# Contents

Copyright................................................................................................................................. 3
License..................................................................................................................................... 4
Introduction to Derby............................................................................................................... 8
  CLASSPATH vs. MODULEPATH................................................................................................. 8
  Deployment options.............................................................................................................. 8
  System requirements............................................................................................................. 9
  Product documentation for Derby....................................................................................... 9
Installing and configuring Derby.............................................................................................. 11
  Installing Derby................................................................................................................... 11
Setting up your environment.................................................................................................... 11
  Choosing a method to run the Derby tools and startup utilities........................................... 12
  Setting the environment variables....................................................................................... 13
  Syntax for the derbyrun.jar file.......................................................................................... 14
  Manually setting the CLASSPATH/MODULEPATH environment variables.................... 15
Using the Derby tools and startup utilities............................................................................ 16
  Running sysinfo.................................................................................................................. 17
  Running ij............................................................................................................................ 18
  Running dblook................................................................................................................... 20
Verifying the Derby system configuration................................................................................ 21
Self-study tutorial for users new to Derby.................................................................................. 23
  Tutorial overview................................................................................................................ 23
  Activity 1: Run SQL using the embedded driver................................................................. 24
    Creating a directory and copying scripts into the directory................................................ 24
    Creating a Derby database and running SQL statements.................................................. 25
  Activity 2: Run SQL using the client driver....................................................................... 27
  Activity 3: Run a JDBC program using the embedded driver.............................................. 29
    The WwdEmbedded program............................................................................................ 31
  Activity 4: Create and run a JDBC program using the client driver and Network Server................................................................................................................................. 33
What next with Derby?............................................................................................................. 36
Quick start guide for experienced JDBC users........................................................................ 38
  Environments in which Derby can run................................................................................ 38
    Embedded environment.................................................................................................... 38
    Client/server environment............................................................................................... 38
  Available drivers................................................................................................................. 38
  Database connection URL.................................................................................................... 38
Documentation conventions..................................................................................................... 40
  Terminology.......................................................................................................................... 40
  SQL syntax........................................................................................................................... 40
  Typographical conventions................................................................................................. 40
Derby libraries and scripts: complete reference........................................................................ 42
  Libraries provided by Derby............................................................................................... 42
  Scripts included with Derby............................................................................................... 44
Trademarks............................................................................................................................... 45
The Apache License, Version 2.0

Apache License
Version 2.0, January 2004
http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object form, that is based on (or derived from) the Work and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship. For the purposes of this License, Derivative Works shall not include works that remain separable from, or merely link (or bind by name) to the interfaces of, the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner or by an individual or Legal Entity authorized to submit on behalf of the copyright owner. For the purposes of this definition, "submitted" means any form of electronic, verbal, or written communication sent to the Licensor or its representatives, including but not limited to communication on electronic mailing lists, source code control systems, and issue tracking systems.
that are managed by, or on behalf of, the Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.

3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:

(a) You must give any other recipients of the Work or Derivative Works a copy of this License; and

(b) You must cause any modified files to carry prominent notices stating that You changed the files; and

(c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and

(d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute must include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works; or, within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The contents of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications
and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise, any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding the above, nothing herein shall supersede or modify the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade names, trademarks, service marks, or product names of the Licensor, except as required for reasonable and customary use in describing the origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special, incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "[]" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.
Introduction to Derby

Welcome to Derby! Derby is a full-featured, open source relational database management system (RDBMS) that is based on Java technology and SQL.

Derby is written and implemented completely in the Java programming language. Derby provides users with a small-footprint standards-based database engine that can be tightly embedded into any Java based solution. Derby ensures data integrity and provides sophisticated transaction support. In the default configuration there is no separate database server to be installed or maintained by the end user.

The on-disk database format used by Derby is portable and platform-independent. You can move Derby databases from machine to machine without needing to modify the data. A Derby application can include a pre-built, populated database if it needs to, and that database will work in any Derby configuration.

For more information about Derby, visit the Derby website at http://db.apache.org/derby. The website provides pointers to the Derby Wiki and other resources, such as the derby-users mailing list, where you can ask questions about issues not covered in the documentation.

Before you install Derby, you should understand the deployment options and system requirements.

CLASSPATH vs. MODULEPATH

Derby software can be run with either a CLASSPATH or a MODULEPATH.

With a CLASSPATH

The simplest way to run Derby is via the CLASSPATH. That is because the CLASSPATH is used by the scripts which start Derby configurations and by the handy java -jar derbyrun.jar shorthand for booting those configurations.

With a MODULEPATH

The MODULEPATH should be used if you want the extra security of module-level encapsulation which Java 9 introduced. In addition, the MODULEPATH should be used to reduce static footprint when assembling shrink-wrapped applications via the JDK's jlink tool.

Deployment options

The Derby software distribution provides two basic deployment options (also referred to as frameworks), the simple embedded option and the Derby Network Server option.

Embedded

Refers to Derby being started by a simple single-user Java application. With this option Derby runs in the same Java virtual machine (JVM) as the application. Derby can be almost invisible to the end user because it is started and stopped by the application and often requires no administration.

The Derby documentation often refers to this as the embedded configuration or embedded mode.

Server (or Server-based)

Refers to Derby being started by an application that provides multi-user connectivity to Derby databases across a network. With this option Derby runs in the Java virtual
machine (JVM) that hosts the Server. Applications connect to the Server from different JVMs to access the database. The Derby Network Server is part of the Derby software distribution and provides this type of framework for Derby. Derby also works well with other, independently developed Server applications.

The Derby documentation often refers to this as the Network Server configuration or client/server configuration.

System requirements

Derby is a database engine written completely in the Java programming language. The database will run in any certified Java Virtual Machine (JVM).

You must have a Java Development Kit (JDK) version 17 or higher installed on your computer. The JDK is required to perform the activities in the Self-study tutorial for users new to Derby.

To check that the correct version of the JDK is installed, issue the `java -version` command.

Product documentation for Derby

The Derby product documentation consists of the Derby manuals and the API reference.

**Getting Started with Derby**

Describes how to install and configure Derby. Includes a self-study tutorial for users new to Derby and a quick-start guide for experienced JDBC users. This guide introduces the `dblook`, `ij`, and `sysinfo` tools, and the libraries and scripts that are included with Derby.

**Derby Developer's Guide**

Describes the functionality and features of Derby common to all deployments, such as Derby's JDBC and SQL specifics, deploying Derby applications, working with properties, and other advanced features.

**Derby Reference Manual**

Documents the implementation of the SQL language in Derby. This guide provides reference information about the JDBC and JTA implementations, keywords, system tables, properties, and `SQLExceptions` in Derby.

**Derby Security Guide**

Describes how to configure the security of a Derby application.

**Tuning Derby**

Offers performance tips, an in-depth discussion of performance, and information about the Derby optimizer.

**Derby Tools and Utilities Guide**

Describes how to use the Derby tools such as `dblook`, `ij`, and `sysinfo`.

**Derby Server and Administration Guide**

Part One of this guide discusses configuring servers, how to program client applications, and database administration. These tasks are independent of any server framework but are unique to multi-user or large systems.

Part Two of this guide discusses administrative tasks such as backing up and restoring databases, importing and exporting data, storing Java code in the database, and debugging deadlocks.

**Derby API Reference**

An API Reference that is automatically generated for all public Derby classes. No reference is provided for the JDBC API, which is part of the Java Platform, Standard Edition. For more information about the classes in the API, see the Derby Reference Manual.
You can access the Version 10.16 manuals and API Reference from the Apache Derby: Documentation page on the Apache Derby Web site. The product documentation is also installed with Derby. The manuals are installed in the docs subdirectory and the API Reference is installed in the javadoc subdirectory.
Installing and configuring Derby

This section will help you install and configure Derby.

After you complete the installation:
- Access the Self-study tutorial to get up and running with Derby. This tutorial demonstrates how to use Derby in the embedded and client/server configurations.
- If you are an experienced JDBC programmer, you should also see the Quick start guide for experienced JDBC users.

Installing Derby

To install Derby you must download the distribution and extract the package.

There are several distributions of Derby, including binary and source distributions for the latest official release and for previous official releases.

The distributions are:
- The bin distribution contains scripts, demonstration programs, documentation, and the optimized .jar files. These .jar files are the same set of .jar files that are in the lib distribution.
- The lib distribution contains an optimized, small footprint set of the Derby .jar files for deployment.
- The lib-debug distribution contains a larger footprint set of the Derby .jar files that are useful for debugging or reporting issues.
- The src distribution contains the source files that are used to create the bin, lib, and lib-debug distributions.

> Important: The remainder of the instructions in this guide assume that you have downloaded the bin distribution.

To install Derby:

Navigate your Web browser to http://db.apache.org/derby/derby_downloads.html. The downloads page provides links to the distributions of Derby. This page also contains a link to http://db.apache.org/derby/dev/derby_source.html, where you can find information on how to use the Subversion version control system to access the Derby source code for a specific branch or for the development trunk.

Download the ZIP or TAR archive for the distribution that you want to use.

Extract the downloaded package. The extracted installation contains several subdirectories:
- The demo subdirectory contains the demonstration programs.
- The bin subdirectory contains the scripts for executing utilities and setting up the environment.
- The javadoc subdirectory contains the API documentation that was generated from source code comments.
- The docs subdirectory contains the Derby documentation.
- The lib subdirectory contains the Derby .jar files.
- The test subdirectory contains regression tests for Derby.

Setting up your environment

Derby includes several scripts that run the Derby tools and utilities. How you run those scripts depends on the configuration that you want to use to access the Derby database and tools.
To set up your environment:
1. **Choose the method that you want to use to run the Derby tools and utilities.**
2. **Set the environment variables.**

## Choosing a method to run the Derby tools and startup utilities

There are several ways that you can run the Derby tools and startup utilities. The method that you choose to run the tools and utilities determines the environment variables that you set for Derby.

1. Choose the method that you want to use. The methods are listed in the following table.

### Table 1. Methods of running the Derby tools and utilities

<table>
<thead>
<tr>
<th>Method</th>
<th>When to Use</th>
<th>Requirements</th>
</tr>
</thead>
</table>
| Run the tools using the command shell scripts that are provided with Derby. | Use this method when you want to run the tools with the least amount of typing and have installed the full bin distribution of Derby. | • Set the DERBY_HOME environment variable  
• Include the location of the java executable file (usually JAVA_HOME\bin) in the PATH environment variable  
• Include the DERBY_HOME\bin directory in the PATH environment variable |
| Run the tools using the derbyrun.jar archive file. | Use this method when:  
• You have only the Derby jar files available (see Libraries provided by Derby), and do not have the full bin distribution of Derby  
• You do not want to use the scripts that are provided with Derby | • Set the DERBY_HOME environment variable  
• Include the location of the java executable file (usually JAVA_HOME\bin) in the PATH environment variable  
The derbyrun.jar file must be in the same folder as the other Derby.jar files.  
For more information, see Syntax for the derbyrun.jar file. |
| Run the tools using the complete java syntax, or use Derby in a Java program. | Use this method when:  
• You do not have the derbyrun.jar file or the Derby scripts installed  
• You want to learn the full syntax of each command and understand the details of setting | • Set the DERBY_HOME environment variable  
• Include the location of the java executable file (usually JAVA_HOME\bin) in the PATH environment variable  
• You must know the full package name for the Java class that supports the tool |
### Table 2. Commands to set the DERBY_HOME environment variable

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td><code>export DERBY_HOME=/opt/ Derby_10</code></td>
</tr>
<tr>
<td>Windows</td>
<td><code>set DERBY_HOME=c:\ Derby_10</code></td>
</tr>
</tbody>
</table>

### Table 3. Commands to set the PATH environment variable

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td><code>export PATH=PATH:/opt/ Derby_10/bin</code></td>
</tr>
<tr>
<td>Windows</td>
<td><code>set PATH=PATH:\ Derby_10\ bin</code></td>
</tr>
</tbody>
</table>

2. Based on the requirements of the method that you chose to run the tools, follow the instructions to set the environment variables.

### Setting the environment variables

There are several environment variables that must be set depending on the method that you selected to run the Derby tools and startup utilities.

As mentioned in choosing a method to run the Derby tools and startup utilities, you must set the DERBY_HOME environment variable so that you can use the command examples that are presented in this manual. Adding the Derby scripts directory to your command execution PATH makes the scripts easier to use and enables you to use the script examples in this manual. The CLASSPATH or MODULEPATH environment variable must be set if you are using Derby in a Java program or executing the tools using the java command.

The steps below show you how to set the environment variables in a command window. The settings are only valid for that window. If you close the command window or open a new command window, you must set the environment variables again.

**Tip:** You can also set environment variables permanently. For example, on Windows you can use the Control Panel to permanently set the environment variables.

To set the environment variables:

1. Set the DERBY_HOME environment variable to the location where you extracted the Derby bin distribution.
   
   For example, if you installed Derby in the `/opt/ Derby_10` directory on UNIX or in the `c:\ Derby_10` directory on Windows, use one of the commands in the following table to set the DERBY_HOME environment variable.

   **Table 2. Commands to set the DERBY_HOME environment variable**

2. Be certain that the java executable file, version 17 or higher, is in your command execution PATH. Open a command window and run the `java -version` command.

3. Add the `DERBY_HOME/bin` directory to the PATH environment variable so that you can run the Derby scripts from any directory, as shown in the following table.

   **Table 3. Commands to set the PATH environment variable**
### Syntax for the derbyrun.jar file

The `derbyrun.jar` file is a special JAR file that simplifies how you invoke the Derby tools and the Network Server.

With the `derbyrun.jar` file, you can run the Derby tools and utilities using shortened names and you do not need to set the Java CLASSPATH environment variable. The `derbyrun.jar` file must be in the same folder as the other Derby JAR files.

#### Syntax

The following table shows the syntax for using `derbyrun.jar` for each of the Derby tools.

**Table 4. Syntax for using `derbyrun.jar`**

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
</table>
| UNIX (Korn Shell) | `java -jar $DERBY_HOME/lib/derbyrun.jar ij [-p propertiesfile] [sql_script]`  
`java -jar $DERBY_HOME/lib/derbyrun.jar sysinfo [-cp ...] [-cp help]`  
`java -jar $DERBY_HOME/lib/derbyrun.jar dblook [arg]* (or no arguments for usage)`  
`java -jar $DERBY_HOME/lib/derbyrun.jar server [arg]* (or no arguments for usage)` |
| Windows          | `java -jar %DERBY_HOME%\lib\derbyrun.jar ij [-p propertiesfile] [sql_script]`  
`java -jar %DERBY_HOME%\lib\derbyrun.jar sysinfo [-cp ...] [-cp help]`  
`java -jar %DERBY_HOME%\lib\derbyrun.jar dblook [arg]* (or no arguments for usage)`  
`java -jar %DERBY_HOME%\lib\derbyrun.jar server [arg]* (or no arguments for usage)` |

To see this syntax reminder, run the command `java -jar derbyrun.jar` with no arguments.
Additional information

You cannot use the \(-cp\) argument or the CLASSPATH environment variable to set CLASSPATH variables when you are using the \(-jar\) argument to start the \(ij\) tool. If you want to run the \(ij\) tool with a custom classpath, you cannot use the \(-jar\) argument. Instead, you have to use the full class name to start the \(ij\) tool (\(java\ org.apache.derby.tools.ij\)). In addition, you cannot use any of the module-aware command line switches such as \(-p, -m,\) and \(--add-modules\).

See Manually setting the CLASSPATH/MODULEPATH environment variables for more information about setting up the classpath and running the \(ij\) tool.

There is no such limitation when you run the \(sysinfo\) tool. See Running \(sysinfo\) for more information on running the \(sysinfo\) tool.

The server argument is a shortcut for running the NetworkServerControl tool. For details on using this tool, see the Derby Server and Administration Guide.

For more information on using \(derbyrun.jar\) to run the \(ij\), \(sysinfo\), and \(dblook\) tools, see the Derby Tools and Utilities Guide.

Including \(derbyrun.jar\) in your CLASSPATH

Alternatively to using the \(derbyrun.jar\) jar file with the \(-jar\) argument, you can instead use the \(derbyrun.jar\) jar file with the \(-cp\) argument or in your CLASSPATH environment variable.

When you use this technique, adding the \(derbyrun.jar\) jar file to your CLASSPATH has the effect of including all of the Derby classes in your classpath. For more information on this use of \(derbyrun.jar\), see the Derby Server and Administration Guide.

Manually setting the CLASSPATH/MODULEPATH environment variables

You can set the CLASSPATH and MODULEPATH environment variables in the operating system either temporarily, permanently, or at run time when you start your Java application and the JVM.

The classpath is a list of the class libraries that are needed by the JVM and other Java applications to run your program. Similarly, the modulepath is a corresponding list of Java modules needed by your program. There are scripts that are included with Derby that can set up the classpath/modulepath to run the Derby tools.

If you want to call the Derby tools directly using Java and not using the scripts, you must manually set the CLASSPATH environment variable or manually declare a modulepath.

In most development environments, it is best to temporarily set these variables in the command line shell where you are entering commands.

Derby provides several scripts in the DERBY_HOME/bin directory to help you set your classpath/modulepath quickly. These scripts are:

- setEmbeddedCP
  Use the setEmbeddedCP script to set CLASSPATH and MODULEPATH when the database engine is used in embedded mode.

- setNetworkServerCP
  Use the setNetworkServerCP script to set CLASSPATH and MODULEPATH when you want to start the network server.

- setNetworkClientCP
  Use the setNetworkClientCP script to set CLASSPATH and MODULEPATH when you want to access databases using the network client.

To set the classpath and modulepath temporarily, run the script that is appropriate for your environment every time that you open a new command window.
Note that these scripts behave slightly differently on UNIX systems and on Windows systems. On Windows systems, running the script in your command shell will set the environment variables for your shell.

On UNIX systems, you need to use the "dot" or "source" command to ensure that the script is run in the calling shell's environment. Otherwise, when a script is run, it launches a new shell for that script. The CLASSPATH and MODULEPATH variables are set within that shell. Once the script is complete, that shell exits and you are returned to your shell. CLASSPATH/MODULEPATH are changed only for the shell that the script was running in. The CLASSPATH and MODULEPATH variables in your shell are unchanged.

The UNIX shell scripts are known to run successfully in the Bash shell, and you may need to modify them slightly if you are using a different UNIX shell.

Here are examples of running the scripts, then displaying the classpath that the script sets:

- On UNIX, using the "dot" command to invoke the script, a sample session might be as follows:

  bash-2.05b$ echo $CLASSPATH
  /derby/db-derby-10.X.Y.0-bin/lib/derbyshared.jar:/derby/db-derby-10.X.Y.0-bin/lib/derby.jar:/derby/db-derby-10.X.Y.0-bin/lib/derbytools.jar:/derby/db-derby-10.X.Y.0-bin/lib/derbyoptionaltools.jar:
  bash-2.05b$ java org.apache.derby.tools.ij
  ij version 10.X
  ij> quit;

- On UNIX, using the "source" command to invoke the script, a sample session might be as follows:

  -bash-2.05b$ echo $CLASSPATH
  -bash-2.05b$ export DERBY_HOME=/derby/db-derby-10.X.Y.0-bin
  -bash-2.05b$ source $DERBY_HOME/bin/setEmbeddedCP

- On Windows, a sample session might be as follows:

  C:\derby\db-derby-10.X.Y.0-bin\bin>echo %CLASSPATH%
  %CLASSPATH%
  C:\derby\db-derby-10.X.Y.0-bin\bin>set
  DERBY_HOME=C:\derby\db-derby-10.X.Y.0-bin
  C:\derby\db-derby-10.X.Y.0-bin\bin>setEmbeddedCP.bat
  C:\derby\DB-DBER-10.X.Y.0-bin\lib\derbyshared.jar;C:\derby\DB-DERBY-10.X.Y.0-bin\lib\derby.jar;C:\derby\DB-DBER-10.X.Y.0-bin\lib\derbytools.jar;C:\derby\DB-DBER-10.X.Y.0-bin\lib\derbyoptionaltools.jar;
  C:\derby\db-derby-10.X.Y.0-bin\bin>java org.apache.derby.tools.ij
  ij version 10.X
  ij> quit;

For more information on running the ij and sysinfo utilities, see the Derby Tools and Utilities Guide

Using the Derby tools and startup utilities

There are several tools and utilities that you might want to use as you begin to work with Derby.
The tools that are included with Derby are dblook, ij, and sysinfo. To run these tools see:

- Running sysinfo
- Running ij
- Running dblook

Derby includes a set of scripts that you can use to start these tools. In addition, there are scripts for booting the Network Server. The scripts are located in the DERBY_HOME/bin directory. When you run these scripts, your CLASSPATH environment variable is set if you have not already set it, and remains set as long as you are running the tool.

Most of the script examples in this guide assume that you are using the embedded mode of the Derby database engine. Use the instructions below to run the tools scripts with the Network Server.

**Running the scripts with the Network Server**

To run the scripts with the Network Server, use the following commands:

- For the sysinfo tool, issue the command

  \[\text{NetworkServerControl sysinfo}\]

- For the ij tool, issue the command

  \[\text{set DERBY_OPTS=-Dij.protocol=jdbc:derby://localhost/}\]
  \[\text{and then start ij by issuing the command ij.}\]

- For the dblook tool, call the script and specify the \(-d\) option and the full connection URL to the Network Server database. For example:

  \[\text{dblook -d 'jdbc:derby://localhost/myDB;user=usr'}\]

**Additional Derby utilities**

In addition, there are Derby utilities that are system procedures that you can call by using the ij tool. For example, there are system procedures that you can use to import and export external files. Instructions on how to use these system procedures are included in the *Derby Server and Administration Guide* and the *Derby Reference Manual*.

### Running sysinfo

The Derby sysinfo tool displays information about your Java environment and your version of Derby.

The sysinfo utility prints system information to a console.

Choose the method that you will use to run the sysinfo script. The methods are listed in the following table.

**Table 5. Methods of running the sysinfo utility**

<table>
<thead>
<tr>
<th>Method</th>
<th>When to Use</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run sysinfo as a standalone command.</td>
<td>Use this method if you are relatively new to the Java programming language and new to Derby.</td>
<td>Follow the steps in Setting the environment variables before you run the sysinfo utility using this method. To run the sysinfo script from the command line, use: sysinfo</td>
</tr>
</tbody>
</table>
## Getting Started with Derby

<table>
<thead>
<tr>
<th>Method</th>
<th>When to Use</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>The <code>sysinfo</code> script sets the appropriate environment variables, including the CLASSPATH, and runs the <code>sysinfo</code> utility.</td>
<td>Use this method if you are new to Derby, but are familiar with the Java programming language.</td>
<td>You must set the DERBY_HOME environment variable before you can run the <code>sysinfo</code> utility using this method.</td>
</tr>
<tr>
<td>Run <code>sysinfo</code> using the jar file that is located in the directory where <code>sysinfo</code> resides.</td>
<td>On UNIX, the command is: java [options] -jar $DERBY_HOME/lib/derbyrun.jar sysinfo</td>
<td>On Windows, the command is: java [options] -jar %DERBY_HOME%\lib\derbyrun.jar sysinfo</td>
</tr>
<tr>
<td>Run <code>sysinfo</code> using the <code>java</code> command.</td>
<td>Use this method if you are familiar with both the Java programming language and Derby, and you have already added the location of the java executable file to your command execution PATH.</td>
<td>You must set your CLASSPATH. Use the steps specified in Manually setting the CLASSPATH/MODULEPATH environment variables. Then specify the class name in the <code>java</code> command. For example: java org.apache.derby.tools.sysinfo</td>
</tr>
<tr>
<td>Run <code>sysinfo</code> using the <code>java</code> command with a modulepath.</td>
<td>Use this method if you are familiar with both the Java programming language and Derby, have already added the location of the java executable file to your command execution PATH, and expect to run Derby via a modulepath.</td>
<td>You must set your MODULEPATH variable. Use the steps specified in Manually setting the CLASSPATH/MODULEPATH environment variables. Then specify the tools module and the sysinfo class name in the <code>java</code> command. On UNIX, the command is: java -p $MODULEPATH \ -m org.apache.derby.tools.org.apache.derby.tools.sysinfo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>On Windows, the command is: java -p %MODULEPATH% \ -m org.apache.derby.tools.org.apache.derby.tools.sysinfo</td>
</tr>
</tbody>
</table>

See “sysinfo” in the *Derby Tools and Utilities Guide* for more information about using the `sysinfo` utility.

### Running ij

The Derby `ij` tool is a JDBC tool that you can use to run scripts or interactive queries against a Derby database.
• Choose the method that you will use to run the `ij` script. The methods are listed in the following table.

**Table 6. Methods of running the `ij` utility**

<table>
<thead>
<tr>
<th>Method</th>
<th>When to Use</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run <code>ij</code> as a standalone command.</td>
<td>Use this method if you are relatively new to the Java programming language and new to Derby.</td>
<td>Follow the steps in Setting the environment variables before you run the <code>ij</code> tool using this method. To run the <code>ij</code> script from the command line, use:&lt;br&gt;<code>ij</code>&lt;br&gt;You must add the <code>DERBY_HOME/bin</code> directory to your PATH environment variable before you can run the <code>ij</code> tool. The <code>ij</code> script sets the appropriate environment variables, including the CLASSPATH, and starts the <code>ij</code> tool.</td>
</tr>
<tr>
<td>Run <code>ij</code> using the jar file that is located in the directory where <code>ij</code> resides.</td>
<td>Use this method if you are new to Derby, but are familiar with the Java programming language.</td>
<td>You must set the <code>DERBY_HOME</code> environment variable before you can run the <code>ij</code> tool using this method. On UNIX, the command is:&lt;br&gt;<code>java -jar $DERBY_HOME/lib/derbyrun.jar ij</code>&lt;br&gt;On Windows, the command is:&lt;br&gt;<code>java -jar %DERBY_HOME%\lib\derbyrun.jar ij</code></td>
</tr>
<tr>
<td>Run <code>ij</code> using the <code>java</code> command.</td>
<td>Use this method if you are familiar with both the Java programming language and Derby, and you have already added the location of the <code>java</code> executable file to your command execution PATH.</td>
<td>You must set your CLASSPATH. Use the steps specified in Manually setting the CLASSPATH/MODULEPATH environment variables. Then specify the class name in the <code>java</code> command. For example:&lt;br&gt;<code>java org.apache.derby.tools.ij</code></td>
</tr>
<tr>
<td>Run <code>ij</code> using the <code>java</code> command with a modulepath.</td>
<td>Use this method if you are familiar with both the Java programming language and Derby, have already added the location of the <code>java</code> executable file to</td>
<td>You must set your MODULEPATH. Use the steps specified in Manually setting the CLASSPATH/MODULEPATH environment variables. Then specify the tools module and the <code>ij</code> class name in the <code>java</code> command. On UNIX, the command is:&lt;br&gt;<code>java -p $MODULEPATH </code></td>
</tr>
</tbody>
</table>
**Getting Started with Derby**

### Method

<table>
<thead>
<tr>
<th>When to Use</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use this method if you are relatively new to the Java programming language and new to Derby.</td>
<td>Follow the steps in Setting the environment variables before you run the dblook utility using this method.</td>
</tr>
<tr>
<td>Use this method if you are new to Derby, but are familiar with the Java programming language.</td>
<td>You must set the DERBY_HOME environment variable before you can run the dblook utility using this method.</td>
</tr>
<tr>
<td>Use this method if you are familiar with the Java programming language.</td>
<td>You must set your CLASSPATH. Use the steps specified in Manually setting the</td>
</tr>
</tbody>
</table>

- **Table 7. Methods of running the dblook utility**

**Running dblook**

The Derby dblook utility is a Data Definition Language (DDL) generation utility.

The dblook utility is a simple utility that dumps all or parts of the DDL of a user-specified database to either a console or a file. The generated DDL can then be used for such things as recreating all or parts of a database, viewing a subset of the objects in a database (for example, those objects that pertain to specific tables and schemas), or documenting the schema of a database.

Choose the method that you will use to run the dblook script. The methods are listed in the following table.

- When you are ready to leave the ij tool, type:

  `ij> exit;`

See the *Derby Tools and Utilities Guide* for more information about the ij tool.
Getting Started with Derby

<table>
<thead>
<tr>
<th>Method</th>
<th>When to Use</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>with both the Java programming language and Derby, and you have already added the location of the java executable file to your command execution PATH.</td>
<td>CLASSPATH/MODULEPATH environment variables. Then specify the class name in the java command. For example: java org.apache.derby.tools.dblook -d connectionURL [options]</td>
</tr>
<tr>
<td>Run dblook using the java command using a modulepath.</td>
<td>Use this method if you are familiar with both the Java programming language and Derby, have already added the location of the java executable file to your command execution PATH, and expect to run Derby with a modulepath.</td>
<td>You must set your MODULEPATH. Use the steps specified in Manually setting the CLASSPATH/MODULEPATH environment variables. Then specify the tools module and the dblook class name in the java command. On UNIX, the command is: java -p $MODULEPATH \ -m org.apache.derby.tools/ org.apache.derby.tools.dblook \ -d connectionURL [options] On Windows, the command is: java -p %MODULEPATH% ^ \ -m org.apache.derby.tools/ org.apache.derby.tools.dblook ^ \ -d connectionURL [options]</td>
</tr>
</tbody>
</table>

See Using the Derby tools and startup utilities for an example of the use of the connectionURL. See "dblook" and its subtopics in the Derby Tools and Utilities Guide for more information about using the dblook utility.

Verifying the Derby system configuration

You should confirm that your computer has the correct software installed and that the environment variables are set before you start working with Derby.

To check the Derby system configuration:

1. Verify that the java executable file, version 17 or higher, is in your command execution PATH by opening a command window and running the java -version command.

   The output from the command looks something like this:

   ```
   java version "9"
   Java(TM) SE Runtime Environment (build 9+181)
   Java HotSpot(TM) 64-Bit Server VM (build 9+181, mixed mode)
   ```

   The output you see might be different from what is shown here because the java -version command outputs vendor-specific information. If the command produces an error or the version listed is not 17 or higher, install a JDK before continuing.

2. Verify that the DERBY_HOME environment variable is set and points to the root directory of the Derby 10.16 installation. Open a command window and run the appropriate command for your system.
If you installed Derby in the /opt/Derby_10 directory on UNIX or the c:\Derby_10 directory on Windows, the command that you use and the expected output are shown in the following table.

**Table 8. Verifying the DERBY_HOME setting**

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td>echo $DERBY_HOME</td>
<td>/opt/Derby_10</td>
</tr>
<tr>
<td>Windows</td>
<td>echo %DERBY_HOME%</td>
<td>C:\Derby_10</td>
</tr>
</tbody>
</table>

If you receive an error or do not see the expected output, ensure that you have set the **DERBY_HOME** environment variable, as described in Setting the environment variables.

Note: You can also use the **sysinfo** utility to verify that the environment variables are set correctly. If the environment variables are set correctly, the **sysinfo** command displays information about your Java virtual machine (JVM) and the version of Derby that you have installed.
Self-study tutorial for users new to Derby

To help you get up and running with Derby as quickly as possible, this self-study guide highlights some of the more important features of Derby.

This tutorial uses a series of activities designed to demonstrate the use of Derby in the embedded and client/server configurations. After performing these activities, you will find Derby to be an easy-to-use and fully functional relational database management system (RDBMS).

**Tutorial skills and software requirements**

To perform the tutorial activities, you do not need to have any prior knowledge of Java software, the Java Database Connectivity (JDBC) API, or SQL. Each activity provides the complete command syntax that you need to use for each operation. Instructions include the syntax for both a UNIX Korn shell and a Windows command prompt.

This tutorial demonstrates, but does not teach, the Java, JDBC and SQL code that is presented. If you want a deeper understanding of these topics, you will need to consult additional reference materials.

To perform the tutorial activities, you must have:

- A Java Development Kit (JDK) version 17 or higher installed on your computer
- The binary (bin) installation of Apache Derby version 10.16 installed on your computer
- A basic knowledge of the computer command line interface:
  - How to start a command shell or window
  - How to navigate the file system hierarchy

**System configuration**

You should verify the system configuration before you perform the tutorial activities.

**Problems and feedback on the tutorial activities**

If you experience problems with any aspect of the tutorial activities, send an e-mail message to derby-user@db.apache.org. Someone from the Derby community will respond to your message.

The questions and feedback received will be used to make this tutorial more useful.

**Tutorial overview**

Each activity in this self-study tutorial highlights an important feature of Derby.

Here is what you can expect to learn in each activity:

**Activity 1:**

Use the Derby `ij` tool to load the Derby embedded driver and start the Derby database engine. Create the database `firstdb` and the table `FIRSTTABLE`. Use a few basic SQL statements to insert and select data. The Derby message log `derby.log` and the database directories and files are introduced.

**Activity 2:**

Use Derby within a client/server configuration. Start the Derby Network Server, which will embed the Derby engine. In a separate process, use the Derby `ij` tool to load the Derby client driver and connect to the Network Server. Create a database called `seconddb` and the table `SECONDTABLE`. Use a few basic SQL statements to insert and select data.

**Activity 3:**
Load the Derby database engine from a simple Java JDBC program. Use the embedded driver to create the database `jdbcDemoDB` and the `WISH_LIST` table. Populate the table with text entered from the keyboard, then view a list of the records in the table. Walk through the code to understand the basic structure of a JDBC program that accesses a Derby database. The `CLASSPATH` variable and connection URL attribute `;shutdown=true` are introduced.

**Activity 4:**
Modify the Java JDBC program to load the client driver and connect to the Derby Network Server. Compile the altered program and test that the program operates as it did in the previous activity.

**Activity 1: Run SQL using the embedded driver**

In this activity, you will use the embedded driver to load the Derby database engine, create and connect to a database, and use some basic SQL statements.

To run SQL using the embedded driver:
1. Create a directory and copy scripts into the directory
2. Create a Derby database and run SQL statements

**Creating a directory and copying scripts into the directory**

To help you complete this activity, you must create a directory and copy several scripts into the new directory. You will use these scripts to quickly add tables and data to a new Derby database.

**Tip:** A command prompt appears after each command is run. If an error occurs, verify the syntax and retype the command.
1. Open a command window and change to a directory where you want to store the files that you create during the self-study tutorial activities.
2. Create the `DERBYTUTOR` directory, as shown in the following table. `DERBYTUTOR` will be your working directory for this activity.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td><code>mkdir DERBYTUTOR</code></td>
</tr>
<tr>
<td>Windows</td>
<td><code>md DERBYTUTOR</code></td>
</tr>
</tbody>
</table>
3. Change to the `DERBYTUTOR` directory, as shown in the following table.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td><code>cd DERBYTUTOR</code></td>
</tr>
<tr>
<td>Windows</td>
<td><code>cd DERBYTUTOR</code></td>
</tr>
</tbody>
</table>
4. Copy the SQL scripts from the Derby `demo\programs\toursdb` subdirectory into the `DERBYTUTOR` directory, as shown in the following table. You will use these scripts to create tables and add data to a new database, `toursdb`.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td><code>cd DERBYTUTOR</code></td>
</tr>
<tr>
<td>Windows</td>
<td><code>cd DERBYTUTOR</code></td>
</tr>
</tbody>
</table>
Operating System | Command
--- | ---
UNIX (Korn Shell) | `cp $DERBY_HOME/demo/programs/toursdb/* .`
Windows | `copy %DERBY_HOME%/demo/programs/toursdb/* .`

> Important: Include the dot (.) at the end of the command so that the files are copied to the correct location.

5. Verify that the files were copied to the DERBYTUTOR directory, as shown in the following table.

**Table 12. Command to verify that the files were copied**

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td><code>ls</code></td>
</tr>
<tr>
<td>Windows</td>
<td><code>dir</code></td>
</tr>
</tbody>
</table>

Creating a Derby database and running SQL statements

Now, you will use the Derby *ij* tool to load the Derby database engine. You will use the Derby embedded driver to create and connect to the `firstdb` database. You will also use a few basic SQL statements to create and populate a table.

1. Run the Derby *ij* tool.

   If you included the `DERBY_HOME/bin` directory in your PATH environment variable, type:

   ```
   ij
   ```

   Otherwise, you can use the `java` command to start the *ij* tool, as shown in the following table.

   **Table 13. Command to start the *ij* tool**

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td><code>java -jar $DERBY_HOME/lib/derbyrun.jar ij</code></td>
</tr>
<tr>
<td></td>
<td><code>ij version 10.16</code></td>
</tr>
<tr>
<td>Windows</td>
<td><code>java -jar %DERBY_HOME%\lib\derbyrun.jar ij</code></td>
</tr>
<tr>
<td></td>
<td><code>ij version 10.16</code></td>
</tr>
</tbody>
</table>

2. Create the database and open a connection to the database using the embedded driver.

   ```
   CONNECT 'jdbc:derby:第一db;create=true';
   ```

   **Description of connection command:**

   - `connect`
     The *ij* command to establish a connection to a database. The Derby connection URL is enclosed in single quotation marks. An *ij* command can be in either uppercase or lowercase.
   - `jdbc:derby:`
     The JDBC protocol specification for the Derby driver.
   - `第一db`
     The Derby database name.
Getting Started with Derby

The name of the database. The name can be any string. Because no filepath is specified, the database is created in the default working directory (DERBYTUTOR).

;create=true

The Derby URL attribute that is used to create a database. Derby does not have an SQL create database command.

;

The semicolon is the ij command terminator.

3. Create a table with two columns using standard SQL.

```
CREATE TABLE FIRSTTABLE
(ID INT PRIMARY KEY,
 NAME VARCHAR(12));
```

0 rows inserted/updated/deleted

4. Insert three records.

```
INSERT INTO FIRSTTABLE VALUES
(10, 'TEN'), (20, 'TWENTY'), (30, 'THIRTY');
```

3 rows inserted/updated/deleted

5. Perform a simple select of all records in the table.

```
SELECT * FROM FIRSTTABLE;
```

<table>
<thead>
<tr>
<th>ID</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>TEN</td>
</tr>
<tr>
<td>20</td>
<td>TWENTY</td>
</tr>
<tr>
<td>30</td>
<td>THIRTY</td>
</tr>
</tbody>
</table>

3 rows selected

6. Perform a qualified select of the record with column ID=20.

```
SELECT * FROM FIRSTTABLE WHERE ID=20;
```

<table>
<thead>
<tr>
<th>ID</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>TWENTY</td>
</tr>
</tbody>
</table>

1 row selected

7. Optional: Create and populate additional tables and other schema objects.

a. Load the SQL script ToursDB_schema.sql.

```
run 'ToursDB_schema.sql';
ij> ...
CREATE TABLE AIRLINES
{
  AIRLINE CHAR(2) NOT NULL ,
  AIRLINE_FULL VARCHAR(24),
  BASIC_RATE DOUBLE PRECISION,
  ...
0 rows inserted/updated/deleted
... Other output messages not shown ...
```

b. Populate the tables with data by running the script loadTables.sql.

```
run 'loadTables.sql';
ij> run 'loadCOUNTRIES.sql';
ij> insert into COUNTRIES values ( 'Afghanistan','AF','Asia');
1 row inserted/updated/deleted
ij> insert into COUNTRIES values ( 'Albania','AL','Europe');
1 row inserted/updated/deleted
... Other output messages not shown ...
```

8. Exit the ij tool.

```
exit;
```
Getting Started with Derby

You should be returned to the DERBYTUTOR directory.

9. Browse the most important files created by this activity:

   • The derby.log file. This file is a message and error log that, under normal circumstances, contains a set of startup messages and a shutdown message.

   Wed Nov 28 09:52:36 PST 2018:
   Booting Derby version The Apache Software Foundation - Apache Derby - 10.15.0.0 alpha - (1847657M): instance a816c00e-0167-5b73-7c80-0000033b46b8 on database directory /Users/rhillegas/sw/z/activity1/DERBYTUTOR/firstdb with class loader jdk.internal.loader.ClassLoaders$AppClassLoader@4f8e5cde
   Loaded from file:/Users/rhillegas/sw/z/db-derby-10.15.0.0-bin/lib/derby.jar
   java.vendor=Oracle Corporation
   java.runtime.version=9+181
   user.dir=/Users/rhillegas/sw/z/activity1/DERBYTUTOR
   os.name=Mac OS X
   os.arch=x86_64
   os.version=10.11.6
   derby.system.home=null
   Database Class Loader started - derby.database.classpath=''
   ----------------------------------------------------------------
   ----------------------------------------------------------------
   Wed Nov 28 09:55:14 PST 2018:
   Shutting down instance a816c00e-0167-5b73-7c80-0000033b46b8 on database directory /Users/rhillegas/sw/z/activity1/DERBYTUTOR/firstdb with class loader jdk.internal.loader.ClassLoaders$AppClassLoader@4f8e5cde
   Database Class Loader started - derby.database.classpath=''

   • The firstdb database directory. Within the directory are the subdirectories seg0 (containing the data files) and log (containing the transaction log files).

Activity 2: Run SQL using the client driver

This activity uses Derby within a client/server configuration by using the Network Server. The ij tool is the client application that connects to the Derby Network Server. In this activity, you create a database called seconddb and run some basic SQL statements.

This activity assumes that you know how to open a command shell and change to the DERBYTUTOR directory.

You use two command windows (referred to as Shell-1 and Shell-2) in this activity. You use Shell-1 to start the Derby Network Server and display Network Server messages. You use Shell-2 to establish a client connection to the Network Server using ij and then perform some basic SQL operations.

1. Open a command window (Shell-1) and change to the DERBYTUTOR directory.
2. Start the Network Server, as shown in the following table.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td>java -jar $DERBY_HOME/lib/derbyrun.jar server start</td>
</tr>
<tr>
<td></td>
<td>Wed Nov 28 10:08:37 PST 2018 : Apache Derby Network Server - 10.15.0.0 alpha - (1847657M)</td>
</tr>
</tbody>
</table>
Getting Started with Derby

A Network Server startup message appears in the Shell-1 command window.

3. Open another command window (Shell-2). Change to the DERBYTUTOR directory.
4. Start ij.

If you included the DERBY_HOME/bin directory in your PATH environment variable, type:

ij

Otherwise, you can use the java command to start the ij tool, as shown in the following table.

Table 15. Command to start the ij tool

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td>java -jar $DERBY_HOME/lib/derbyrun.jar ij</td>
</tr>
<tr>
<td></td>
<td>ij version 10.16</td>
</tr>
<tr>
<td>Windows</td>
<td>java -jar %DERBY_HOME%\lib\derbyrun.jar ij</td>
</tr>
<tr>
<td></td>
<td>ij version 10.16</td>
</tr>
</tbody>
</table>

You will enter all subsequent commands from the network client, so you will type the commands in the Shell-2 command window.

5. Create and open a connection to the database using the client driver.

CONNECT 'jdbc:derby://localhost:1527/seconddb;create=true';

Remember: A client connection URL contains a hostname and a port number. For example: //localhost:1527/

6. Create a table with two columns (ID and NAME) using the following SQL statement:

CREATE TABLE SECONDTABLE
  (ID INT PRIMARY KEY,
   NAME VARCHAR(14));
0 rows inserted/updated/deleted

7. Insert three records into the table.

INSERT INTO SECONDTABLE VALUES
  (100,'ONE HUNDRED'),(200,'TWO HUNDRED'),(300,'THREE HUNDRED');
3 rows inserted/updated/deleted

8. Select all of the records in the table.

SELECT * FROM SECONDTABLE;
ID  | NAME
---|------
100 | ONE HUNDRED
200 | TWO HUNDRED
300 | THREE HUNDRED
3 rows selected
9. Select a subset of records from the table by specifying a `WHERE` clause.

```sql
SELECT * FROM SECONDTABLE WHERE ID=200;
```

<table>
<thead>
<tr>
<th>ID</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>TWO HUNDRED</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 row selected

10. Exit `ij`.

```sql
exit;
```

11. Shut down the Derby Network Server, as shown in the following table.

**Table 16. Command to shut down the Network Server**

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td><code>java -jar $DERBY_HOME/lib/derbyrun.jar server shutdown</code></td>
</tr>
<tr>
<td></td>
<td>Wed Nov 28 10:15:54 PST 2018 : Apache Derby Network Server - 10.15.0.0 alpha - (1847657M) shutdown</td>
</tr>
<tr>
<td>Windows</td>
<td><code>java -jar %DERBY_HOME%\lib\derbyrun.jar server shutdown</code></td>
</tr>
<tr>
<td></td>
<td>Wed Nov 28 10:15:54 PST 2018 : Apache Derby Network Server - 10.15.0.0 alpha - (1847657M) shutdown</td>
</tr>
</tbody>
</table>

The server shutdown confirmation appears in both command windows.

**Activity notes**

The client connection URL contains network information (hostname and portnumber) not found in the URL for an embedded connection. This information tells the client driver the location of the Network Server. The client driver sends requests to and receives responses from the Network Server.

In this activity the Derby database engine is embedded in the Network Server and returns data to the `ij` client (a client/server configuration). In contrast, establishing a connection using an embedded URL (one without `//localhost:1527/`) would have caused the Derby engine to be embedded in the `ij` application (an embedded configuration).

In this configuration, multiple client programs can connect to the Network Server and access the database simultaneously. (This activity does not demonstrate this capability.)

**Activity 3: Run a JDBC program using the embedded driver**

This activity loads the Derby database engine using a simple Java JDBC program.

This activity assumes that you have opened a command window and navigated to the `DERBYTUTOR` directory.

JDBC is the Java Database Connectivity API and is also the native API for Derby. The program uses the embedded driver to create the `jdbcDemoDB` database (if the database does not exist) and then connect to the database. You can then populate a table within the database with text. The program demonstrates some basic JDBC processing along with related error handling.

The Java compiler and runtime use the classpath, specified by the `CLASSPATH` environment variable, to locate the binary files (jar files and class files) that are needed.
Getting Started with Derby

to run Derby and other Java applications. Before performing this activity, you need to set
the classpath and compile the WwdEmbedded.java program.

1. Copy the program files into the DERBYTUTOR directory and set the CLASSPATH
environment variable, as shown in the following table.

**Table 17. Commands to copy the program files and set the CLASSPATH
environment variable**

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
</table>
| UNIX (Korn Shell)| `cp $DERBY_HOME/demo/programs/workingwithderby/* .`
|                  | `export CLASSPATH=$DERBY_HOME/lib/derby.jar:$DERBY_HOME/lib/derbyshared.jar:` |
| Windows          | `copy %DERBY_HOME%\demo\programs\workingwithderby\* .`
|                  | `set CLASSPATH=%DERBY_HOME%\lib\derby.jar;%DERBY_HOME%\lib\derbyshared.jar;` |

> **Important:** Include the dot (.) at the end of each command so that your current
working directory is included in the classpath and the files are copied to the correct
location.

2. Compile the program source files.

The sample program is contained in two source files: WwdEmbedded.java and
WwdUtils.java. Issue the following command to compile both at the same time:

```
javac WwdEmbedded.java WwdUtils.java
```

> **Important:** A command prompt appears if the compilation is successful. The
binary files WwdEmbedded.class and WwdUtils.class are created. If an error
message appears, verify that the JDK is properly installed.

3. Run the program.

The WwdEmbedded.java program populates a table with wish-list items. The
program prompts you for text input (up to 32 characters), stores the text input in a
database table, and then lists the items stored in the table. The program continues
to ask for wish-list items until you type the command exit or a problem is
encountered. Some basic information on program progress is displayed at the
beginning and the end of the program.

```
java WwdEmbedded
org.apache.derby.jdbc.EmbeddedDriver loaded.
Connected to database jdbcDemoDB
  . . . creating table WISH_LIST
Enter wish-list item (enter exit to end):
  a peppermint stick
On 2012-09-14 09:46:37.77 I wished for a peppermint stick

Enter wish-list item (enter exit to end):
  a long vacation
On 2012-09-14 09:46:37.77 I wished for a peppermint stick
On 2012-09-14 09:46:51.654 I wished for a long vacation

Enter wish-list item (enter exit to end):
  exit
Closed connection
Database shut down normally
```
The WwdEmbedded program

This section describes the WwdEmbedded.java program, highlighting details specific to accessing a Derby database from a JDBC program.

Most of the code related to the database activities performed is included in this section, but you might find it helpful to open the program file and follow along in a text viewer or editor. The SECTION NAMES referred to in this section can be found in the comments within the program code and serve as cross-reference points between this section and the Java program. The program uses methods from the WwdUtils class. The utility class code is not described here but is available for review in the file WwdUtils.java.

Initialize the program

INITIALIZATION SECTION: The initial lines of code identify the Java packages used in the program, then set up the Java class WwdEmbedded and the main method signature. Refer to a Java programming guide for information on these program constructs.

```java
import java.sql.*;

public class WwdEmbedded
{
    public static void main(String[] args)
    {
```

Define key variables and objects

DEFINE VARIABLES SECTION: The initial lines of the main method define the variables and objects used in the program. This example uses variables to store the information needed to connect to the Derby database. The use of variables for this information makes it easy to adapt the program to other configurations and other databases.

```java
driver  // Stores the name of the Derby embedded driver.
dbName  // Stores the name of the database.
connectionURL  // Stores the Derby connection URL that is used to access the database.
createString  // Stores the SQL CREATE statement for the WISH_LIST table.
```

Boot the database

BOOT DATABASE SECTION: The DriverManager class loads the embedded driver and connects to the database using the Derby connection URL stored in the variable connectionURL. This URL includes the parameter ;create=true so that the database will be created if it does not already exist. The primary try and catch block begins here. This construct handles errors for the database access code.

```java
String connectionURL = "jdbc:derby:" + dbName + ";create=true";

try {
    conn = DriverManager.getConnection(connectionURL);
```
Set up program to execute SQL

**INITIAL SQL SECTION:** The program initializes the objects needed to perform subsequent SQL operations and checks to see if the required data table exists.

The statement object `s` is initialized. If the utility method `WwdUtils.wwdChk4Table` does not find the `WISH_LIST` table, the statement object's `execute` method creates the table by executing the SQL stored in the variable `createString`.

```java
s = conn.createStatement();
if (! WwdUtils.wwdChk4Table(conn)) {
    System.out.println("... creating table WISH_LIST");
    s.execute(createString);
}
```

The `INSERT` statement used to add data to the table is bound to the prepared statement object `psInsert`. The prepared statement uses the question mark parameter `?` to represent the data that will be inserted by the user. The program sets the actual value to be inserted later on, before executing the SQL. This is the most efficient way to execute SQL statements that will be used multiple times.

```java
psInsert = conn.prepareStatement("insert into WISH_LIST(WISH_ITEM) values (?)");
```

Interact with the database

**ADD / DISPLAY RECORD SECTION:** This section uses the utility method `WwdUtils.getWishItem` to gather information from the user. It then uses the objects set up previously to insert the data into the `WISH_LIST` table and then display all records. A standard `do` loop causes the program to repeat this series of steps until the user types `exit`. The data-related activities performed in this section are as follows:

- The `setString` method sets the substitution parameter of the `psInsert` object to the value typed by the user. Then the `executeUpdate` method performs the database insert.

```java
psInsert.setString(1,answer);
psInsert.executeUpdate();
```

- The statement object `s` is used to select all the records in the `WISH_LIST` table and store them in the `ResultSet` named `myWishes`.

```java
myWishes = s.executeQuery("select ENTRY_DATE, WISH_ITEM from WISH_LIST order by ENTRY_DATE");
```

The `while` loop reads each record in turn by calling the `next` method. The `getTimestamp` and `getString` methods return specific fields in the record in the proper format. The fields are displayed using rudimentary formatting.

```java
while (myWishes.next()) {
    System.out.println("On " + myWishes.getTimestamp(1) + " I wished for " + myWishes.getString(2));
}
```

Close the `ResultSet` to release the memory being used.

```java
myWishes.close();
```

Shut down the database
DATABASE SHUTDOWN SECTION: If an application starts the Derby engine, the application should shut down all databases before exiting. The attribute \texttt{;shutdown=true} in the Derby connection URL performs the shutdown. When the Derby engine is shutdown, all booted databases will automatically shut down. The shutdown process cleans up records in the transaction log to ensure a faster startup the next time the database is booted.

**Tip:** You can shut down individual databases without shutting down the engine by including the database name in the connection URL.

"This section verifies that the embedded driver is being used, then issues the shutdown command and catches the shutdown exception to confirm that the Derby engine shut down cleanly. The shutdown status is displayed before the program exits.

```java
if (driver.equals("org.apache.derby.jdbc.EmbeddedDriver")) {
    boolean gotSQLException = false;
    try {
        DriverManager.getConnection("jdbc:derby:;shutdown=true");
    } catch (SQLException se) {
        if (se.getSQLState().equals("XJ015")) {
            gotSQLException = true;
        }
    }
    if (!gotSQLException) {
        System.out.println("Database did not shut down normally");
    } else {
        System.out.println("Database shut down normally");
    }
}

> Important: The XJ015 error (successful shutdown of the Derby engine) and the 08006 error (successful shutdown of a single database) are the only exceptions thrown by Derby that might indicate that an operation succeeded. All other exceptions indicate that an operation failed. You should check the log file to be certain.

Handle errors

The catch block at the end of the program calls the \texttt{Throwable.printStackTrace} method to display the chain of exceptions that are thrown if a problem occurs.

```java
// Beginning of the primary catch block: prints stack trace
} catch (Throwable e) {
    /* Catch all exceptions and pass them to 
     * the Throwable.printStackTrace method */
    System.out.println("... . . . exception thrown");
    e.printStackTrace(System.out);
}
```

To view the error output, type a wish-list item with more than 32 characters, such as I wish to see a Java program fail.

**Activity 4: Create and run a JDBC program using the client driver and Network Server**

This activity demonstrates the ease with which a program that embeds Derby can be modified for a client/server implementation that uses the Derby Network Server.

This activity assumes you have performed the preceding activities and have a working directory called \texttt{DERBYTUTOR}, and have copies of the program files from the \texttt{$DERBY_HOME/demo/programs/workingwithderby/} directory. A basic knowledge of the \texttt{WwdEmbedded.java} program and experience starting and connecting to the Network Server are helpful. You will need to use a text editor to create the \texttt{WwdClient.java} program.
Note: As a convenience, the workingwithderby directory contains a program, WwdClientExample.java, which has already been edited in the appropriate manner. You can use this program directly as it is, or you can compare the contents of this program to the WwdClient.java program that you will construct in this activity, to see how the changes are made.

You will create a Derby client program, WwdClient.java, by changing a few lines of the WwdEmbedded.java program. You can run the client program in multiple command shells, allowing simultaneous update from two or more sources.

You use two command windows (Server-Shell and Client-Shell) in this activity. You use the Server-Shell to start the Derby Network Server and display Network Server messages. You use the Client-Shell to edit, compile and run the newly created WwdClient.java program. You set the CLASSPATH environment variable in the Client-Shell to support the client JDBC program.

1. Create the WwdClient program using the following steps:
   a. Open a command window (Client-Shell).
   b. Change to the DERBYTUTOR directory.
   c. Make a copy of the WwdEmbedded.java program called WwdClient.java, as shown in the following table.

   Table 18. Command to copy the program

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td>cp WwdEmbedded.java WwdClient.java</td>
</tr>
<tr>
<td>Windows</td>
<td>copy WwdEmbedded.java WwdClient.java</td>
</tr>
</tbody>
</table>

   d. Open the WwdClient.java file in a text editor and update the class name to reflect the new file name:

   Original declaration
   
   public class WwdEmbedded

   New declaration
   
   public class WwdClient

   e. Edit the DEFINE VARIABLES SECTION of the program so that the driver variable contains the name of the Derby client driver class and the connectionURL variable contains the hostname and port number of the Network Server.

   Original definitions
   
   String driver = "org.apache.derby.jdbc.EmbeddedDriver";
   String dbName="jdbcDemoDB";
   String connectionURL = "jdbc:derby:" + dbName + ";create=true";

   New definitions
   
   String driver = "org.apache.derby.jdbc.ClientDriver";

   f. Compile the application.

   javac WwdClient.java

   A command prompt appears if the compilation is successful. The binary file WwdClient.class is created. If an error message appears, modify the line indicated so that it is identical to the example. (As noted above, you can compare the contents of your WwdClient.java against the
Getting Started with Derby

WwdClientExample.java program provided in the workingwithderby directory to verify that your editing was performed successfully.

2. Set up the client/server environment using the following steps:
   a. Open a command window (Server-Shell).
   b. Change to the DERBYTUTOR directory.
   c. Start the Network Server, as shown in the following table.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td>java -jar $DERBY_HOME/lib/derbyrun.jar server start</td>
</tr>
<tr>
<td></td>
<td>Wed Nov 28 13:21:39 PST 2018 : Apache Derby Network Server - 10.15.0.0 alpha - (1847657M) started and ready to accept connections on port 1527</td>
</tr>
<tr>
<td>Windows</td>
<td>java -jar %DERBY_HOME%lib\derbyrun.jar server start</td>
</tr>
<tr>
<td></td>
<td>Wed Nov 28 13:21:39 PST 2018 : Apache Derby Network Server - 10.15.0.0 alpha - (1847657M) started and ready to accept connections on port 1527</td>
</tr>
</tbody>
</table>

3. Run the client program using the following steps:
   a. Return to the Client-Shell window.
   b. Set the CLASSPATH environment variable to include the location of the file derbyclient.jar (not derby.jar as in the embedded example), as shown in the following table.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows</td>
<td>set CLASSPATH=%DERBY_HOME%lib\derbyclient.jar;%DERBY_HOME%lib\derbysquared.jar;%DERBY_HOME%lib\derbytools.jar; .</td>
</tr>
</tbody>
</table>

> Important: Include the dot (.) at the end of the command so that your current working directory is included in the classpath.

   c. Run the program:

   ```java
   java WwdClient
   Connected to database jdbcDemoDB
   Enter wish-list item (enter exit to end):
   a sunny day
   On 2012-09-14 09:46:37.77 I wished for a peppermint stick
   On 2012-09-14 09:46:51.654 I wished for a long vacation
   On 2012-09-14 09:56:36.6 I wished for a sunny day
   Enter wish-list item (enter exit to end):
   a new car
   On 2012-09-14 09:46:37.77 I wished for a peppermint stick
   On 2012-09-14 09:46:51.654 I wished for a long vacation
   On 2012-09-14 09:56:36.6 I wished for a sunny day
   ```
4. Shut down the Network Server, as shown in the following table.

**Table 21. Command to shut down the Network Server**

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX (Korn Shell)</td>
<td>java -jar $DERBY_HOME/lib/derbyrun.jar server shutdown</td>
</tr>
<tr>
<td>Windows</td>
<td>java -jar %DERBY_HOME%\lib\derbyrun.jar server shutdown</td>
</tr>
</tbody>
</table>

The server shutdown confirmation appears in both command windows.

**Activity notes**

In a client/server environment, the client program is often used from other computers on the network. Whenever a system accepts connections from other computers, there is a chance of abuse. To maintain security, the Derby Network Server defaults to accepting connections only from clients running on the local machine (localhost). Before this or any other Derby client program can access the Network Server from another machine, additional steps should be taken to secure the Network Server environment. Once secured, the Network Server can be safely configured to accept connections from other machines. Refer to the *Derby Security Guide* for important information on securing the Network Server and enabling network connections.

With the Network Server started, you can run the client program simultaneously in multiple windows. To demonstrate this, open two command windows and perform the substeps of the "Run the client program" step in each window. Both clients will operate without a problem. In contrast, it would not be possible for a program that uses the embedded driver (for example, WwdEmbedded.java) to access the database until the database or the Network Server is shut down.

You may have noticed that the client program does not shut down the database. This is because the database is a shared resource in a client/server environment and, in most cases, should be shut down only when the Network Server is shut down. If multiple clients are accessing the database and one client shuts down the database, the remaining clients will encounter a failure the next time they attempt an SQL command.

Derby’s two architectures have caused confusion for some new Derby users, who mistakenly think that embedded is a single-user configuration. This is not true. The embedded driver supports multiple simultaneous connections, performs locking, and provides performance, integrity, and recoverability. Any application that uses the embedded driver can open multiple Derby connections and then provide a means for multiple users to interact with the database on each connection. The Derby Network Server is an example of such an application.

**What next with Derby?**
Congratulations on completing the activities in this tutorial. You now have experience with using Derby in both the embedded and client/server architectures.

With this basic knowledge, you are ready to begin using Derby to address your own specific needs. To learn more about this lightweight and powerful tool, refer to the Derby documentation, described in Product documentation for Derby.

Also, take a few moments to become familiar with the many online resources available to Derby users and developers by browsing the Derby Web site at Apache as well as the Derby Wiki. Whether you are performing a general evaluation of Derby or have a specific need to address, these links are a good stepping stone to finding additional information of interest:

- The "Learning material and other references" section on the front page of the Derby Wiki provides links to tutorials and other useful materials.
- The Derby Quick Start page is a good reference page organized by area of interest.
- You will find that many content-rich areas, such as the Derby Users mailing list, are available to you.
- If you are interested in how others are using Derby, see the Uses of Derby page on the Wiki. This page contains informational links to development projects and products that use Derby. When you implement a system using Derby, please add it to this list.

Activities summary

We hope these activities have helped you understand the steps needed to create and access Derby databases. Although Derby is easy to set up and use, you will find that it has the features and reliability of much larger database systems. The examples presented here do not begin to scratch the surface of what can be done.
Quick start guide for experienced JDBC users

This section is for experienced JDBC programmers who already know how to set the classpath, how to run a Java program, and how to use a JDBC driver.

For more detailed information on the topics covered in this section, see the Derby Developer's Guide and the Derby Tools and Utilities Guide. See Product documentation for Derby for an overview of the Derby documentation.

Environments in which Derby can run

Before you configure your system to run Derby, it is useful to understand something about the different environments in which Derby can run, because these environments affect the classpath, driver name, and database connection URL.

See the Derby Developer's Guide for more information on Derby environments.

Embedded environment

An embedded environment is an environment in which only a single application can access a database at one time, and no network access occurs.

When an application starts an instance of Derby within its JVM, the application runs in an embedded environment. Loading the embedded driver starts Derby.

Client/server environment

A client/server environment is an environment in which multiple applications connect to Derby over the network.

Derby runs embedded in a server framework that allows multiple network connections. (The framework itself starts an instance of Derby and runs in an embedded environment. However, the client applications do not run in the embedded environment.)

You can also embed Derby in any Java server framework.

See the Derby Server and Administration Guide for more information on how to run Derby on a server.

Available drivers

Different JDBC drivers are available depending on the environment you choose for Derby.

- org.apache.derby.jdbc.EmbeddedDriver
  A driver for embedded environments, when Derby runs in the same JVM as the application.
- org.apache.derby.jdbc.ClientDriver
  A driver for the Network Server environment. The Network Server sets up a client/server environment.

Database connection URL

You must use a database connection URL when using the Derby-provided embedded driver to connect to a database.
The format for the database connection URL for connecting to a database is:

```text
cjdbc:derby:databaseName;URLAttributes
```

where:

- `databaseName`
The name of the database that you want to connect to
- `URLAttributes`
  One or more of the supported attributes of the database connection URL, such as `;territory=ll_CC` or `;create=true`.

For more information, see the *Derby Developer's Guide*.

For the network client driver that is provided by Derby, the format for the database connection URL for connecting to a database is this:

```text
cjdbc:derby://server[:port]/databaseName[;URLAttributes=value[;...]]
```

where the `server` and `port` specify the host name (or IP address) and port number where the server is listening for requests and `databaseName` is the name of the database you want to connect to. The `URLAttributes` can be either Derby embedded or network client attributes. See the *Derby Server and Administration Guide* for more information on accessing the Network Server by using the network client.
Documentation conventions

This section describes the terminology, syntax, and typographical conventions of the Derby documentation.

Terminology

The Derby documentation uses the specialized term environment to describe the method your application uses to interact with Derby.

An environment is sometimes referred to as a framework. The two types of environments are the embedded environment and the client/server environment.

SQL syntax

SQL syntax is presented in modified BNF notation.

The meta-symbols of BNF are listed in the following table.

**Table 22. BNF meta-symbols**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Or. Choose one of the items.</td>
</tr>
<tr>
<td>[ ]</td>
<td>Encloses optional items.</td>
</tr>
<tr>
<td>*</td>
<td>Flags items that you can repeat 0 or more times. Has a special meaning in some SQL statements.</td>
</tr>
<tr>
<td>( )</td>
<td>Groups required items so that they can be marked with the symbol</td>
</tr>
<tr>
<td>( ) ,</td>
<td>Other punctuation that is part of the syntax.</td>
</tr>
</tbody>
</table>

The following example shows how SQL syntax is presented:

```
CREATE [ UNIQUE ] INDEX indexName
    ON tableName ( simpleColumnName [ , simpleColumnName ]* )
```

Command-line syntax for running Java programs and utilities (as well as examples) always begins with the command java:

```
java org.apache.derby.tools.ij
```

This documentation attempts to be JVM neutral, but any command line examples or syntax using JVM specific references should be verified with your JVM documentation.

Typographical conventions

This documentation uses some typographical conventions to highlight elements of the SQL language, operating system commands, and the Java programming language.

The following table lists the typographical conventions used in the Derby documentation.

**Table 23. Derby typographical conventions**
<table>
<thead>
<tr>
<th>Usage</th>
<th>Typeface</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>New terms</td>
<td>Italic</td>
<td>defined by keys</td>
</tr>
<tr>
<td>File and directory names</td>
<td>Italic</td>
<td>C:\derby</td>
</tr>
<tr>
<td>Dictionary objects</td>
<td>Italic</td>
<td>The Employees table</td>
</tr>
<tr>
<td>In syntax, items that you do not type</td>
<td>Italic</td>
<td>CREATE TABLE tableName</td>
</tr>
<tr>
<td>exactly as they appear, but replace with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the appropriate name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQL examples</td>
<td>Bold and/or fixed-width</td>
<td>SELECT city_name FROM Cities</td>
</tr>
<tr>
<td>Java application examples</td>
<td>Bold and/or fixed-width</td>
<td>Connection conn = DriverManager.getConnection(&quot;jdbc:derby:Sample&quot;)</td>
</tr>
<tr>
<td>Things you type in a command prompt</td>
<td>Bold and/or fixed-width</td>
<td>java org.apache.derby.tools.ij</td>
</tr>
<tr>
<td>Comments within examples</td>
<td>Bold and/or fixed-width</td>
<td>--This line ignored</td>
</tr>
<tr>
<td>SQL keywords (commands)</td>
<td>All caps</td>
<td>You can use a CREATE TABLE statement</td>
</tr>
</tbody>
</table>
Derby libraries and scripts: complete reference

This section describes Derby libraries and scripts.

Libraries provided by Derby

This section shows the different libraries (modules) used by Derby and their purposes.

The following table shows the Derby shared library. This module is required by all Derby configurations.

Table 24. Engine library

<table>
<thead>
<tr>
<th>Library Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>derbyshared.jar</td>
<td>This module is required by all configurations, regardless of whether you are running an embedded engine, a network server, a remote client, or the database tools.</td>
</tr>
</tbody>
</table>

The following table shows the Derby engine library.

Table 25. Engine library

<table>
<thead>
<tr>
<th>Library Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>derby.jar</td>
<td>For embedded databases. You always need this library for embedded environments. For client/server environments, you only need this library on the server.</td>
</tr>
</tbody>
</table>

For embedded environments, you need another module in the classpath/modulepath in order to use the tools. For a client/server environment, you need that library on the client only. The following table shows the tools module.

Table 26. Tools libraries

<table>
<thead>
<tr>
<th>Library Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>derbytools.jar</td>
<td>Required for running all the Derby tools (such as ij, dblook, and import/export). This module is also required if you are running a network server. This module is also required if your application directly references the JDBC drivers.</td>
</tr>
<tr>
<td>derbyrun.jar</td>
<td>Executable jar file that can be used to start the Derby tools.</td>
</tr>
</tbody>
</table>

The following table shows the Derby Network Server library. You need this module as well as the shared, engine, and tools modules.

Table 27. Network Server library

<table>
<thead>
<tr>
<th>Library Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>derbynet.jar</td>
<td>Required to start the Derby Network Server.</td>
</tr>
</tbody>
</table>
The following table shows the Derby network client library.

**Table 28. Network client library**

<table>
<thead>
<tr>
<th>Library Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>derbyclient.jar</td>
<td>Required to use the Derby network client driver.</td>
</tr>
</tbody>
</table>

The following table shows the Derby locale libraries.

**Table 29. Locale libraries**

<table>
<thead>
<tr>
<th>Library Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>derbyLocale_cs.jar</td>
<td>Required to provide translated messages for the Czech locale.</td>
</tr>
<tr>
<td>derbyLocale_de_DE.jar</td>
<td>Required to provide translated messages for the German locale.</td>
</tr>
<tr>
<td>derbyLocale_es.jar</td>
<td>Required to provide translated messages for the Spanish locale.</td>
</tr>
<tr>
<td>derbyLocale_fr.jar</td>
<td>Required to provide translated messages for the French locale.</td>
</tr>
<tr>
<td>derbyLocale_hu.jar</td>
<td>Required to provide translated messages for the Hungarian locale.</td>
</tr>
<tr>
<td>derbyLocale_it.jar</td>
<td>Required to provide translated messages for the Italian locale.</td>
</tr>
<tr>
<td>derbyLocale_ja_JP.jar</td>
<td>Required to provide translated messages for the Japanese locale.</td>
</tr>
<tr>
<td>derbyLocale_ko_KR.jar</td>
<td>Required to provide translated messages for the Korean locale.</td>
</tr>
<tr>
<td>derbyLocale_pl.jar</td>
<td>Required to provide translated messages for the Polish locale.</td>
</tr>
<tr>
<td>derbyLocale_pt_BR.jar</td>
<td>Required to provide translated messages for the Brazilian Portuguese locale.</td>
</tr>
<tr>
<td>derbyLocale_ru.jar</td>
<td>Required to provide translated messages for the Russian locale.</td>
</tr>
<tr>
<td>derbyLocale_zh_CN.jar</td>
<td>Required to provide translated messages for the Simplified Chinese locale.</td>
</tr>
<tr>
<td>derbyLocale_zh_TW.jar</td>
<td>Required to provide translated messages for the Traditional Chinese locale.</td>
</tr>
</tbody>
</table>

To summarize, the following table shows the libraries (modules) which are required for each Derby configuration.

**Table 30. Required libraries**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Required modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote client</td>
<td>derbyclient.jar, derbyshared.jar</td>
</tr>
<tr>
<td>Embedded engine</td>
<td>derby.jar, derbyshared.jar</td>
</tr>
</tbody>
</table>
### Scripts included with Derby

Derby includes scripts that start the Derby tools, add the appropriate libraries to the CLASSPATH, and start and stop the Network Server. These scripts available only when you download the bin distribution of Derby.

The Derby scripts are located in the /bin directory where you installed Derby. To run the scripts, you need to set several environment variables so that the scripts run correctly. See Setting the environment variables to set the environment variables.

You must run the Derby scripts in an appropriate command line environment, such as a Windows command prompt or a UNIX shell.

The complete list of scripts that are included with Derby is:

- **bin/dblook**
  - Runs the dblook tool.
- **bin/ij**
  - Starts the ij tool.
- **bin/NetworkServerControl**
  - Runs NetworkServerControl.
- **bin/setEmbeddedCP**
  - Puts all of the Derby libraries for an embedded environment in the CLASSPATH.
- **bin/setNetworkClientCP**
  - Puts the libraries needed to connect to the Derby Network Server into the CLASSPATH.
- **bin/setNetworkServerCP**
  - Puts the libraries needed to start the Derby Network Server into the CLASSPATH.
- **bin/startNetworkServer**
  - Starts the Network Server on the local machine.
- **bin/stopNetworkServer**
  - Stops the Network Server on the local machine.
- **bin/sysinfo**
  - Runs the sysinfo tool.
Trademarks

The following terms are trademarks or registered trademarks of other companies and have been used in at least one of the documents in the Apache Derby documentation library:

Cloudscape, DB2, DB2 Universal Database, DRDA, and IBM are trademarks of International Business Machines Corporation in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

Oracle and Java are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Other company, product, or service names may be trademarks or service marks of others.