Dr. DeeBee® ODBC Driver Kit (Gold Edition)

Overview

The Dr. DeeBee ODBC Driver Kit (Gold Edition) contains the complete C/C++ source code for a fully functional ODBC 3.0 driver (Level 2 API, minimum+ SQL grammar). Programmers can modify this source code to provide ODBC access their own proprietary databases.

The source code provides a complete ODBC driver implementation. The driver has the following limitations:

- Only minimum level SQL is supported, with some additional core level SQL functionality. See Appendix A for the SQL grammar supported.
- Some level 2 ODBC API calls that are not commonly used are not supported. In particular, SQLBrowseConnect, SQLTablePrivileges, SQLColumnPrivileges, SQLProcedures, and SQLProcedureColumns are not supported.
- Column and table names are not case-sensitive (this can easily be changed). String data comparisons are case sensitive.
- Interval types are not supported.
- Qualifiers or owners are not allowed on databases, tables, etc.
- There is limited query optimization.

In the source code provided, simple dBASE files (dBASE files without indexes or memos) are used as the underlying database. All dBASE specific code is isolated to two modules: ISAM.C and DBASE.C.

Our initial testing shows that this driver will work with off-the-shelf applications such as Access, Visual Basic, PowerBuilder, MFC, Visual C/C++, etc. If you encounter problems, please let us know.

New Features in the Gold Edition

This release adds the following new features to the Silver Edition:

- ODBC 3.0 compliance.
- Scrollable cursors.
- The code can be compiled on UNIX (GNU compiler, Sun OS 4.1.1)
- BETWEEN operator.
- SELECT TABLE.*.
- SELECT COUNT(FIELD).

See Appendix B for notes on how to migrate from the Silver Edition to the Gold Edition.

What You Need

In addition to the Dr. DeeBee ODBC Driver Kit (Gold Edition), you will need the following to build and distribute your ODBC driver:

- A C/C++ compiler such as Microsoft Visual C++.
- The ODBC SDK. The ODBC SDK is available directly from Microsoft as part of MSDN Level 2. Call Microsoft at 1-800-759-5474 or 1-206-882-8080 for more information. At the time of this writing, the ODBC SDK was also posted on the Microsoft web site at http://www.microsoft.com/data/odbc/download/.

It is assumed that the user has working knowledge of what ODBC is, the ODBC API, how to use ODBC, etc. Recommended reading in these areas is:

- *Windows Multi-DBMS Programming*; Ken North; John Wiley & Sons; 1995
- *Inside ODBC*; Kyle Geiger; MS Press; expected June 1995
- *The ODBC Solution*; Robert Signore, John Creamer, Micheal O. Stegman; McGraw-Hill; 1995
- *Microsoft ODBC 2.0 Programmer's Reference and SDK Guide*; Microsoft Press; 1994

SYWARE Support

Included with your purchase is one hour of telephone support at 617-497-1300. Additional telephone support is available on a fee-per-event basis. Questions can also be E-mailed to support@syware.com.

If you find bugs or have other feedback, we welcome your comments. Please E-mail them to support@syware.com.

Installing the Dr. DeeBee ODBC Driver Kit (Gold Edition)

WARNING:
If you are installing over a previous version of the kit, backup any old installation of the kit before installing. The installation overwrites everything in any previous installation without making any backup files.

To install the Dr. DeeBee ODBC Driver Kit (Gold Edition), do the following:

- Install your C compiler.
- Install the ODBC SDK.
- Put the installation disk in drive A: and run SETUP.EXE.

Once installed, you will see the following:

C:\DRDBDR	- Your installation directory (the default)
C:\DRDBDR\SOURCE	- ODBC driver source code (for Windows)
C:\DRDBDR\SOURCE\INSTALL	- Source code for 32-bit Windows installer components
C:\DRDBDR\UNIX	- ODBC driver source code (for UNIX)
C:\DRDBDR\SETUP	- 16-bit ODBC driver DLL and installer
C:\DRDBDR\SETUP32	- 32-bit ODBC driver DLL and installer

C:\DRDBDR\SETUP\DRDBDR.DLL is a 16-bit compiled version of the source code found in C:\DRDBDR\SOURCE. C:\DRDBDR\SETUP32\DRDBDR32.DLL is a 32-bit compiled version of the source code found in C:\DRDBDR\SOURCE.

Getting Started

You will probably want to start by rewriting ISAM.C to read and write data from your database (rather than dBASE files). Once this is done, you will have an ODBC driver for your DBMS or file format with the same limitations specified in the Overview section above. See Appendix C for a suggested strategy on how to implement ISAM.C.

After this is done, you can add functionality to your driver by modifying the rest of the code.

Distributing Your Driver

Except for DRDBDR.DLL and the files in the SETUP32 directory; none of the components in the Dr. DeeBee ODBC Driver Kit (Gold Edition) are redistributable. The driver you create using the kit (in the form of a DLL) is redistributable royalty-free in most cases. See your license (Appendix D) for more details.

If you copy C:\DRDBDR\SETUP*.* to a diskette, you will have a setup disk that will load the 16-bit Dr. DeeBee ODBC Sample Driver. If you copy C:\DRDBDR\SETUP32*.* to a diskette, you will have a setup disk that will load the 32-bit Dr. DeeBee ODBC Sample Driver. However, your license agreements with SYWARE only allows you to redistribute

DRDBDR.DLL and C:\DRDBDR\SETUP32*.*. Your right to redistribute the other components in C:\DRDBDR\SETUP can be obtained from your ODBC SDK license.

To create a setup disk for your 16-bit driver, do the following:

- Delete C:\DRDBDR\SETUP\DRDBDR.DLL.
- Copy your DLL into C:\DRDBDR\SETUP.
- Edit C:\DRDBDR\SETUP\ODBC.INF as follows:
  - In the section [Dr. DeeBee Sample Driver 16], change DRDBDR.DLL to the name of your DLL, change 1998-06-12 to the date on your DLL, and change 262352 to the size of your DLL.
  - Search for "Dr. DeeBee" elsewhere in the ODBC.INF and make the appropriate changes.

To create a setup disk for your 32-bit driver, do the following:

- Delete C:\DRDBDR\SETUP32\DRDBDR32.DLL.
- Copy your DLL into C:\DRDBDR\SETUP32.
- Edit C:\DRDBDR\SETUP32\ODBCLOAD.INI as appropriate.

Using C++

The kit, as installed, assumes C (not C++) compiles. If your underlying database API happens to be C++, you might want to compile the driver kit as C++. The code was written such that it will compile either way. All you have to do is change the module names from *.C to *.CPP. Two batch files (C_TO_CPP.BAT and CPP_TO_C.BAT) are provided for this purpose.

ODBC 2.x versus ODBC 3.0

If you are building a 16-bit driver, it must be ODBC 2.x compliant (ODBC 3.0 is not supported on 16-bit platforms). If you are building a 32-bit driver, the Dr. DeeBee ODBC Driver Kit (Gold Edition) will build a single driver (a single DLL) that can be used with either ODBC 2.x or ODBC 3.0.

For 16-bit drivers, the supplied makefiles will create an ODBC 2.x driver.

For 32-bit drivers, the supplied makefiles will create a hybrid ODBC 3.0/ODBC 2.x driver. Whether your driver behaves like ODBC 2.x or ODBC 3.0 depends on which ODBC Driver Manager (ODBC32.DLL) is calling it. If ODBC32.DLL is 3.0 or later, the behave like a ODBC 3.0 driver. Otherwise it will behave like an ODBC 2.x driver.

UNIX ODBC Drivers

The code in C:\DRDBDR\UNIX can be compiled on UNIX systems (GNU compiler, Sun OS 4.1.1). Once you have your driver, you need to do one of two things: make it visible to one of the proprietary UNIX ODBC Driver Managers available from third parties or link the code in directly with the application that is to use the driver. Since third part ODBC Driver Manager's are proprietarty, instructions on how to make your driver visible to the Driver Manager can only be obtained from the provider of the Driver Manager.

ODBC Data Types

The Dr. DeeBee ODBC Driver Kit (Gold Edition) can support any of the ODBC data types (SQL_CHAR, SQL_INTEGER, etc.) except the interval types. The data types your driver will support depends on your underlying database. As installed, the Dr. DeeBee ODBC Driver Kit (Gold Edition) supports the dBase data types (SQL_BIT, SQL_CHAR, SQL_DATE, and SQL_DECIMAL).

There is a table of types in SQLTYPE.C, one entry for each ODBC datatype. Specify which types your driver supports by modifying this table. If your underlying database does not support one of the ODBC datatypes in this table, **do not remove the entry from this table**. Instead, just set the value of the 'supported' element in the structure to FALSE.

If your database has two datatypes that you want to map onto the same ODBC type (this happens sometimes, you'll know when it does), add extra entries to the table. Just make sure that the "more general" entry for any given ODBC data type comes first.

See the comments in SQLTYPE.C for more details.

Sorting

Sorting is used to implement the ORDER BY and GROUP BY clauses of a SELECT statement. The Dr. DeeBee ODBC Driver Kit (Gold Edition) sorts in two ways: pushdown sorts and upper-level sorts.

The pushdown sort is implemented by pushing the sorting functionality down to the ISAM layer. If the upper layers of the system determine that a pushdown sort can be used, it calls ISAMSort(). If the ISAM layer can implement the sort, the ISAM layer returns a status of NO_ISAM_ERR and a pushdown sort is done.

If the upper layers of the system determine that a pushdown sort cannot be used, or if an ISAMSort() call of a pushdown sort returns a status other then NO_ISAM_ERR, an upper-level sort is done.

Use of Indexes

To solve a query, the upper levels of the system opens a table and retrieves the records in the table. For each record retrieved, it tests the selection criteria specified and filters out the records that do not meet the criteria. This filtering can be pushed down to the ISAM layer. When this is done, the query would take less time to execute since fewer records would have to be processed by the upper levels.

This section describes this pushdown mechanism in general terms. For details, see the documentation of ISAM.H (in particular, ISAMOpenTable(), ISAMRestrict(), ISAMNextRecord(), and the declaration of COLUMNDEF).

When the upper levels of the system calls the ISAM layer to open a table, the ISAM layer returns the name and type of each of the columns. In addition to this information, the ISAM layer also returns the selectivity of each column. The selectivity is an indication of how selective the column is (for example, RECORD_ID would be very selective, NAME would be moderately selective, ZIPCODE would not be very selective).

When the upper levels of the system receives a query, it walks the predicate to find the selective clauses (based on the selectivity specified when the table was opened). After the upper levels of the system open the table, but before any records are retrieved from the table, it passes these clauses down to the ISAM layer to tell the ISAM layer "you only need to return records that satisfy this criteria". It then starts to retrieve the records from the ISAM layer. A typical ISAM implementation will use its indexes to decide which records should returned.

For example, suppose the query is:

```
SELECT * FROM ORDERS, ITEMS WHERE ORDER.ID = ITEM.ORDERID
```

the tables are:

```
      ORDERS                    ITEMS
NAME        ID          ORDERID     ITEM
--------          --          -----------     ------
FRED        77          77          MILK
BILL        99          77          CHEESE
                        99          EGGS
```

Also assume that the selectivity of ITEMS.ORDERID (as return by ISAMOpenTable()) is non-zero.

In this case, the system would generate the following sequence of ISAM calls:

```
ISAMOpenTable(ORDERS)
ISAMOpenTable(ITEMS)
ISAMRewind(ORDERS)
  ISAMNextRecord(ORDERS) (which positions to FRED's record)
    ISAMRestrict(ITEMS, ORDERID == 77)
    ISAMRewind(ITEMS)
      ISAMNextRecord(ITEMS) (which positions to the MILK record)
      ISAMNextRecord(ITEMS) (which positions to the CHEESE record)
      ISAMNextRecord(ITEMS) (which returns end-of-file)
  ISAMNextRecord(ORDERS) (which positions to BILL's record)
    ISAMRestrict(ITEMS, ORDERID == 99)
    ISAMRewind(ITEMS)
      ISAMNextRecord(ITEMS) (which positions to the EGGS record)
      ISAMNextRecord(ITEMS) (which returns end-of-file)
  ISAMNextRecord(ORDERS) (which returns end-of-file)
ISAMCloseTable(ORDERS)
ISAMCloseTable(ITEMS)
```

Transactions

Transactions are supported to the extent they are supported by the underlying database. For example, if you were building a driver for a true relational engine (such as Oracle or SQL Server), the transaction mechanism implemented by the engine could be used to implement transactions in the driver. On the other hand, if you were building a driver for simple text files, transactions would not be supported since regular file input/output does not support transaction operations such as commit or rollback.

Exposing the underlying database's transaction capabilities is relatively straight forward. Initially, you specify the transaction capabilities of your underlying system. There are a variety of options ranging from "transactions are not supported" to "full transaction support". If you specify that transactions are supported, they are initiated implicitly by calls to ISAM layer. The ISAM layer receives explicit calls to commit or rollback a transaction.

Transactions are described in detail in ISAM.H.

Passthrough SQL

Before an SQL query is processed by the upper levels of the system, it is first passed to ISAMPrepare(). This gives the ISAM layer the option of passing it to a SQL backend or having the upper levels of the system process it.

ISAMPrepare() responds in one of three ways:

1. It indicates that the upper levels of the system should process the query.

2. It indicates that the query will be processed by the backend and no result set will be returned (for example, an INSERT statement).

3. It indicates that the query will be processed by the backend and a result set will be returned (for example, a SELECT statement).

If a result set is returned, it is returned like any other table. The ISAMPrepare() call returns the name of this virtual table. The upper level of the system will process a "SELECT * FROM <virtual-table>" to retrieve the values.

After ISAMPrepare() is called, ISAMExecute() is called to actually run the query. ISAMExecute() may be called several times after a single call to ISAMPrepare(). When the upper levels of the system no longer needs the query, ISAMFreeStatement() is called.

The SQL prepared by ISAMPrepare() can contain parameters, and these parameters are specified by ISAMParameter() calls that are made after the call to ISAMPrepare() but before the ISAMExecute().

The sample code shows two simple examples of passthrough SQL. The first processes the query "SQL" by returning a table with one column and two rows. The second processes the query "MessageBox(?,?)" by putting up a message box whose content and title are specified by parameters one and two (respectively).

Architecture

The architecture of the source codes is shown in the following diagram:

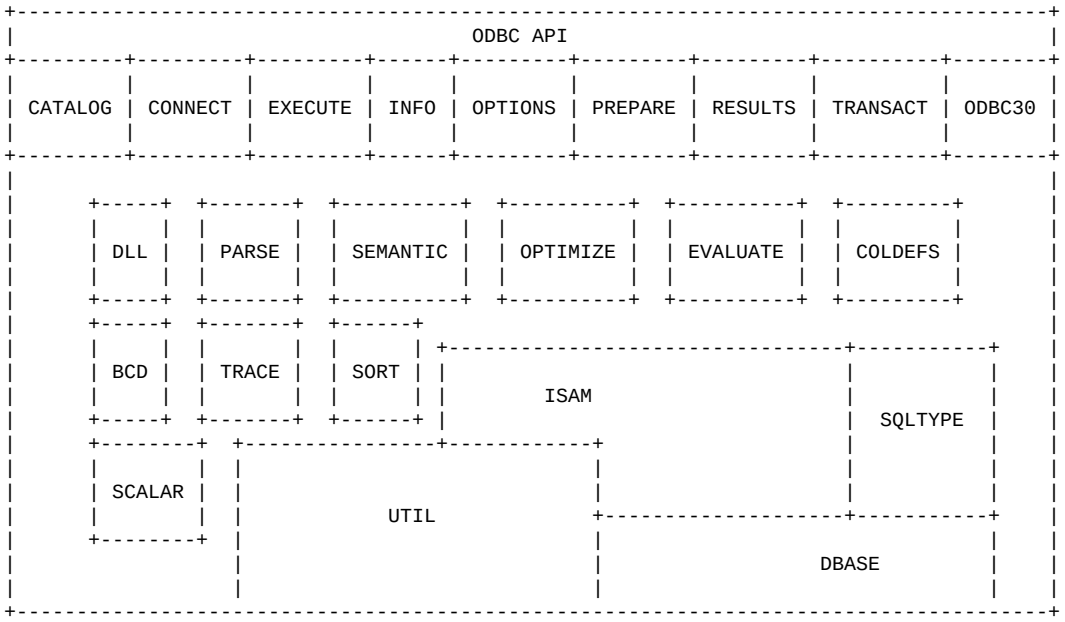

Figure 1: Source Code Architecture

The modules are:

CATALOG.C - ODBC entry points for catalog functions:

- SQLTables
- SQLColumns
- SQLStatistics
- SQLTablePrivileges
- SQLColumnPrivileges
- SQLSpecialColumns
- SQLPrimaryKeys
- SQLForeignKeys
- SQLProcedures
- SQLProcedureColumns

CONNECT.C - ODBC entry points for database connection functions:

- SQLAllocEnv
- SQLAllocConnect
- SQLConnect
- SQLDriverConnect
- SQLBrowseConnect

SQLDisconnect
SQLFreeConnect
SQLFreeEnv

EXECUTE.C - ODBC entry points for SQL execution functions:

SQLExecute
SQLExecDirect
SQLNativeSql
SQLParamData
SQLPutData
SQLCancel

INFO.C - ODBC entry points for informational functions:

SQLGetInfo
SQLGetTypeInfo
SQLGetFunctions

OPTIONS.C - ODBC entry points for connection and statement option functions:

SQLSetConnectOption
SQLSetStmtOption
SQLGetConnectOption
SQLGetStmtOption

PREPARE.C - ODBC entry points for query preparation setup functions:

SQLAllocStmt
SQLFreeStmt
SQLPrepare
SQLBindParameter
SQLDescribeParam
SQLParamOptions
SQLNumParams
SQLSetScrollOptions
SQLSetCursorName
SQLGetCursorName

RESULTS.C - ODBC entry points for result retrieval functions:

SQLNumResultCols
SQLDescribeCol
SQLColAttributes
SQLBindCol
SQLFetch
SQLGetData
SQLMoreResults

SQLRowCount
SQLSetPos
SQLExtendedFetch
SQLError

TRANSACT.C - ODBC entry points for transaction functions:
SQLTransact

ODBC30.C - ODBC entry points for ODBC30 functions:
SQLAllocHandle
SQLBulkOperations
SQLCloseCursor
SQLColAttribute
SQLCopyDesc
SQLEndTran
SQLFetchScroll
SQLFreeHandle
SQLGetConnectAttr
SQLGetDescField
SQLGetDescRec
SQLGetDiagField
SQLGetDiagRec
SQLGetEnvAttr
SQLGetStmtAttr
SQLSetConnectAttr
SQLSetDescField
SQLSetDescRec
SQLSetEnvAttr
SQLSetStmtAttr

SORT.C - Sorting operations.

DLL.C - LibMain, etc.

PARSE.C - Parses SQL statement (as a text string) and creates a parse tree. This module implements a recursive descent parser for SQL.

SEMANTIC.C - Check a parse tree for semantic correctness. This module also contains a routine to display parse trees on the debug monitor.

OPTIMIZE.C - Query optimizer. Currently the only optimization done is to find restrictions on tables to cut down the search space.

EVALUATE.C - Evaluates SQL expressions and executes SQL statements.

COLDEFS.C - This module contains the definition of the columns returned by the virtual tables returned by the catalog functions and SQLGetTypeInfo(). It is unlikely you will ever need to modify these.

SQLTYPE.C - Definition of the SQL types supported by the driver. As installed, the Dr. DeeBee ODBC Driver Kit (Gold Edition) supports SQL_BIT, SQL_CHAR, SQL_DATE, and SQL_DECIMAL. If you want your driver to support other types, modify the entries in the tables in this module. See the comments in SQLTYPE.C.

BCD.C- Operations to compare, negate, add, subtract, multiply, and divide Binary Coded Decimal values.

SCALAR.C- Implementation of scalar functions.

ISAM.C - Low level record access interface. The majority of the work needed to access data in a format other than dBASE is done in this module. The driver writer is expected to provide the implementation of the following routines (as documented in ISAM.H):

ISAMOpen
ISAMGetTableList
ISAMGetNextTableName
ISAMFreeTableList
ISAMForeignKeys
ISAMCreateTable
ISAMAddColumn
ISAMCreateIndex
ISAMDeleteIndex
ISAMOpenTable
ISAMRewind
ISAMSort
ISAMRestrict
ISAMNextRecord
ISAMGetData
ISAMPutData
ISAMInsertRecord
ISAMUpdateRecord
ISAMDeleteRecord
ISAMGetBookmark
ISAMPosition
ISAMCloseTable
ISAMDeleteTable

ISAMPrepare
ISAMParameter
ISAMExecute
ISAMFreeStatement
ISAMClose
ISAMSetTxnInfo
ISAMCommitTxn
ISAMRollbackTxn
ISAMGetErrorMessage
ISAMGetColumnType
ISAMCaseSensitive
ISAMName
ISAMVersion
ISAMDriver
ISAMMaxTableNameLength
ISAMMaxColumnNameLength
ISAMUser
ISAMDatabase

UTIL.C - Utility functions:

CharToDouble - Converts strings to doubles
CharToDate - Converts strings to dates
CharToTime - Converts strings to times
CharToTimestamp - Converts strings to timestamps
DoubleToChar - Converts doubles to strings
DateToChar - Converts dates to strings
TimeToChar - Converts times to strings
TimestampToChar - Converts timestamps to strings
ReturnString - Copies strings and their length
ReturnStringD - Copies strings and their length
ConvertSqlToC - Converts data from one type to another
PatternMatch - Wildcard pattern matching
TrueSize - Determines size of a string

DBASE.C - Routines to read and write records in dBASE files. This module is only used by ISAM.C.

TRACE.C - Tracing facilities. To enable tracing, set ISAM_TRACE to TRUE in UTIL.H (not TRACE.H), delete all your .OBJ and .PCH files, and recompile. Setting ISAM_TRACE to TRUE will trace every ISAM.C call. The output is sent to the debug window (DBWIN.EXE).

Tips and Tricks

The following tips and tricks will make your development easier:

1. Before modifying ISAM.C or any other modules, create a project (see Appendix C for a list of files your project should include) and recompile the system. This will allow you find problems in your development environment independently of bugs you might enter into the code.

2. Run SETUP.EXE in C:\DRDBDR\SETUP or C:\DRDBDR\SETUP32 to install the driver and create a datasource (MYSOURCE) using the driver. When creating the new datasource, be sure to use the "Database" edit control to specify the name of the directory that holds the .DBF files.

   Once you do this, redirect the MYSOURCE datasource to use the DLL created by your compiler rather than the one in the Windows system directory. To do this...

   ...in Windows 3.x - Using a text editor, such as NOTEPAD, edit C:\WINDOWS\ODBC.INI. Look for the [MYSOURCE] section and change the <file> designated by the "Driver=<file>" keyword/value pair to specify the complete pathname of the .DLL file created by your compilation.

   ...in Windows NT/Win95 - Using the registry editor change the value of /HKEY_CURRENT_USER/Software/ODBC/ODBC.INI/MYSOURCE/Driver to specify the complete pathname of the .DLL file created by your compilation.

   Once you do this, you will not have to reinstall after each compilation of your driver, since the MYSOURCE datasource will always be pointing at the DLL just created.

3. If you are using Microsoft Visual C++ to create a 16-bit driver, set "Calling Program" under Options | Debug to be C:\ODBCSDK\BIN\ODBCTEST.EXE. You can then set breakpoints in your driver, and run (DEBUG | GO).

4. If you are using Microsoft Visual C++ to create a 32-bit driver, set the executable to use when running under the debugger to C:\ODBCSDK\BIN32\ODBCTE32.EXE. You can then set breakpoints in your driver, and run (DEBUG | GO).

5. You can easily generate a trace of the calls to ISAM.C by setting the ISAM_TRACE flag to TRUE and recompiling. This flag is declared in UTIL.H.

Appendix A: SQL Grammar supported

(Grammar that is new in the Gold Edition is in **boldface**)

statement ::= CREATE create | DROP drop | SELECT select orderby | INSERT insert |
DELETE delete | UPDATE update | passthroughSQL

passthroughSQL ::= any statement supported by the backend

create ::= TABLE tablename (createcols) |
INDEX indexname ON tablename (indexcolumns)

indexcolumns ::= indexcolumn | indexcolumn , indexcolumns

indexcolumn ::= columnname asc

createcols ::= createcol , createcols | createcol

createcol ::= columnname datatype | columnname datatype (integer) |
columnname datatype (integer , integer)

drop ::= TABLE tablename | INDEX indexname

select ::= selectcols FROM tablelist where groupby having

delete ::= FROM tablename where

insert ::= INTO tablename insertvals

update ::= tablename SET setlist where

setlist ::= set | setlist , set

set ::= columnname = NULL | columnname = expression

insertvals ::= (columnlist) VALUES (valuelist) | VALUES (valuelist) |
(columnlist) VALUES (SELECT select) |
VALUES (SELECT select)

columnlist ::= columnname , columnlist | columnname

valuelist ::= NULL , valuelist | expression , valuelist | expression | NULL

selectcols ::= selectallcols * | selectallcols selectlist

selectallcols ::= | ALL | DISTINCT

selectlist ::= selectlistitem , selectlist | selectlistitem

selectlistitem ::= expression | expression aliasname | expression AS aliasname |
aliasname . *

where ::= | WHERE boolean

having ::= | HAVING boolean

boolean ::= and | and OR boolean

and ::= not | not AND and

not ::= comparison | NOT comparison

comparison ::= (boolean) | colref IS NULL | colref IS NOT NULL |
expression LIKE pattern | expression NOT LIKE pattern |
expression IN (valuelist) | expression NOT IN (valuelist) |
expression op expression | EXISTS (SELECT select) |
expression op selectop (SELECT select) |
expression IN (SELECT select) |
expression NOT IN (SELECT select) |
expression BETWEEN expression AND expression |
expression NOT BETWEEN expression AND expression

selectop ::= | ALL | ANY

op ::= > | >= | < | <= | = | <>

pattern ::= string | ? | USER

expression ::= expression + times | expression - times | times

times ::= times * neg | times / neg | neg

neg ::= term | + term | - term

term ::= (expression) | colref | simpleterm | aggterm | scalar

scalar ::= scalarescape | scalarshorthand

scalarescape ::= --*(VENDOR(MICROSOFT),PRODUCT(ODBC) FN fn)*--

scalarshorthand ::= { FN fn }

fn ::= functionname (valuelist) | functionname ( ) |
POSITION (expression IN expression) |
EXTRACT (expression FROM expression)

aggterm ::= COUNT (*) | AVG (expression) | MAX (expression) |
MIN (expression) | SUM (expression) | **COUNT (expression)**

simpleterm ::= string | realnumber | ? | USER | date | time | timestamp

groupby ::= | GROUP BY groupbyterms

groupbyterms ::= colref | colref , groupbyterms

orderby ::= | ORDER BY orderbyterms

orderbyterms ::= orderbyterm | orderbyterm , orderbyterms

orderbyterm ::= colref asc | integer asc

asc ::= | ASC | DESC

colref ::= aliasname . columnname | columnname

tablelist ::= tablelistitem , tablelist | tablelistitem

tablelistitem ::= tableref | outerjoin

outerjoin ::= ojescape | ojshorthand

ojescape ::= --*(VENDOR(MICROSOFT),PRODUCT(ODBC) OJ oj)*--

ojshorthand ::= { OJ oj }

oj := tableref LEFT OUTER JOIN tableref ON boolean |
tableref LEFT OUTER JOIN oj ON boolean

tableref ::= tablename | tablename aliasname

indexname ::= identifier

functionname ::= identifier

tablename ::= identifier

datatype ::= identifier

columnname ::= identifier

aliasname ::= identifier

identifier ::= an identifier (identifiers containing spaces must be enclosed in double quotes)

string ::= a string (enclosed in single quotes)

realnumber ::= a non-negative real number (including E notation)

integer ::= a non-negative integer

date ::= dateescape | dateshorthand

dateescape ::= --*(VENDOR(MICROSOFT),PRODUCT(ODBC) d dateval)*--

dateshorthand ::= { d dateval }

dateval ::= a date in yyyy-mm-dd format in single quotes (for example, '1996-02-05')

time ::= timeescape | timeshorthand

timeescape ::= --*(VENDOR(MICROSOFT),PRODUCT(ODBC) t timeval)*--

timeshorthand ::= { t timeval }

timeval ::= a time in hh:mm:ss format in single quotes (for example, '10:19:48')

timestamp ::= timestampescape | timestampshorthand

timestampescape ::= --*(VENDOR(MICROSOFT),PRODUCT(ODBC) ts timestampval)*--

timestampshorthand ::= { ts timestampval }

timestampval ::= a timestamp in yyyy-mm-dd hh:mm:ss[.ffffff] format in single quotes
(for example, '1996-02-05 10:19:48.529')

Appendix B: Migrating from the Silver Edition to the Gold Edition

If you implemented your old driver by only modifying ISAM.C and DBASE.C, for the most part, the ISAM.C and DBASE.C you implemented for the Silver Edition can be used with only minor chages in the Gold Edition. If you modified any other code you will have to re-implement those changes.

In ISAM.C there are four changes you must make:

1. szDefault has been added to ISAMCOLUMNDEF.

   This field specifies the default value used when inserting records into the table.

   Note: To preserve the semantics of the Silver edition, set this value to "NULL" (without the quotes).

2. The first argument of the PatternMatch() routine in UTIL.H has been chnaged from a boolean to a character.

   If it is '\0' there is no escape character for pattern matching. Otherwise, it is the escape character to use when pattern matching. For backward compatibility, if this character is TRUE, '\\' is used.

   Note: To preserve the semantics of the Silver edition, set this value to '\\' (if it was TRUE) or '\0' (if it was FALSE).

3. ISAMForeignKey has an added argument: lpfDeferrability.

   Set this to the applicable deferrability (see the documentation in ISAM.H).

   Note: To preserve the semantics of the SIlver edition, set this value to a -1.

4. ISAMExecute has an added parameter: lpfFunctionCode.

   Set this to indicate the type of SQL statement just executed (use one of the SQL_DIAG_* codes in SQL.H).

   Note: To preserve the semantics of the Silver edition, set this value to SQL_DIAG_UNKNOWN_STATEMENT.

Appendix C: Implementation Strategy for ISAM.C

The first thing you want to do is create a project to build your driver with. If you happen to be building a 16-bit driver using Microsoft Visual C/C++ 1.5, you can use the DRDBDR.MAK file provided. If you happen to be building a 32-bit driver using Microsoft Visual C/C++ 2.0, 3.0, 4.0, or 5.0 you can use the DRDBDR32.MAK file provided. Otherwise you will have to build your own project containing the following files (a sample makefile for UNIX builds is provided):

BCD.C	SCALAR.C	SCALAR.H
CATALOG.C	SEMANTIC.C	SEMANTIC.H
COLDEFS.C	SETUP.C	SQLTYPE.H
CONNECT.C	SORT.C	TRACE.H
DBASE.C	SQLTYPE.C	UNIXDEFS.H
DLL.C	TRACE.C	UNIXINCL.H
DRDBDR.C	TRANSACT.C	UNIXSQL.H
EVALUATE.C	UTIL.C	UTIL.H
EXECUTE.C		
INFO.C	BCD.H	DRDBDR.RC
ISAM.C	DBASE.H	DRDB.ICO
ODBC30.C	DRDBDR.H	
OPTIMIZE.C	EVALUATE.H	ODBCINST.LIB (if 16-bit)
OPTIONS.C	ISAM.H	ODBCCP32.LIB (if 32-bit)
PARSE.C	ODBC30.H	
PREPARE.C	OPTIMIZE.H	DRDBDR.DEF (if 16-bit)
RESULTS.C	PARSE.H	DRDBDR32.DEF (if 32-bit)

Once your project is set up, it is suggested that you use the following code...test...code...test...code...test strategy when rewriting ISAM.C to connect to your database. On windows based systems, the testing can be done using ODBC Test (from the ODBC SDK). On UNIX systems, the testing canbe done by compiling and running the code in ISAMTEXT.C. The testing assumes that there is a table called EMP with a column called NAME and a column called SALARY:

Step 1: Connecting:

Code: ISAMOpen()
ISAMClose()
ISAMGetErrorMessage()

Test: Connect | Full Connect
Connect | Full Disconnect

Note: For now, disable transactions by setting fTxnCapable in LPISAM to SQL_TC_NONE.

Step 2: Get driver description:

Code: ISAMCaseSensitive()
ISAMMaxColumnNameLength()
ISAMMaxTableNameLength()
ISAMName()
ISAMVersion()
ISAMDriver()
ISAMUser()
ISAMDatabase()

Test: Connect | Full Connect
Connect | SQLGetInfo(SQL_IDENTIFIER_CASE)
Connect | SQLGetInfo(SQL_MAX_COLUMN_NAME_LEN)
Connect | SQLGetInfo(SQL_MAX_TABLE_NAME_LEN)
Connect | SQLGetInfo(SQL_DBMS_NAME)
Connect | SQLGetInfo(SQL_DBMS_VER)
Connect | SQLGetInfo(SQL_DRIVER_NAME)
Connect | SQLGetInfo(SQL_USER_NAME)
Connect | SQLGetInfo(SQL_DATABASE_NAME)
Connect | Full Disconnect

Step 3: List of tables:

Code: ISAMGetTableList()
ISAMGetNextTableName()
ISAMFreeTableList()

Test: Connect | Full Connect
Catalog | SQLTables
Results | GetDataAll
Connect | Full Disconnect

Step 4: List of columns for a table:

Code: ISAMOpenTable()
ISAMCloseTable()

Test: Connect | Full Connect
Catalog | SQLColumns(EMP)
Results | GetDataAll

Connect | Full Disconnect

Step 5: Simple select:

Code: ISAMRewind()
ISAMNextRecord()
ISAMGetData()

Test: Connect | Full Connect
Statement | SQLExecDirect("select * from EMP")
Results | GetDataAll
Connect | Full Disconnect

Step 6: Select with restriction:

Code: ISAMRestrict()

Test: Connect | Full Connect
Statement | SQLExecDirect("select * from EMP where NAME = 'FRED'")
Results | GetDataAll
Connect | Full Disconnect

Note: ISAMRestrict() will only be called if ISAMTableOpen() returns a non-zero value for fSelectivity for the NAME column.

Step 7: Select with ORDER BY clause using an upper-level sort:

Code: ISAMGetBookmark()
ISAMPosition()

Test: Connect | Full Connect
Statement | SQLExecDirect("select * from EMP order by NAME")
Results | GetDataAll
Connect | Full Disconnect

Note: Supress pushdown sorts by implementing ISAMSort() as:

```
if (count != 0)
    return ISAM_NOTSUPPORTED;
else
    return NO_ISAM_ERR;
```

Step 8: Select with ORDER BY clause using a pushdown sort:

Code: ISAMSort()

Test: Connect | Full Connect
Statement | SQLExecDirect("select * from EMP order by NAME")
Results | GetDataAll
Connect | Full Disconnect

Step 9: Modifying data:

Code: ISAMPutData()
ISAMUpdateRecord()

Test: Connect | Full Connect
Statement | SQLExecDirect("update EMP set SALARY = 20000")
Connect | Full Disconnect

Step 10: Inserting records:

Code: ISAMInsertRecord()

Test: Connect | Full Connect
Statement | SQLExecDirect(
"insert into EMP(NAME, SALARY) values ('CRAIG', 20000)")
Connect | Full Disconnect

Step 11: Deleting records:

Code: ISAMDeleteRecord()

Test: Connect | Full Connect
Statement | SQLExecDirect("delete from EMP where NAME ='CRAIG'")
Connect | Full Disconnect

Step 12: Creating a table:

Code: ISAMCreateTable()

ISAMAddColumn()

Test: Connect | Full Connect
Statement | SQLExecDirect(
"create table EMP2(NAME CHAR(10), SALARY DECIMAL(14,2))")
Connect | Full Disconnect

Step 13: Deleting a table:

Code: ISAMDeleteTable()

Test: Connect | Full Connect
Statement | SQLExecDirect("drop table EMP2")
Connect | Full Disconnect

Step 14: Passthrough SQL:

Code: ISAMPrepare()
ISAMParameter()
ISAMExecute()
ISAMFreeStatement()

Test: Connect | Full Connect
Statement | SQLExecDirect(<<SQL to be passed to the back end >>)
If the query returns a result set: Results | GetDataAll
Connect | Full Disconnect

Step 15: Creating an index:

Code: ISAMCreateIndex()

Test: Connect | Full Connect
Statement | SQLExecDirect("create index EMPINDEX on EMP(NAME)")
Connect | Full Disconnect

Step 16: Deleting an index:

Code: ISAMDeleteIndex()

Test: Connect | Full Connect
Statement | SQLExecDirect("drop index EMPINDEX")
Connect | Full Disconnect

Step 17: Foreign Keys:

Code: ISAMForeignKey()

Test: Connect | Full Connect
Catalog | SQLForeignKeys(EMP)
Results | GetDataAll
Connect | Full Disconnect

Step 18: Transactions:

Code: ISAMSetTxnIsolation()
ISAMCommitTxn()
ISAMRollbackTxn()

Test: Connect | Full Connect
Statement | SQLExecDirect(
"insert into EMP(NAME, SALARY) values ('CRAIG', 20000)")
If you are using the ODBC 3 SDK:
Environment | SQLEndTran(SQL_ROLLBACK)
If you are using the ODBC 2 SDK:
Misc | SQLTransact(SQL_ROLLBACK)
Connect | Full Disconnect

Note: Don't forget to enable transactions by setting fTxnCapable in LPISAM to something other than SQL_TC_NONE.

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Dr. DeeBee ODBC Driver Kit (Gold Edition)

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