyright (c) 1997-2011 Flexera Software LLC. All Rights Reserved.

Figure 4.45 Checking for DB2 updates

From this site, you can download the refreshed DB2 Information Center image and install it on your server. You can also obtain information about updates to the DB2 code and news about DB2 in general.

Problem Determination Tools

Although people never want to encounter problems in their database systems, it happens, so it is important to be able to perform a logical and systematic diagnosis of a database system to identify source of problems. One of the best ways to collect diagnostic data in DB2 data is by using the `db2pd` tool.

The db2pd Tool

The `db2pd` tool is a command-line monitoring and troubleshooting tool that collects immediate statistics for DB2 instances and databases. This tool does not degrade the DB2 engine performance because it acquires the information directly from memory, rather than gathering data on the fly. Use this tool for troubleshooting, problem determination, database monitoring, performance tuning, and as an aid in application development design.

The `db2pd` tool provides many options to display information about database transactions, table spaces, table statistics, dynamic SQL, database configurations, and many other database details; for example

- To display the operating system information, issue

  ```
  db2pd -osinfo
  ```
- To display all instance-related information, issue

  ```
  db2pd -inst
  ```
- To display all database-related information to the *sample* database, issue

  ```
  db2pd -db sample
  ```
- Use the `db2pd -help` command to display all the available options. This tool is not available through the graphical interface.

Case Study 1

You recently installed DB2 Express-C on your Windows laptop. During the installation, the *DB2* instance was created. Now you want to start using DB2 by creating a database. Because you are new to DB2, you decide to use the DB2 First Steps tool (refer to Figure 4.41).

You click the **Create Sample Database** button from the First Steps. Next you choose the option **XML and SQL objects and data**, which creates a Unicode database, and click **OK**. Wait for a few minutes for the *sample* database to be created. Alternatively, you can create the *sample* database from a Windows command prompt or a Linux/UNIX shell using this command:

```
db2sampl -sql -xml
```

After the database is created, you launch the DB2 Command Line Processor by choosing **Start > Programs > IBM DB2 > DB2COPY1 > Command Line Processor**. You should see a prompt like this: `db2 =>`, which is the DB2 CLP prompt. From the prompt, connect to the *sample* database.

```
connect to sample
```

You want to examine the table spaces created by the tool; issue the following command:

```
list tablespaces
```

Five table spaces are created by default. You wonder what sample user tables were created. The following command lists all tables defined under the schema of the user ID currently connected to the database.

```
list tables
```

To list tables of a specific schema (xyz, for example), use this command:

```
list tables for schema xyz
```

Issue `quit` to exit the CLP interactive mode. Sample codes and scripts are installed with the installation that works with the *SAMPLE* database. Run the file *tbread.db2* that contains SQL statements to query the sample tables. Issue the following in the CLP.

```
db2 -tvf ..\samples\clp\tbread.db2
```

You now want to get familiar with the CLPPlus. Issue the command `clpplus` to start the command line interface. But first, connect to the *SAMPLE* database.

```
CONNECT userid@localhost:50001/sample
```

Load a sample file into the SQL buffer with the `GET` command.

```
GET ..\samples\sqlpl\rsultset.db2
```

Run the script with the RUN command. You get an error complaining about the end label "`@`". Use the `EDIT` command to remove the `@` sign at the end of the file. Save and close the editor.

Run the script again. This time it should work, and a stored procedure is successfully created. Call the stored procedure with the following command:

```
CALL median_result_set(?)
```

Congratulations! You have successfully created a Unicode database, queried few tables, and executed SQL scripts using the command-line tools CLP and CLPlus.

Case Study 2

Using the *SAMPLE* database you created in the First Steps, you now explore the IBM Data Studio graphical interface. Launch the IBM Data Studio full client. Open the Database Administration Explorer and create a database connection to the *SAMPLE* database. After a database connection is established, navigate to the *SAMPLE* database folder.

The *SAMPLE* database already has a set of tables defined in it. However, you decide to create a table of your own. To do so, you right-click the **Tables** folder and choose **Create Table**. You are presented with the following selections:

- Identify the schema for the new table. Select the user ID you logged in with. We discuss the significance of schemas in Chapter 7; for now it is sufficient to enter your user ID.
- The Properties pane is opened. Enter the name of the table you want to create, for example, **Table1**.

- Go to the Columns tab, click the **Add** icon. Enter the name of the first column for **Table1**, for example, **Col1**. Choose the data type from the pull-down menu, for example, **INTEGER**. You could create more columns by repeating this step, but one column is sufficient for now.

There are other tabs in which you can define the properties for the new table. However, completing these two windows is enough to create the table. Click the **Review and deploy changes** icon to generate the `CREATE TABLE` statement. Click the **Advanced Options** button to customize the deployment such as generating `REORG` and `RUNSTATS` commands. Click **Run** to run the statements now. Note that you can also schedule to deploy these changes some other time, such as the next maintenance window.

Table1 is displayed under the Tables view. To display the contents of the table, right-click on the table name and choose **Browse data**. Since nothing has been inserted into Table1, no contents are displayed. To insert a row into the table, right-click the table name, and click **Edit Data**. Enter a value under Col1. Click the **Play** button to commit the changes.

Your colleague, who is a DB2 expert, drops by your office and offers his help for any problems you may have. You tell him you would like to get familiar with how to tune SQL statements. He asks you to right-click on the database name, and select **Start Tuning.**

In the **Capture** tab, you enter the SQL statement you want to tune and get advise on. Click the **Invoke Advisors and Tools** button to run the `explain` command against the statement.

You are now in the **Review** tab where you are presented with recommendations based on the query, the current database statistics, and existing indexes defined in the database. You also check out the Access Plan Graph to understand how the query result is obtained. Lastly, you review the summary report and save the report for future reference.

Though you have not finished exploring all the functionality in IBM Data Studio, this exercise has made you realize how easy to use and powerful it is!

Summary

This chapter introduced most of the tools that are available in DB2. They come in two categories: the command-driven and the graphical user interface (GUI) tools. To use the command-line tools you need to have some knowledge of DB2 commands and SQL statements. If you aren't familiar with these, the GUI tools come in handy.

The command-line tools include the Command Line Processor (CLP), the CLP Plus, the Command Window (only on the Windows platform), and the Command Editor. The IBM Data Studio is a GUI that comes with every DB2 edition. From the IBM Data Studio, you can launch different perspectives to manage and administer your instances and databases. The SQL and XQuery editor helps you create and run SQL scripts. If you want to leverage the power of routines such as stored procedures, user-defined functions, and triggers, the database routines editor and debugger is what you need. It helps you with many tasks from developing and testing the routines to deploying and debugging the routines.

The IBM Data Studio Web Console provides health monitoring, job management, and connection management for DB2 databases. It can be used in a single-user environment or a multiuser environment to share monitored features and analysis across database servers.

The web console generates reports and keep track of your databases according to criteria you provide. These reports are handy for investigating performance problems and setting benchmarks for your database.

Review Questions

1. Which IBM tool can be used to schedule SQL scripts in DB2?
2. The DB2 Command Window is only available on Windows. What is the equivalent tool on the Linux/UNIX platforms?
3. Which registry variable needs to be changed to set `autocommit` to *off* permanently for the CLP?
4. When is it handy to start the CLP in interactive mode with a different terminator character as in `db2 -td!`?
5. Which command is necessary to guarantee the CLP back-end process is terminated?
6. When would you choose to use CLPPlus over CLP?
7. Which tool can be used to develop SQL user-defined functions?
8. Can the IBM Data Studio be used to perform database development for DB2 for i databases?
9. It's 9:00 a.m., and you would like to investigate a problem that happened at 3:00 a.m. Where do you look for more information?
10. How can you obtain the most current information about a given DB2 topic?
11. Which of the following tools can be used to execute SQL statements against a DB2 database?

    A. Command Window

    B. Command Editor

    C. Command Line Processor

    D. Command Line Processor Plus

12. Which of the following is the default termination character for files processed by the DB2 CLP?

    A. :

    B. ;

    C. |

    D. $

13. If you have the following CLP input file named *samp.sql*, how many commits will occur during the processing of the `db2 -tvf samp.sql` command?

```
connect to sample;
select * from org;
select * from dept;
connect reset;
```

A. 0
B. 1
C. 2
D. 3
E. 4

14. In which function of the IBM Data Studio would you be able to view a data access explain plan visually?

A. Configure Automatic Maintenance editor
B. IBM Data Studio Web Console
C. SQL and XQuery Editor
D. Query Tuner Workflow Assistant

15. Which of the followings are tasks of the IBM Data Studio Web Console?

A. View alerts
B. Manage database jobs
C. View data access plan graphs
D. Deploy and debug stored procedures
E. Manage data connection profiles

16. If you have the following CLP input file named *samp.sql*, how many commits will occur during the processing of `the db2 +c -tvf samp.sql` command?

connect to sample;

```
select * from org;
select * from dept;
```

A. 0
B. 1
C. 2
D. 3
E. 4

17. If you have the following CLP input file named *samp.sql*, which of the following commands will run this file successfully?

    connect to sample@

    ```
    select * from org@
    select * from dept@
    connect reset@
    ```

    A. `db2 –t@f samp.sql`

    B. `db2 -td@ -f samp.sql`

    C. `db2 -t@ -f samp.sql`

    D. `db2 -td@f samp.sql`

18. If your application receives the SQL code `-911`, which of the following commands can be used to get its description?

    A. `db2 ? -911`

    B. `db2 ? 911N`

    C. `db2 ? SQL-911`

    D. `db2 ? SQL911N`

19. Which of the following commands cannot be run from the CLP in interactive mode?

    A. History

    B. Edit

    C. Runcmd

    D. Repeat

20. Which two of the following can be performed from the CLP in interactive mode?

    A. `db2 ? SQL911N`

    B. db2stop

    C. list applications

    D. select * from staff

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