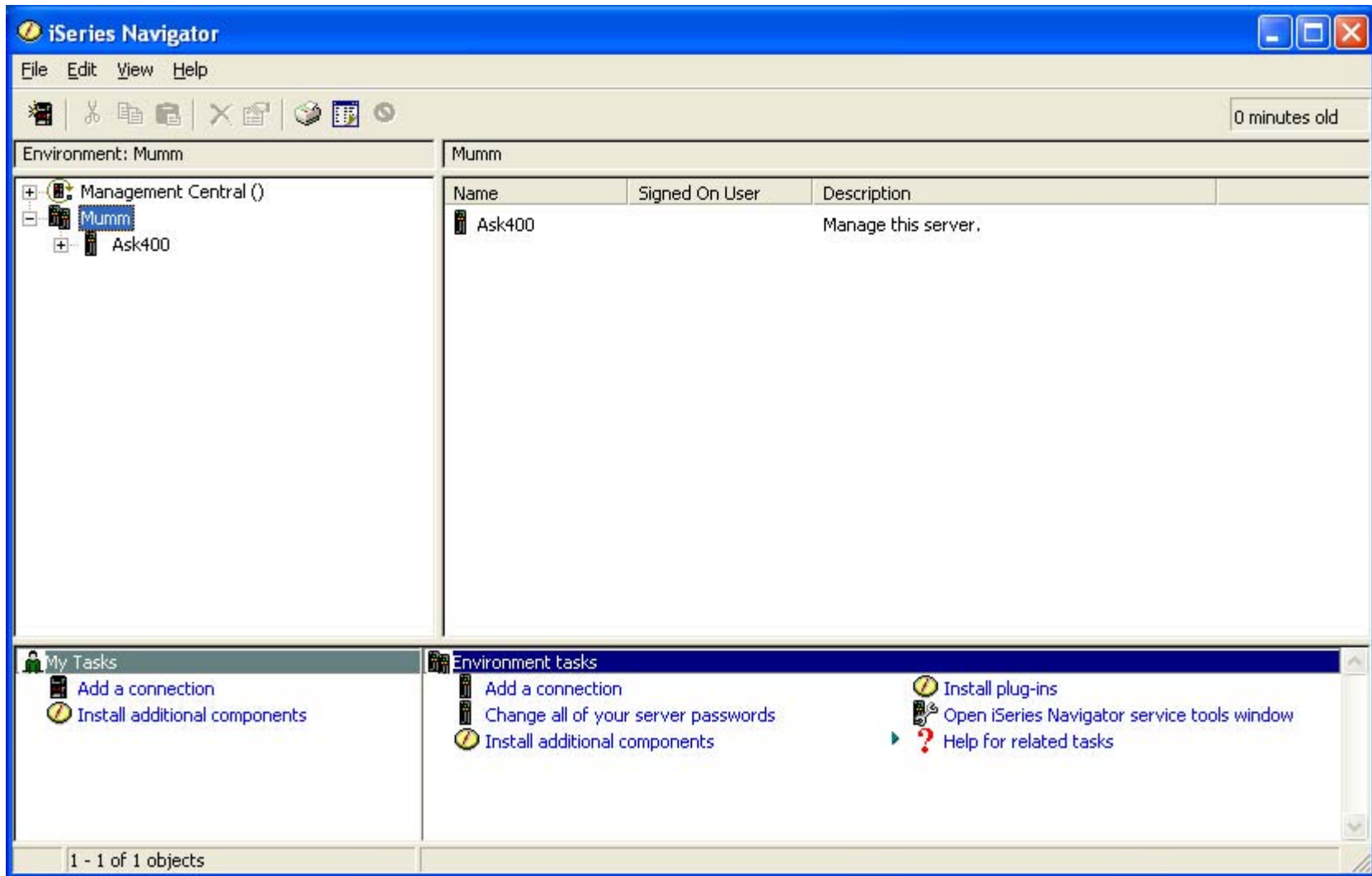


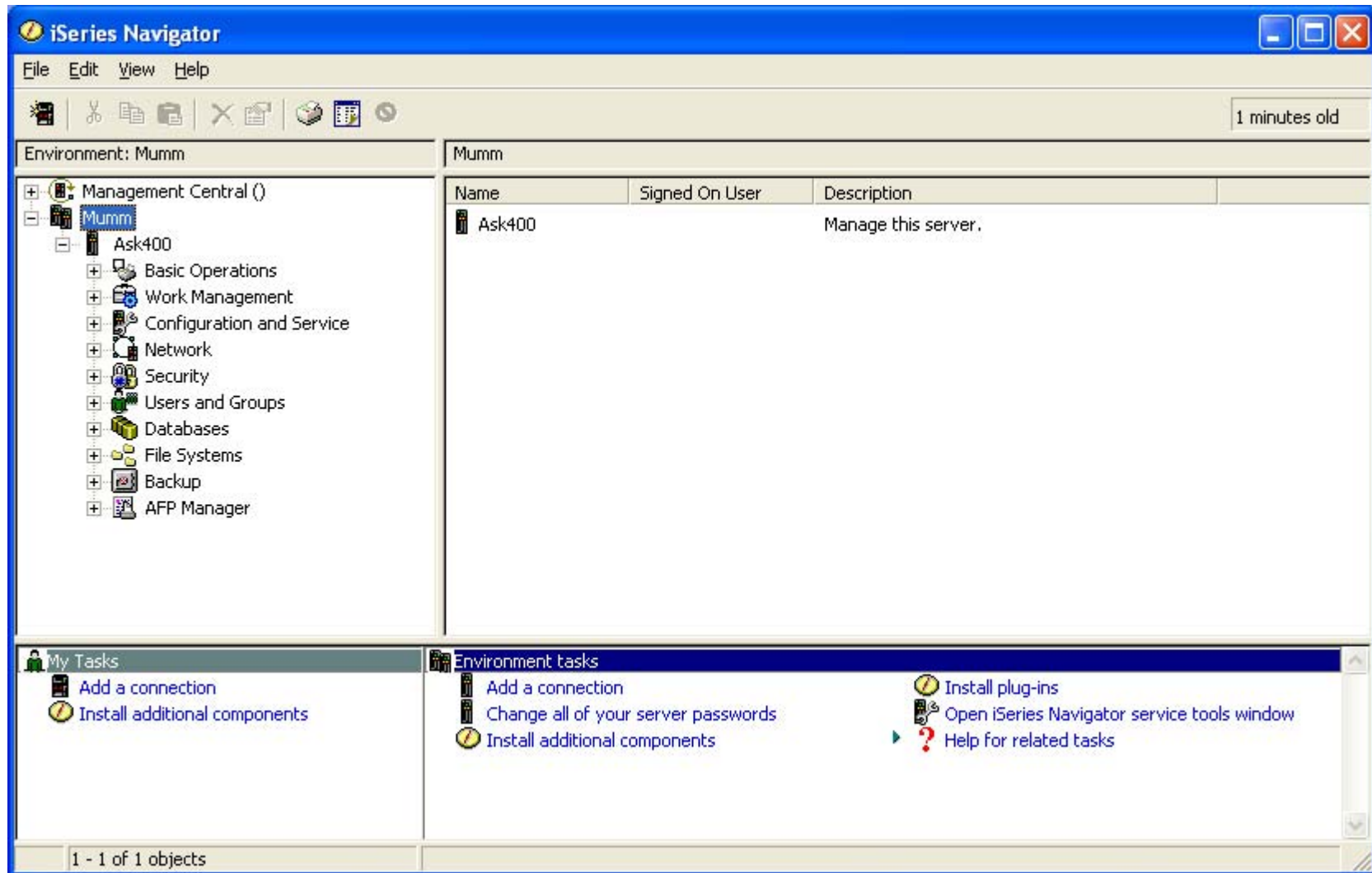
# iSeries Navigator and Database Functions

Start iSeries Navigator

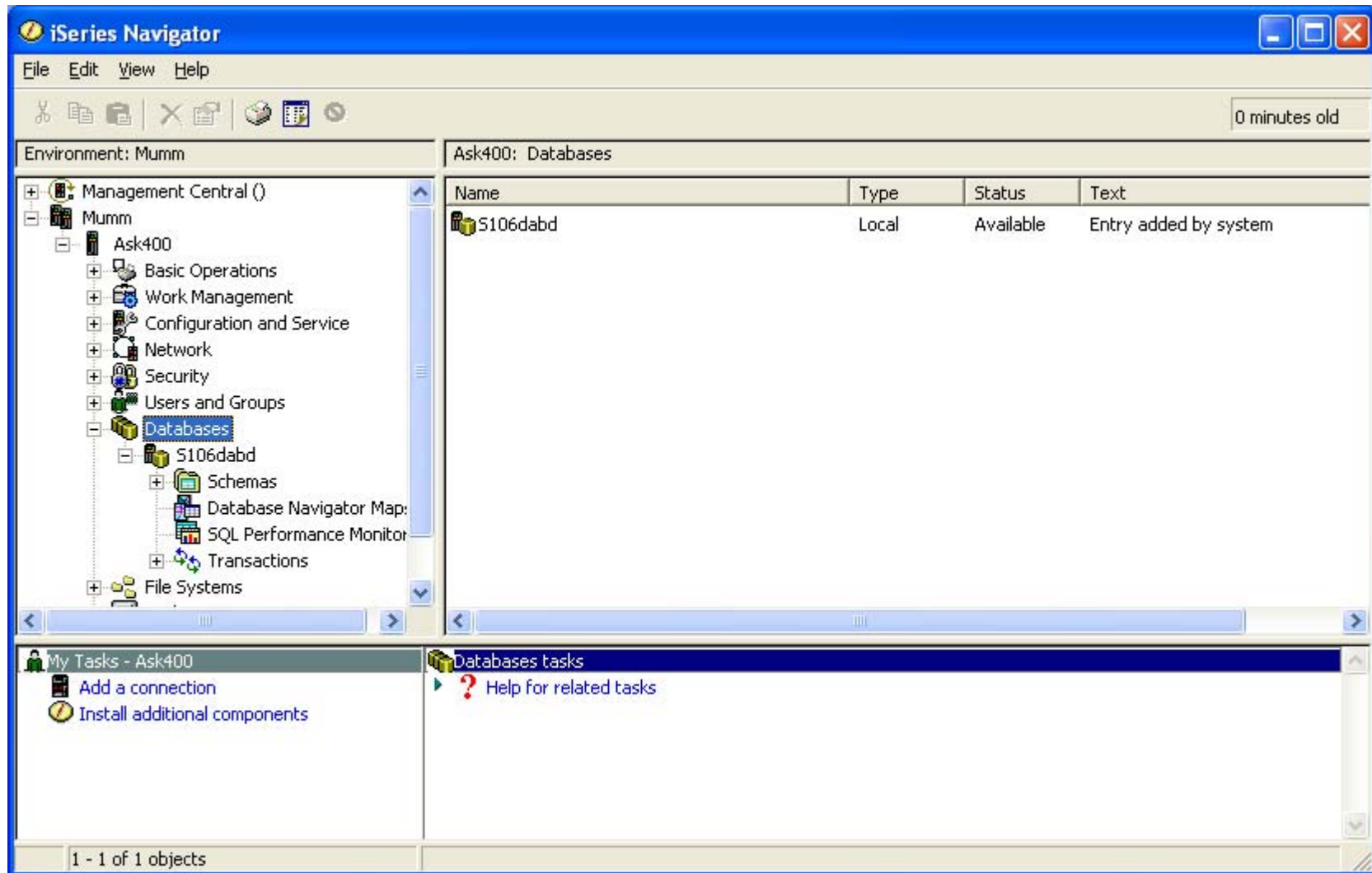


## iSeries Navigator and Database Functions

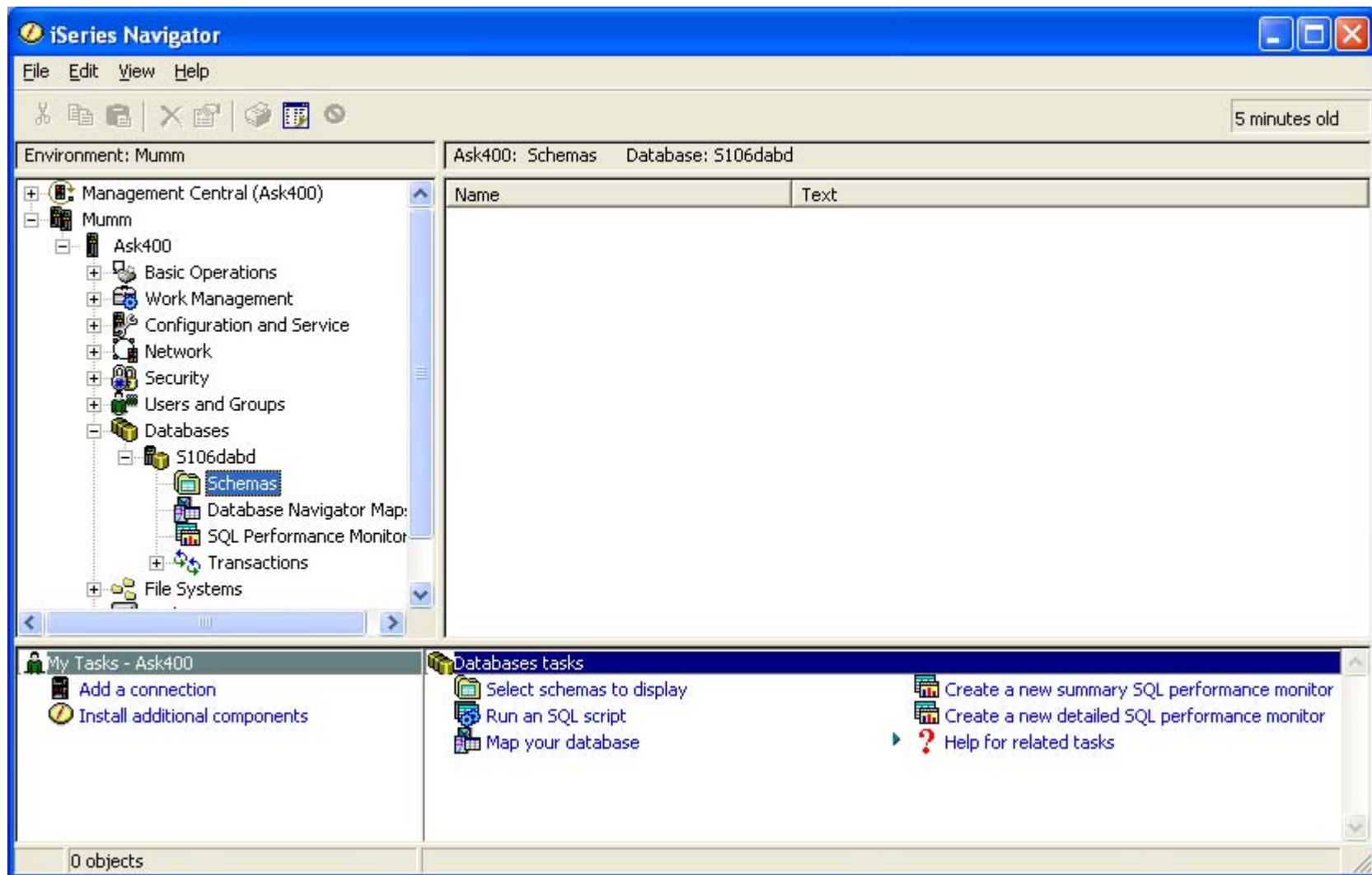
Sign in with a valid user id and password



Select Databases



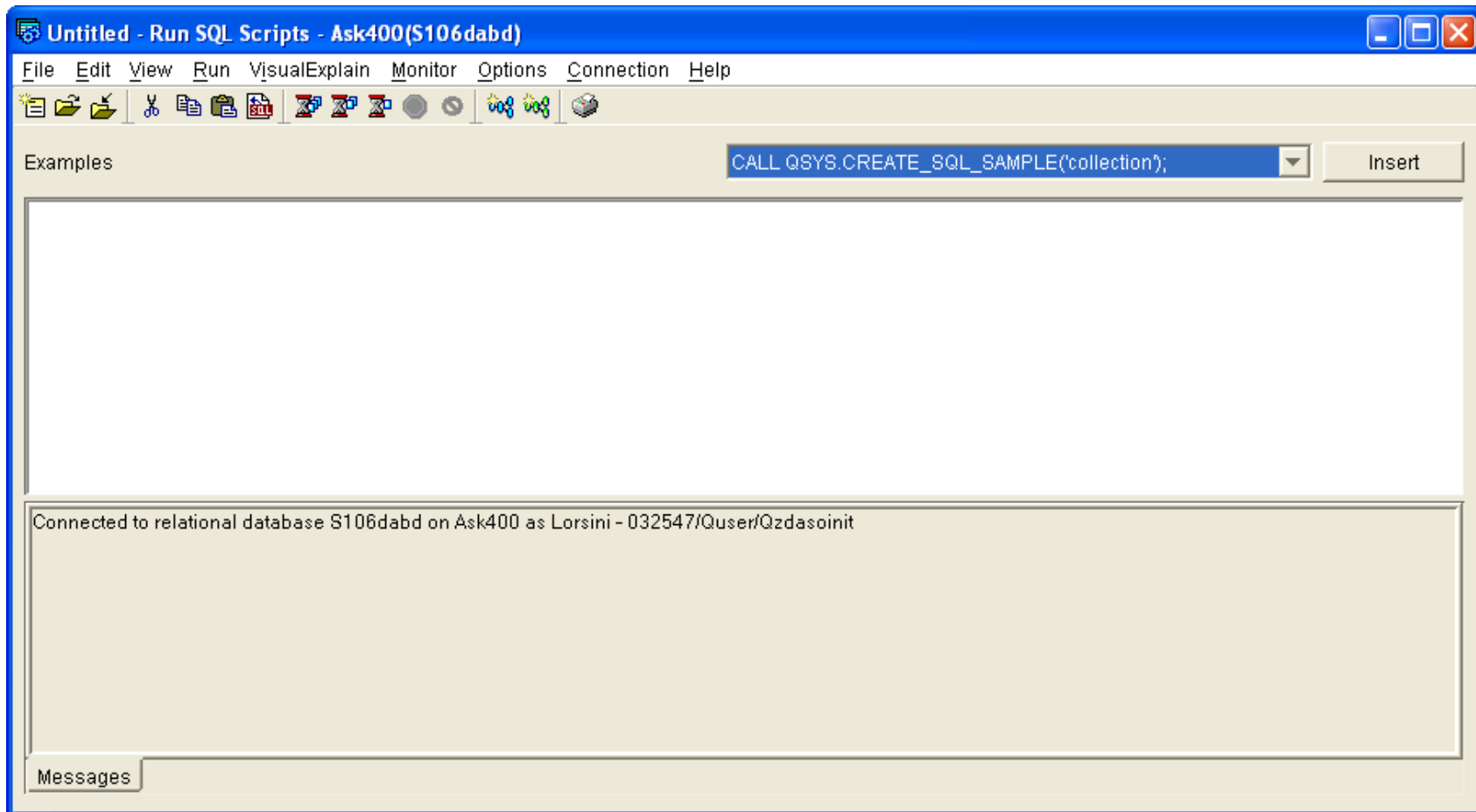
Select Schemas



## I Series Navigator and Database Functions

Select Run an SQL Script in the bottom Panel

Use the drop and locate the statement `CALL QSYS.CREATE_SQL_SAMPLE('collection');`

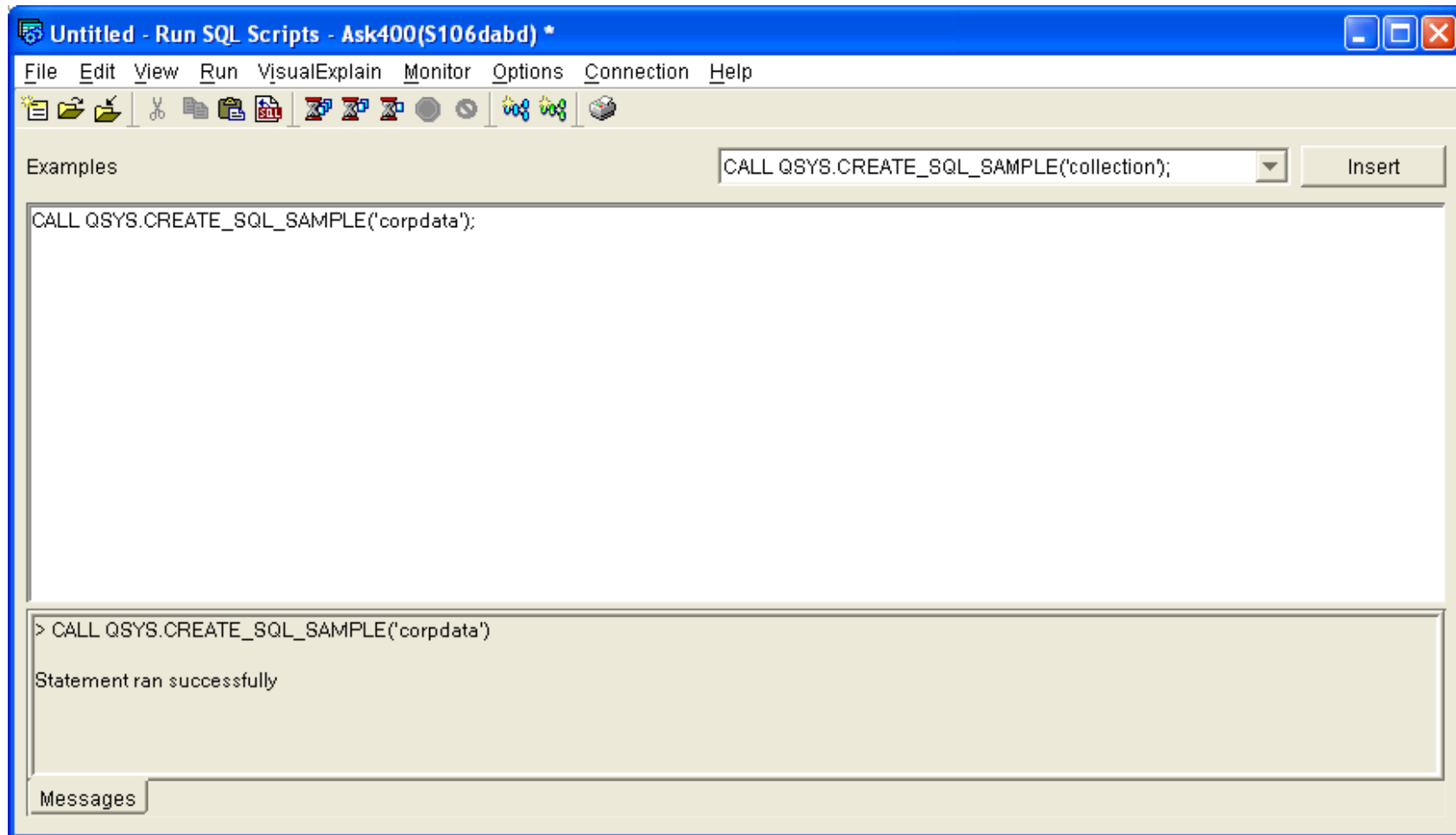


## ISeries Navigator and Database Functions

Press the Insert Button, the text is inserted in the input field.

Change the word **collection** to **corpdata**

Press 'Ctrl-Y' or run selected from the menu

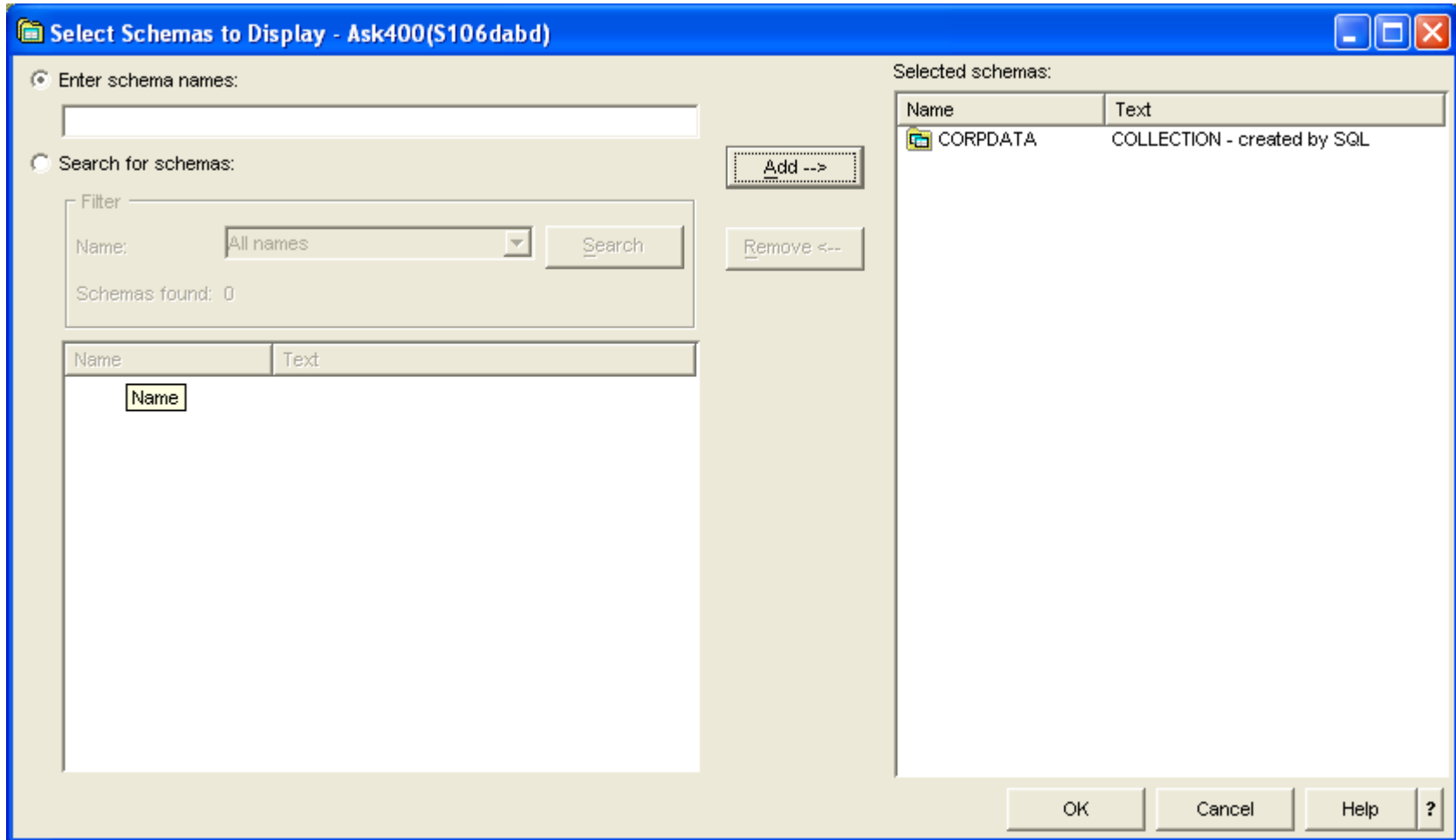


## ISeries Navigator and Database Functions

The test collection called corpdata has been created.

In the database tasks panel ( bottom pane) Select Select schemas to display (double-click)

Remove any schemas (libraries) you don't want to see displayed. In the text entry box Enter schema names: type corpdata click the Add--> button Click the OK button



## iSeries Navigator and Database Functions

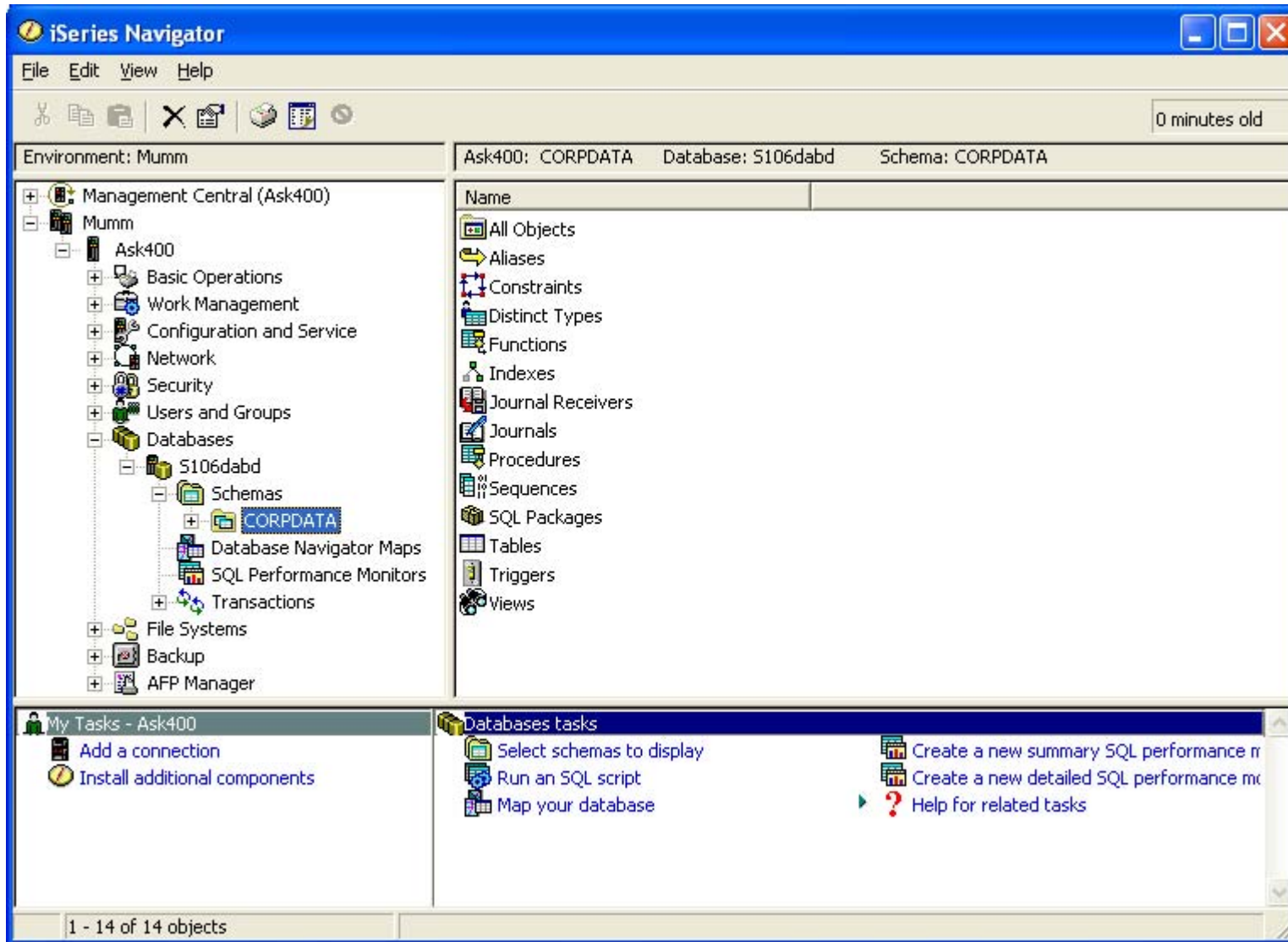
Selected schema (collection, library) is now shown

The screenshot shows the iSeries Navigator interface. The top menu bar includes File, Edit, View, and Help. Below the menu is a toolbar with various icons and a timestamp of '1 minutes old'. The main window is divided into several panes:

- Environment:** Mumm
- Ask400: Schemas Database: S106dabd**
- Left Pane (Tree View):** Management Central (Ask400) > Mumm > Ask400 > Databases > S106dabd > Schemas. The 'Schemas' folder is expanded, showing 'CORPDATA' selected.
- Right Pane (Table View):** A table with two columns: 'Name' and 'Text'. The table contains one entry: 'CORPDATA' with the text 'COLLECTION - created by SQL'.
- Bottom Left Pane (My Tasks - Ask400):** Contains tasks like 'Add a connection' and 'Install additional components'.
- Bottom Right Pane (Databases tasks):** Contains tasks like 'Select schemas to display', 'Run an SQL script', 'Map your database', 'Create a new summary SQL performance r', 'Create a new detailed SQL performance m', and 'Help for related tasks'.
- Status Bar:** Shows '1 - 1 of 1 objects' and 'User schema list modified successfully'.

## iSeries Navigator and Database Functions

Double click the schema name (CORPDATA) to see the objects listed in the schema (library)



## iSeries Navigator and Database Functions

Click the Tables icon in the right hand pane to display a list of tables in the collection CORPDATA.

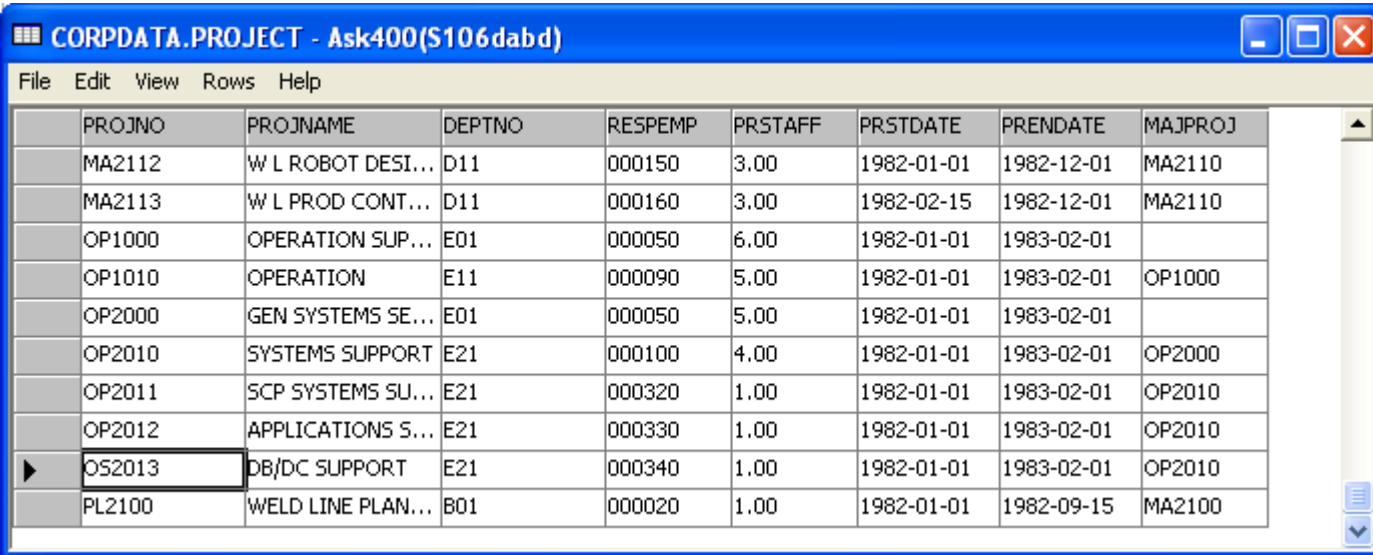
The screenshot shows the iSeries Navigator interface. The left pane displays a tree view of the database structure, with the 'Tables' icon selected under the 'CORPDATA' schema. The right pane displays a table listing the tables in the collection.

SQL Name	Partitioned	Owner	Last Changed	Short N
ACT	No	LORSINI	1/17/05 2:49:25 PM	ACT
CL_SCHED	No	LORSINI	1/17/05 2:49:20 PM	CL_SCH
DEPARTMENT	No	LORSINI	1/17/05 2:49:21 PM	DEPAR
EMP_PHOTO	No	LORSINI	1/17/05 2:49:31 PM	EMP_PH
EMP_RESUME	No	LORSINI	1/17/05 2:49:33 PM	EMP_RI
EMPLOYEE	No	LORSINI	1/17/05 2:49:22 PM	EMPLO
EMPPROJECT	No	LORSINI	1/17/05 2:49:25 PM	EMPPRO
IN_TRAY	No	LORSINI	1/17/05 2:49:26 PM	IN_TRA
ORG	No	LORSINI	1/17/05 2:49:26 PM	ORG
PROJECT	No	LORSINI	1/17/05 2:49:24 PM	PROJA
PROJECT	No	LORSINI	1/17/05 2:49:24 PM	PROJE
SALES	No	LORSINI	1/17/05 2:49:26 PM	SALES
STAFF	No	LORSINI	1/17/05 2:49:26 PM	STAFF

The bottom pane shows 'My Tasks - Ask400' and 'Databases tasks' with various options like 'Add a connection', 'Run an SQL script', and 'Map your database'.

## ISeries Navigator and Database Functions

Double Click the Table Project to display the contents



PROJNO	PROJNAME	DEPTNO	RESPEMP	PRSTAFF	PRSTDATE	PRENDATE	MAJPROJ
MA2112	W L ROBOT DESI...	D11	000150	3.00	1982-01-01	1982-12-01	MA2110
MA2113	W L PROD CONT...	D11	000160	3.00	1982-02-15	1982-12-01	MA2110
OP1000	OPERATION SUP...	E01	000050	6.00	1982-01-01	1983-02-01	
OP1010	OPERATION	E11	000090	5.00	1982-01-01	1983-02-01	OP1000
OP2000	GEN SYSTEMS SE...	E01	000050	5.00	1982-01-01	1983-02-01	
OP2010	SYSTEMS SUPPORT	E21	000100	4.00	1982-01-01	1983-02-01	OP2000
OP2011	SCP SYSTEMS SU...	E21	000320	1.00	1982-01-01	1983-02-01	OP2010
OP2012	APPLICATIONS S...	E21	000330	1.00	1982-01-01	1983-02-01	OP2010
OS2013	DB/DC SUPPORT	E21	000340	1.00	1982-01-01	1983-02-01	OP2010
PL2100	WELD LINE PLAN...	B01	000020	1.00	1982-01-01	1982-09-15	MA2100

What kind of damage can you do here?

- Edit Rows (records) in the table - Simply type over the data and press enter
- Delete Rows
- Insert new rows

What happens if I attempt to add a project for an employee that does not exist?

I will receive an error message.

Operation not allowed by referential constraint Q\_CORPDATA\_PROJECT\_RESPEMP\_00001 in CORPDATA.

Message ID: SQL0530

Cause . . . . . : If this is an INSERT or UPDATE statement, the value is not valid for the foreign key because it does not have a matching value in the parent key. If this is a DELETE statement affected by a SET DEFAULT delete rule, the default value is not valid for the same reason. If this is an ALTER TABLE statement, the result of the operation would violate the constraint Q\_CORPDATA\_PROJECT\_RESPEMP\_00001. Constraint Q\_CORPDATA\_PROJECT\_RESPEMP\_00001 in CORPDATA for table PROJECT in CORPDATA requires that any non-null value of the foreign key have a matching value in the parent key.

Recovery . . . . : To conform to the constraint rule, you must either: -- change the INSERT or UPDATE value to match a value in the parent key, -- insert a row in the parent file that matches the foreign key values being inserted or updated. -- insert a row in the parent file that matches the foreign key default values of the dependent rows. Otherwise, you must drop the referential constraint.

Here's the type of constraints allowed by DB2/400

## Constraints

Constraints are rules enforced by the database manager. DB2 UDB for iSeries supports the following constraints:

### Unique constraints

A **unique constraint** is the rule that the values of the key are valid only if they are unique. Unique constraints can be created using the CREATE TABLE and ALTER TABLE statements. Although CREATE INDEX can create a unique index that also guarantees uniqueness, such an index is not a constraint.

Unique constraints are enforced during the execution of INSERT and UPDATE statements. A PRIMARY KEY constraint is a form of UNIQUE constraint. The difference is that a PRIMARY KEY cannot contain any nullable columns.

**Referential constraints:**

A **referential constraint** is the rule that the values of the foreign key are valid only if:

- They appear as values of a parent key, or
- Some component of the foreign key is null.

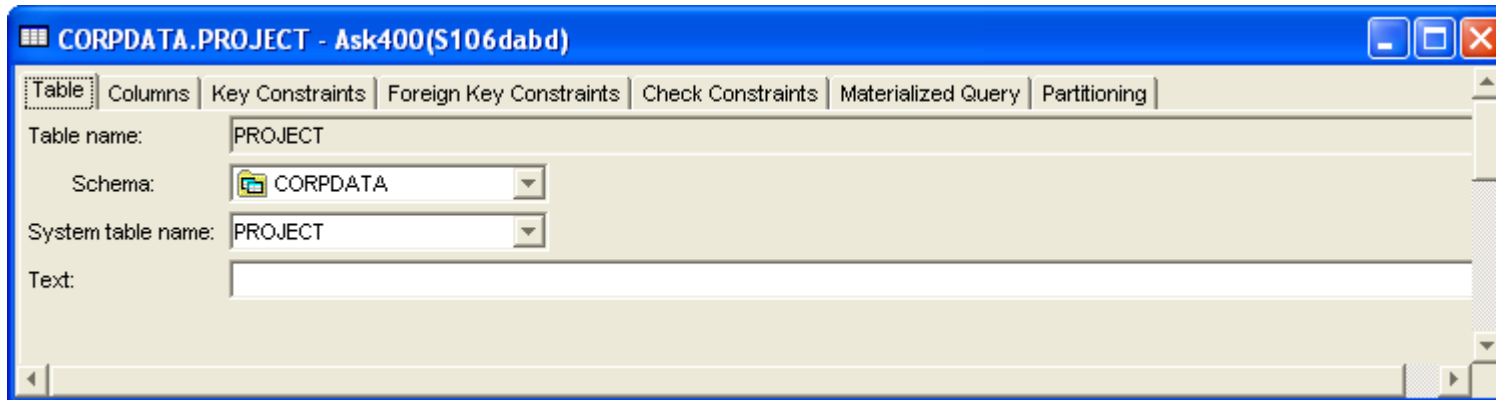
Referential constraints are enforced during the execution of INSERT, UPDATE, and DELETE statements.

**Check constraints**

A **check constraint** is a rule that limits the values allowed in a column or group of columns. Check constraints can be added using the CREATE TABLE and ALTER TABLE statements. Check constraints are enforced during the execution of INSERT and UPDATE statements. To satisfy the constraint, each row of data inserted or updated in the table must make the specified condition either TRUE or unknown (due to a null value).

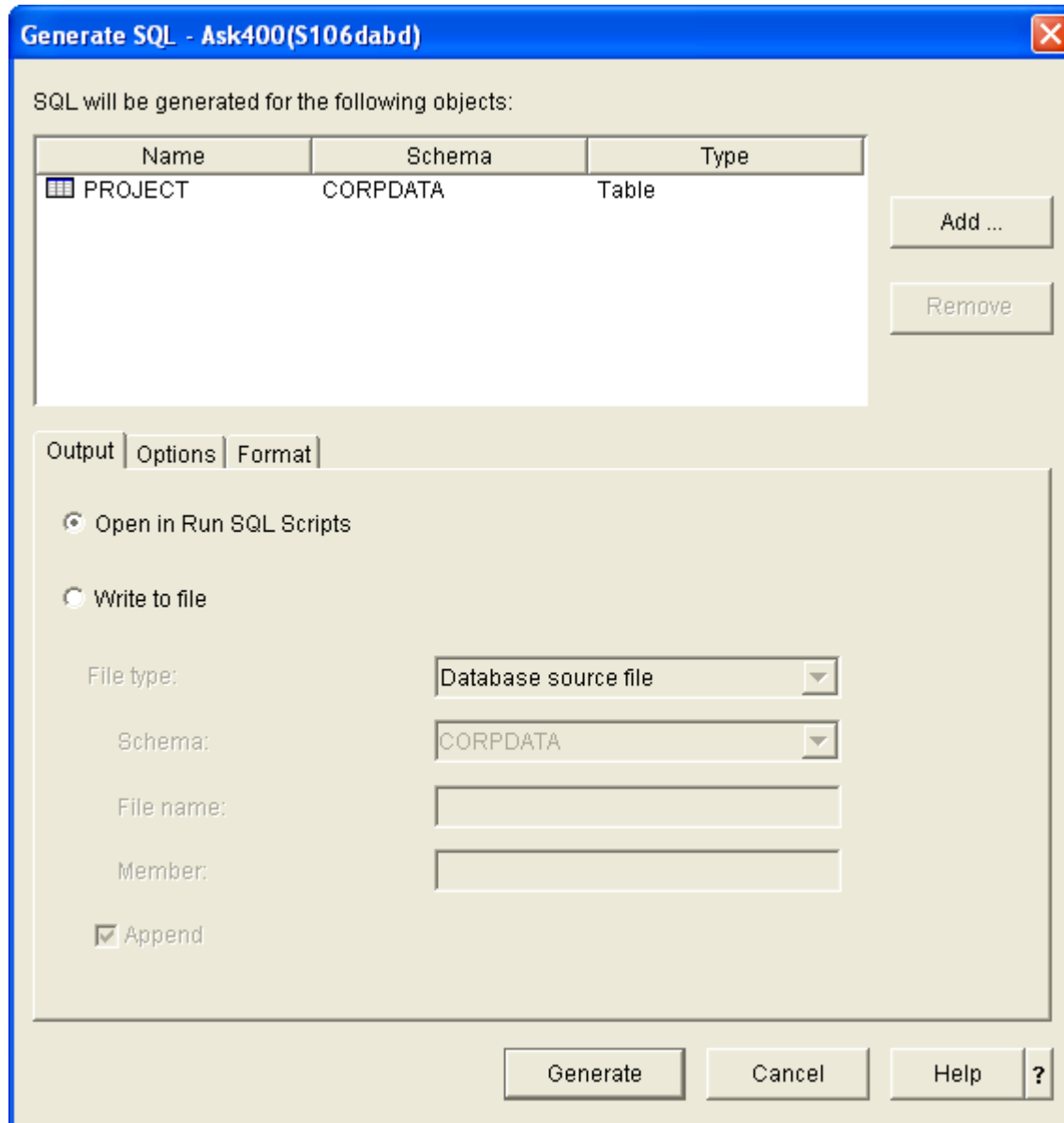
How can you determine what constraints are on a table?

Right click on the table and select Definition from the context menu



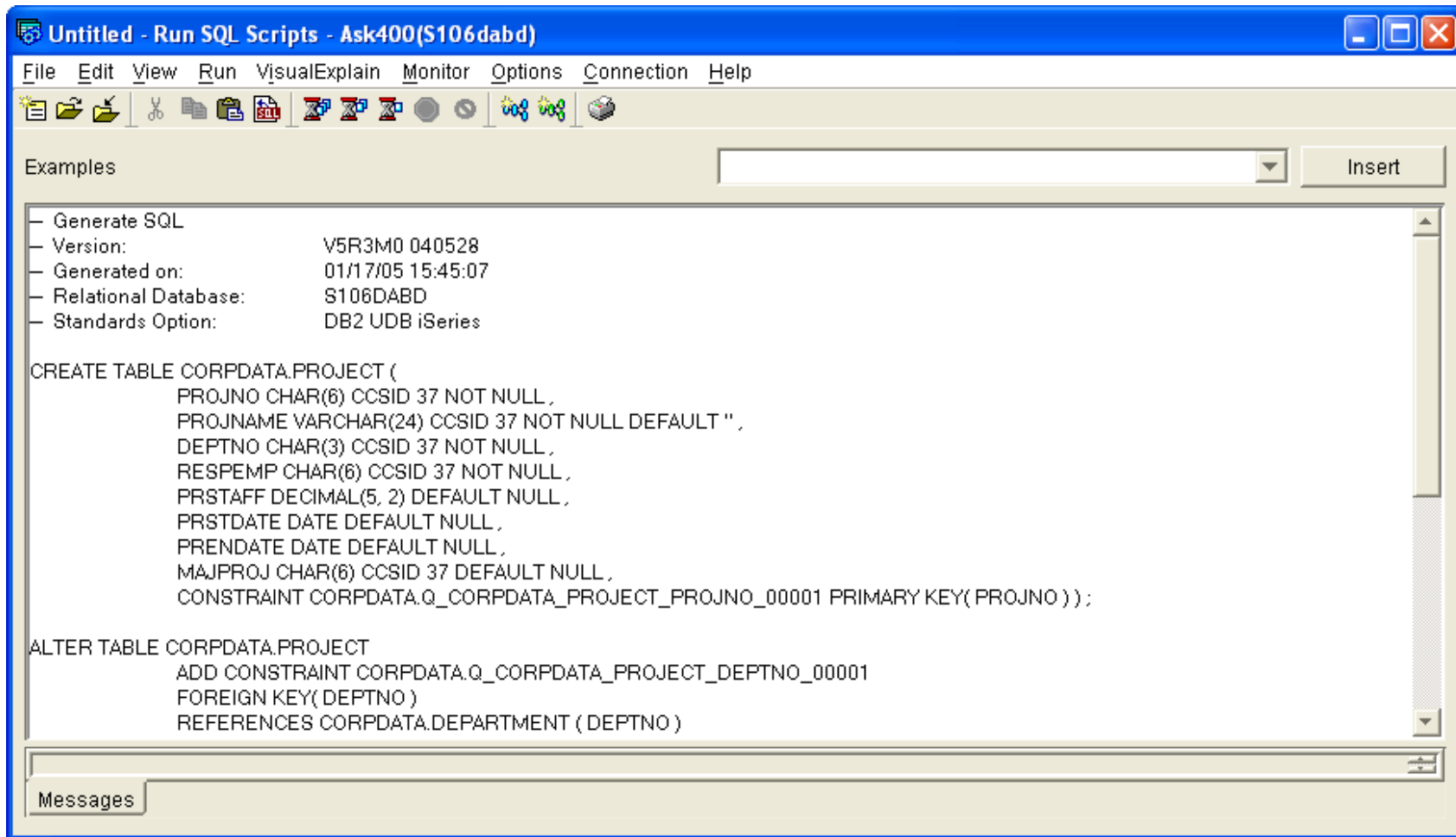
Select the constraints tabs to view the constraints which are assigned to the table. You could also view the SQL that would be used to create the table.

Right Click on the Table and select Generate SQL...



## I Series Navigator and Database Functions

Click the Generate button and the “source” for the table will be generated in a Run SQL Scripts window. The Run SQL Scripts function was used earlier to create the collection CORPDATA.



## I Series Navigator and Database Functions

The First statement, CREATE TABLE, creates the table and defines the columns. It defines the primary key in the file as PROJNO.

```
CREATE TABLE CORPDATA.PROJECT (  
    PROJNO CHAR(6) CCSID 37 NOT NULL , PROJNAME VARCHAR(24) CCSID 37 NOT NULL DEFAULT " ,  
    DEPTNO CHAR(3) CCSID 37 NOT NULL , RESPEMP CHAR(6) CCSID 37 NOT NULL ,  
    PRSTAFF DECIMAL(5, 2) DEFAULT NULL , PRSTDATE DATE DEFAULT NULL ,  
    PRENDATE DATE DEFAULT NULL , MAJPROJ CHAR(6) CCSID 37 DEFAULT NULL ,  
    CONSTRAINT CORPDATA.Q_CORPDATA_PROJECT_PROJNO_00001 PRIMARY KEY( PROJNO ) ) ;
```

The second statement adds a constraint to the department file. It prevents rows in the department file from being deleted if a project exists in the project file for that department. This prevents “orphan” project rows.

```
ALTER TABLE CORPDATA.PROJECT  
    ADD CONSTRAINT CORPDATA.Q_CORPDATA_PROJECT_DEPTNO_00001  
    FOREIGN KEY( DEPTNO ) REFERENCES CORPDATA.DEPARTMENT ( DEPTNO )  
    ON DELETE RESTRICT ON UPDATE NO ACTION ;
```

The third statement adds a constraint to the employee file. It prevents rows in the employee file from being deleted if a project exists in the project file for that department. This prevents “orphan” project rows.

```
ALTER TABLE CORPDATA.PROJECT  
    ADD CONSTRAINT CORPDATA.Q_CORPDATA_PROJECT_RESPEMP_00001  
    FOREIGN KEY( RESPEMP ) REFERENCES CORPDATA.EMPLOYEE ( EMPNO )  
    ON DELETE RESTRICT ON UPDATE NO ACTION ;
```

Hopefully you can see the benefit of generating SQL to understand how a table has been defined.

Another way to understand the relationship between tables in the collection is to use the Database map function of iSeries Navigator.

## iSeries Navigator and Database Functions

The screenshot shows the iSeries Navigator application window. The title bar reads "iSeries Navigator". The menu bar includes "File", "Edit", "View", and "Help". Below the menu bar is a toolbar with icons for various actions. The main window is divided into several panes:

- Environment:** Mumm
- Database:** S106dabd
- Schema:** CORPDATA

The left pane shows a tree view of the database structure:

- S106dabd
  - Schemas
    - CORPDATA
      - All Objects
      - Aliases
      - Constraints
      - Distinct Types
      - Functions
      - Indexes
      - Journal Receivers
      - Journals
      - Procedures
      - Sequences
      - SQL Packages
      - Tables
      - Triggers
      - Views

The right pane displays a table list with the following columns: SQL Name, Partitioned, Owner, Last Changed, and Short N. The data is as follows:

SQL Name	Partitioned	Owner	Last Changed	Short N
ACT	No	LORSINI	1/17/05 2:49:25 PM	ACT
CL_SCHED	No	LORSINI	1/17/05 2:49:20 PM	CL_SCH
DEPARTMENT	No	LORSINI	1/17/05 2:49:21 PM	DEPAR
EMP_PHOTO	No	LORSINI	1/17/05 2:49:31 PM	EMP_PH
EMP_RESUME	No	LORSINI	1/17/05 2:49:33 PM	EMP_RI
EMPLOYEE	No	LORSINI	1/17/05 2:49:22 PM	EMPLO
EMPPROJECT	No	LORSINI	1/17/05 2:49:25 PM	EMPPR
IN_TRAY	No	LORSINI	1/17/05 2:49:26 PM	IN_TRA
ORG	No	LORSINI	1/17/05 2:49:26 PM	ORG
PROJECT	No	LORSINI	1/17/05 2:49:24 PM	PROJA
PROJECT	No	LORSINI	1/17/05 2:49:24 PM	PROJE
SALES	No	LORSINI	1/17/05 2:49:26 PM	SALES
STAFF	No	LORSINI	1/17/05 2:49:26 PM	STAFF

The bottom pane shows "My Tasks - Ask400" and "Databases tasks". The "Databases tasks" list includes:

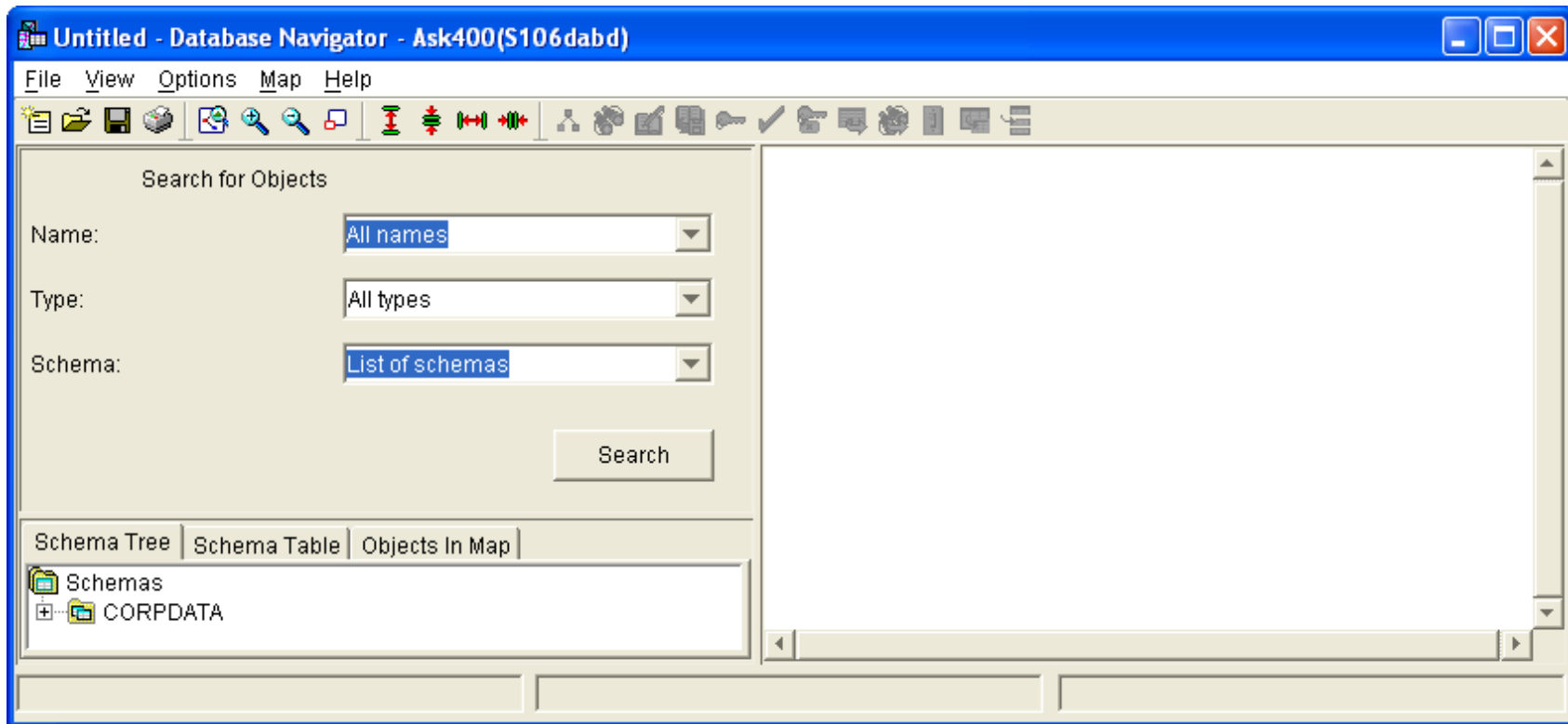
- Select schemas to display
- Run an SQL script
- Map your database
- Create a new summary SQL performance r
- Create a new detailed SQL performance m
- Help for related tasks

A tooltip is visible over the "Map your database" task, with the text: "Display a list of objects related to the selected item."

Click Map your database

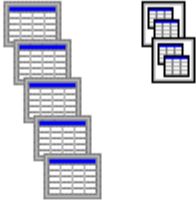

## I Series Navigator and Database Functions

Use the Drop down boxes to search for DB2/400 objects or expand the Schema Tree by clicking the plus sign.



Select the objects you wish to map by double clicking on the object name a status window is displayed showing the relations as they are found. This operation can take a while for a complex environment.

**Finding Relations** ✖

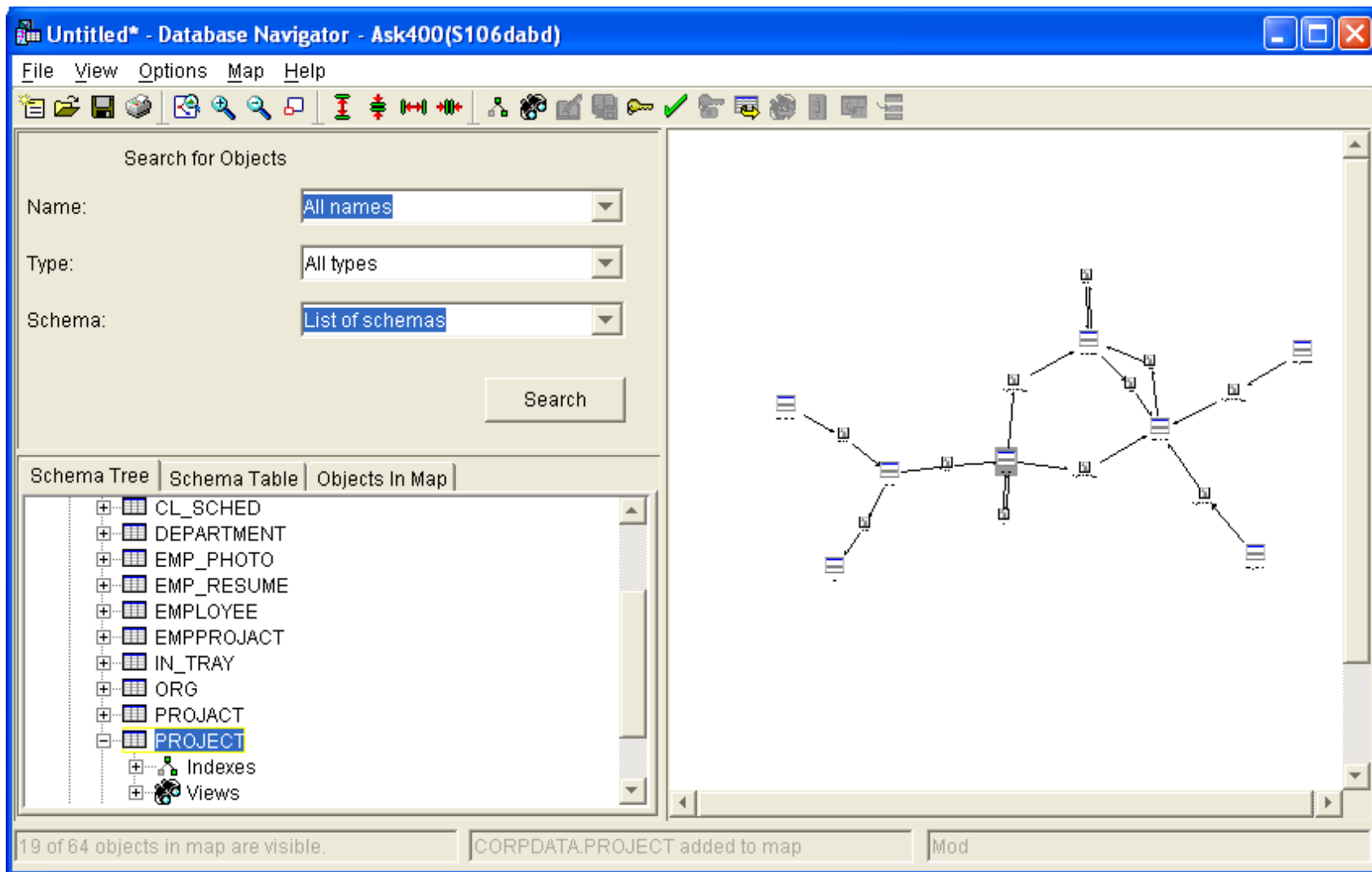


Related Objects:

<input type="text" value="0"/> Aliases	<input type="text" value="5"/> Primary key constraints
<input type="text" value="1"/> Check constraints	<input type="text" value="7"/> Tables
<input type="text" value="8"/> Foreign key constraints	<input type="text" value="Omitted"/> Table partitions
<input type="text" value="6"/> Indexes	<input type="text" value="0"/> Triggers
<input type="text" value="Omitted"/> Journals	<input type="text" value="0"/> Unique key constraints
<input type="text" value="Omitted"/> Journal receivers	<input type="text" value="11"/> Views
<input type="text" value="Omitted"/> Materialized query tables	

## ISeries Navigator and Database Functions

When the relations have been identified a Map is displayed.



Use the Zoom in and Zoom out icons to display the map. Moving the cursor over an object in the map will cause a pop-up window to show a description of the objects. Right click on an object to view the table context menu. This menu contains functions to Edit,

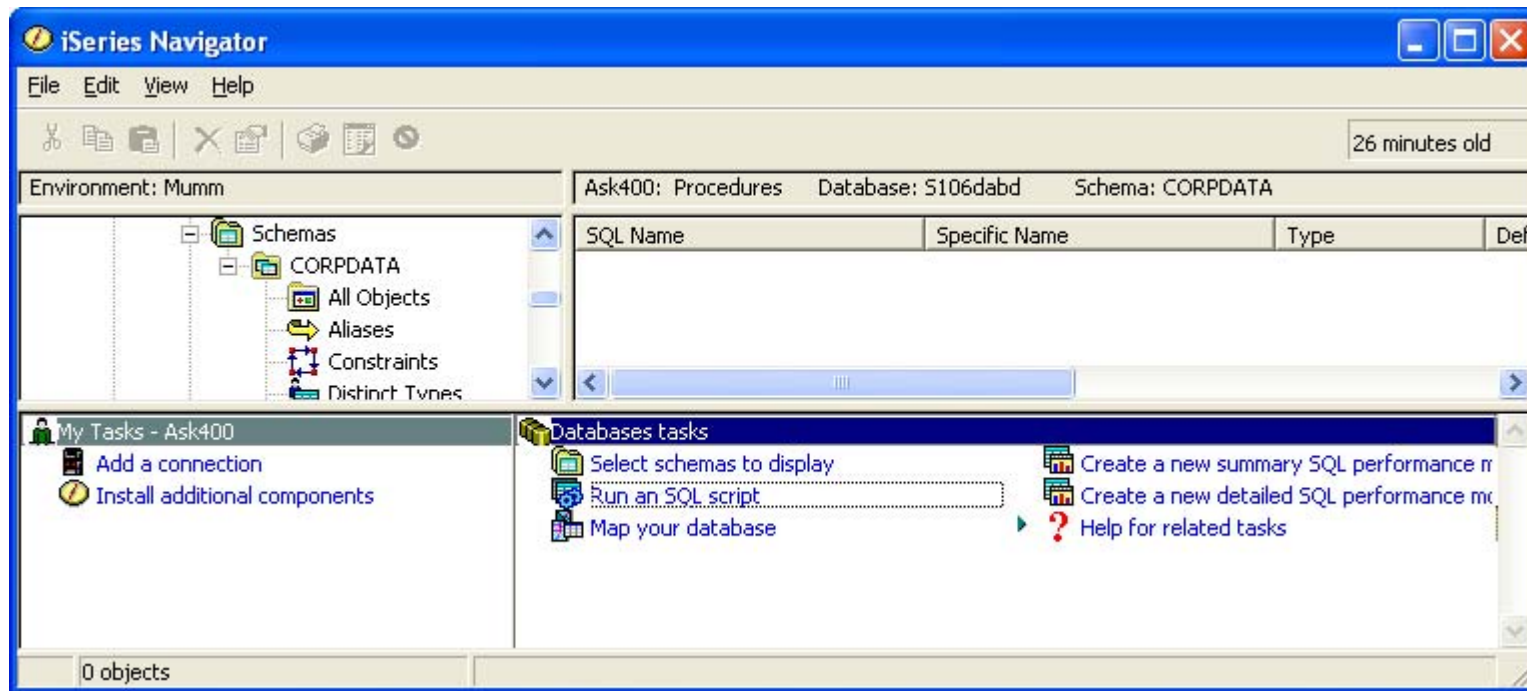
## iSeries Navigator and Database Functions

View, Display the definition, Generate SQL, work with journalling, work with permissions, reorganize, delete, rename the file. In addition you can remove the table from the map.

Saving the map will create tables in the collection which contain the relations displayed on the map. You can open saved maps without having to generate the relationships again.

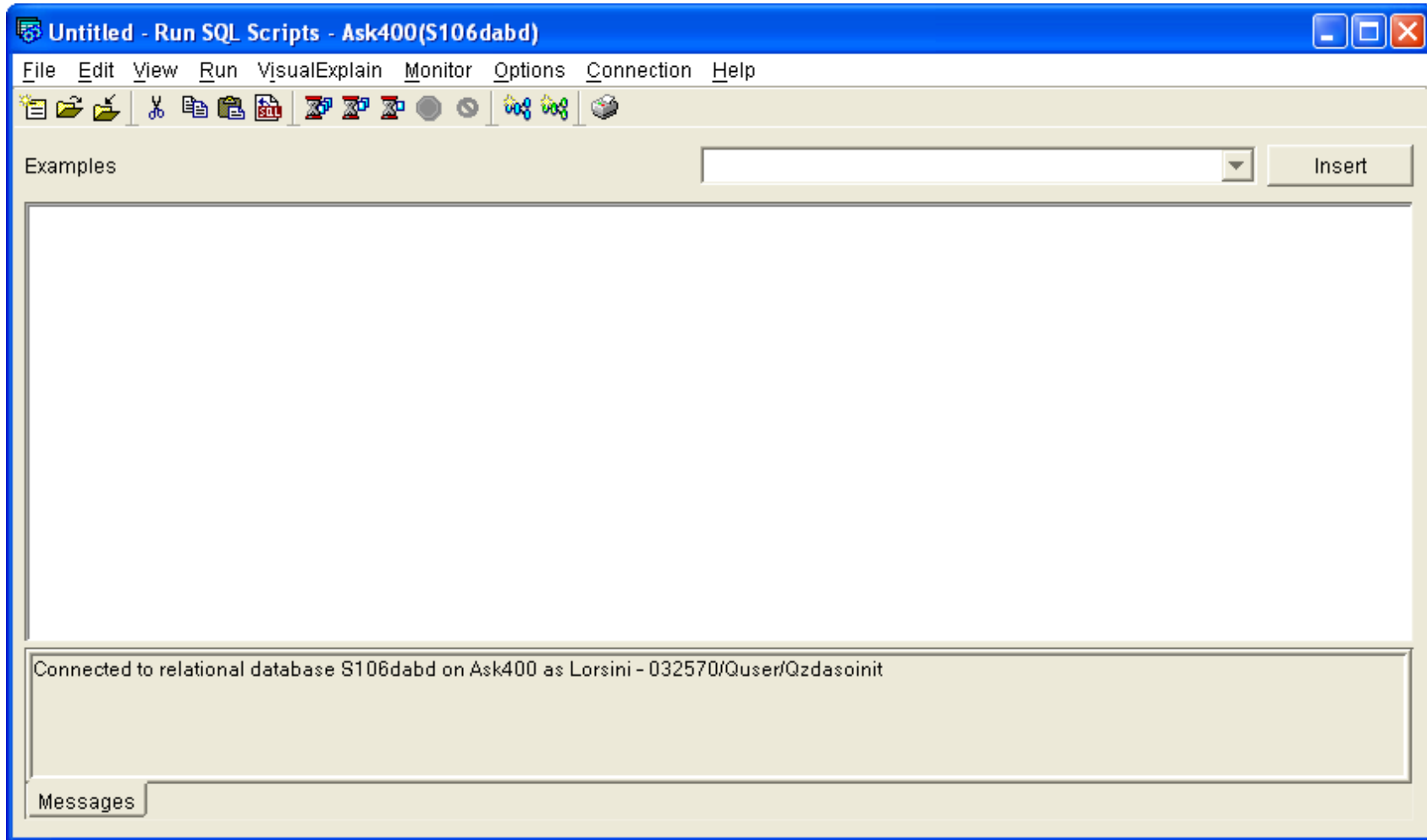
Mapping shows a static view of the database it aids you in understanding the relationship of objects in the database. To understand performance aspects of your database the Visual Explain function of iSeries navigator can be used.

To use Visual Explain, start a new SQL script. By selecting Run SQL Script from the database tasks listed when the Database section of iSeries navigator is selected.



## ISeries Navigator and Database Functions

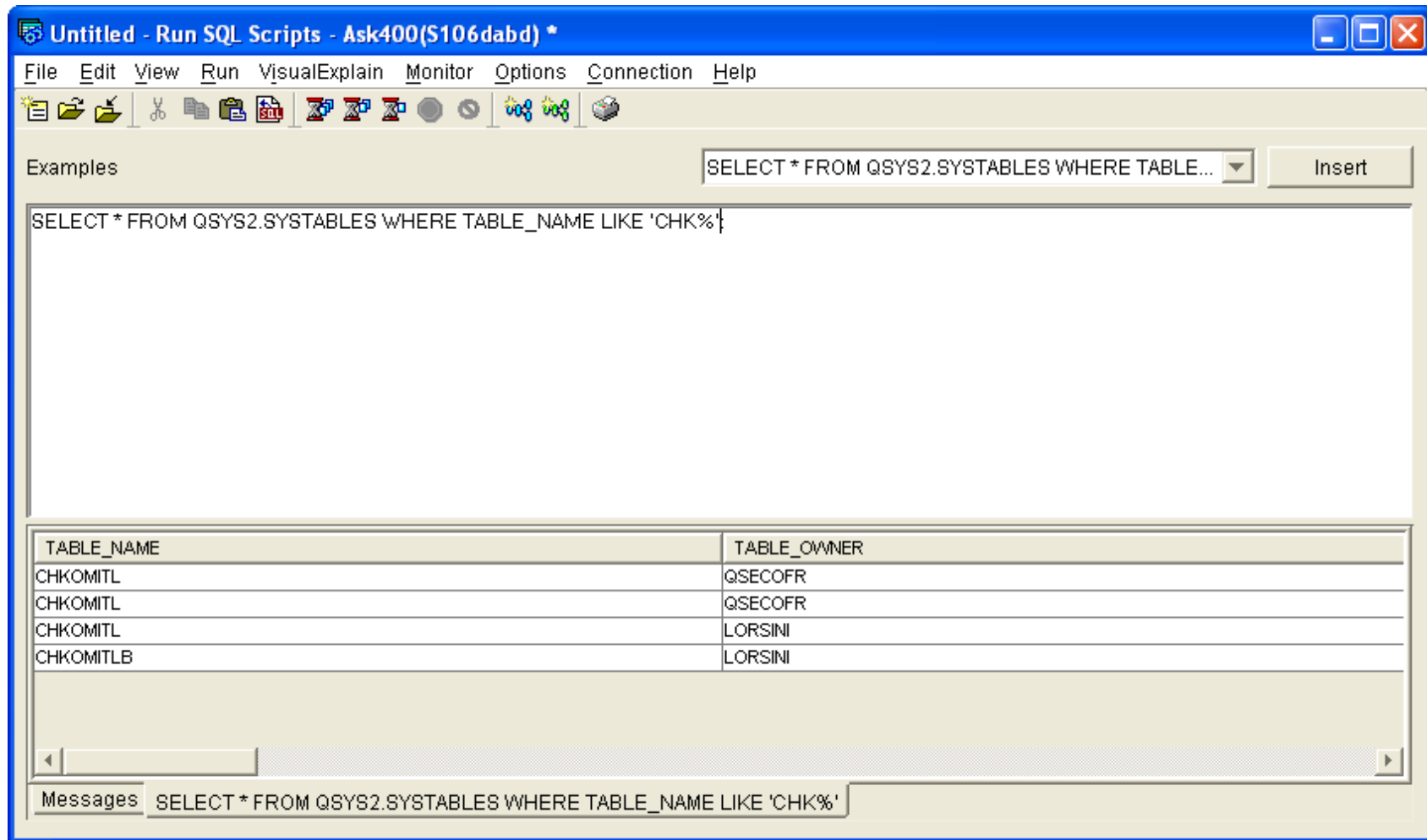
An empty SQL scripts menu is shown.



Type in the SQL statement you would like to analyze.

## I Series Navigator and Database Functions

In this case all rows in table SYSTABLES in library (collection) QSYS2 which start with CHK are shown. Selecting Visual Explain option Run and Explain causes the SQL statement to be run, and the Visual Explain window to be shown at the completion of the Query.



The screenshot shows a window titled "Untitled - Run SQL Scripts - Ask400(S106dabd) \*". The menu bar includes File, Edit, View, Run, Visual Explain, Monitor, Options, Connection, and Help. The toolbar contains various icons for file operations and execution. The main area displays the SQL query: `SELECT * FROM QSYS2.SYSTABLES WHERE TABLE_NAME LIKE 'CHK%'`. Below the query, a table shows the results of the query.

TABLE_NAME	TABLE_OWNER
CHKOMITL	QSECOFR
CHKOMITL	QSECOFR
CHKOMITL	LORSINI
CHKOMITLB	LORSINI

At the bottom, a Messages pane shows the same SQL query: `SELECT * FROM QSYS2.SYSTABLES WHERE TABLE_NAME LIKE 'CHK%'`.

## ISeries Navigator and Database Functions

The Visual Explain Window has three sections:

1. The diagram of the SQL statement this is shown from left to right
2. The Attribute Window which shows run time statistics
3. Optimizer messages. These are extracted from the joblog of the server job which was used to run the SQL statement.

The screenshot shows the Visual Explain window for the query Ask400(S106dabd). The window is divided into three main sections:

- Query Plan Diagram:** Shows the execution flow from left to right. It starts with a 'Final Select' operation, followed by a 'Nested Loop Join' operation. The join operation is connected to two 'Table Probe' operations, which are in turn connected to two 'Index Scan - Key Positioning' operations.
- Attribute Window:** Displays run time statistics for the query. The table below shows the data:
- Message Window:** Displays optimizer messages, including starting and ending debug messages, and messages related to access path suggestions and file processing.

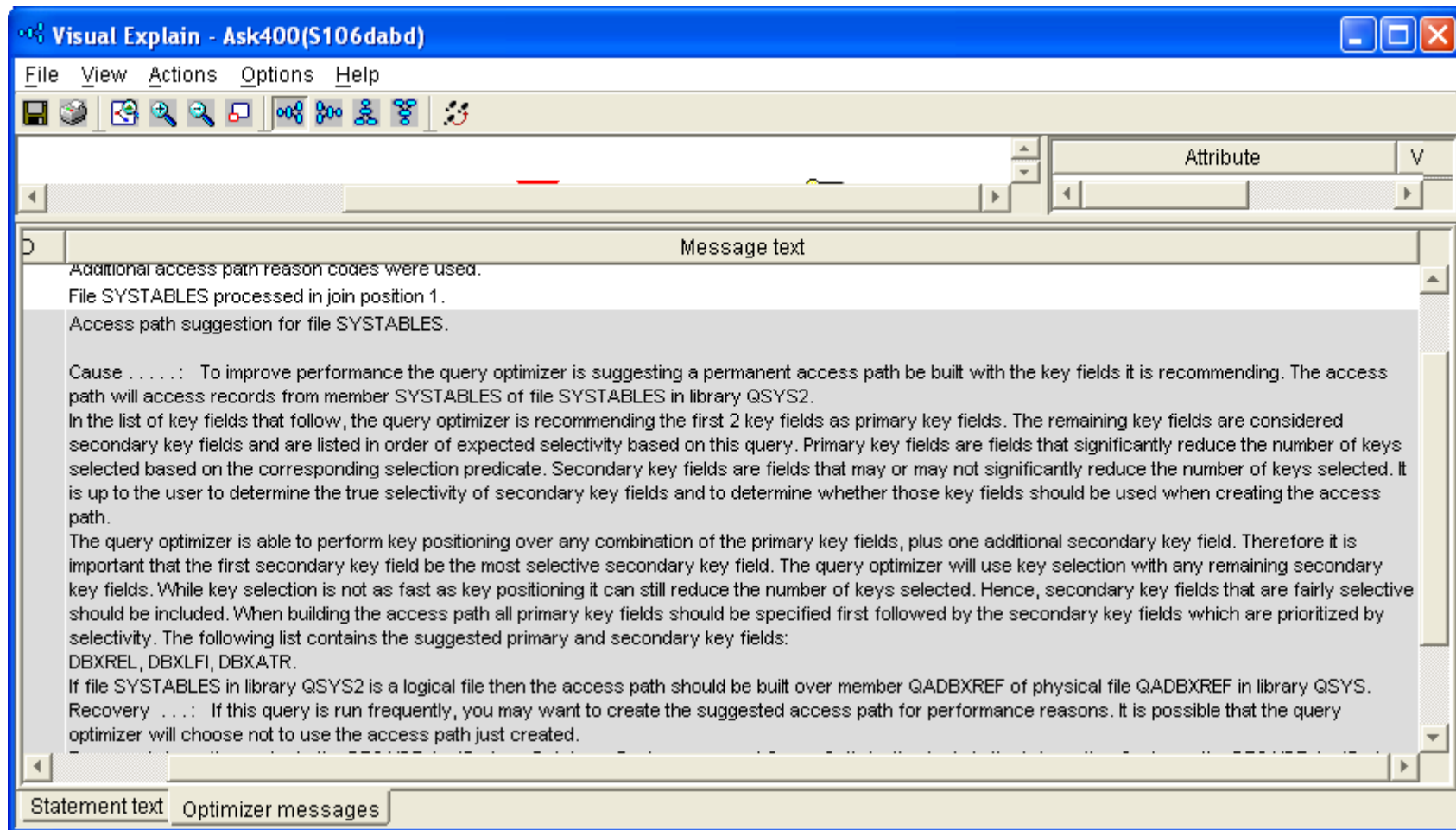
Attribute	V
<b>Time information (start time, tota...</b>	
Timestamp for Creation of Monit...	20i
Statement Start Timestamp	20i
Statement End Timestamp	20i
Optimization Time, in Milliseconds	10
ODP Open Time, in Milliseconds	14
Total Time, in Microseconds	51:
Statement Open Time, in Microse...	30'
Statement Fetch Time, in Micros...	15i

Message ID	Message text
CPI434A	**** Starting optimizer debug message for query .
CPI432C	All access paths were considered for file SYSTABLES.
CPI432D	Additional access path reason codes were used.
CPI4326	File SYSTABLES processed in join position 1 .
CPI432F	Access path suggestion for file SYSTABLES.
CPI4326	File SYSTABLES processed in join position 2.
CPI433A	Unable to retrieve query options file.
CPI434B	**** Ending debug message for query .

Statement text: Optimizer messages

## Optimizer Messages:

Clicking on a message will display the second level text for the message. In the case of Access path suggestions the table and column names for the suggested access path (view) are displayed.

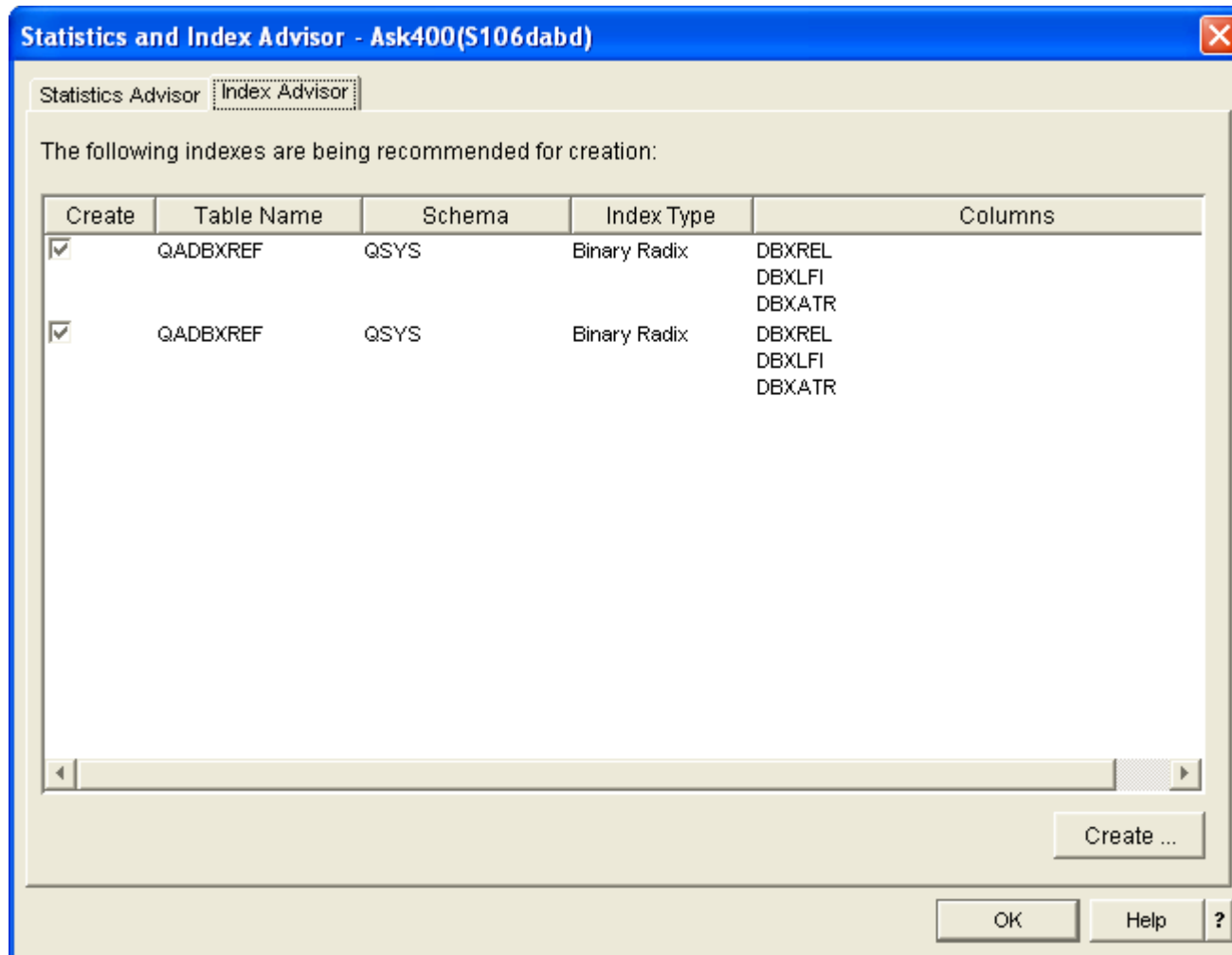


## I Series Navigator and Database Functions

So just follow the instructions in the message and you'll be all set!

Just kidding....

Click the Actions menu and select Addvisor, then select the Index Addvisor Tab



## ISeries Navigator and Database Functions

To create the recommended Indexes click the Create... Button in the lower right hand corner of the window. The New Index window is shown. Type in an Index Name in the example AdvisorOne is used, type some text if you want to and click OK.

**New Index - Ask400(S106dabd)**

Index name:

Index schema:

Table name:

Table schema:

Available columns:

Column Name	Short Name	Data Type	Len
DBXFIL	DBXFIL	CHARACTER	
DBXLIB	DBXLIB	CHARACTER	
DBXDIC	DBXDIC	CHARACTER	
DBXOWN	DBXOWN	CHARACTER	
DBXTXT	DBXTXT	CHARACTER	
DBXLNK	DBXLNK	CHARACTER	
DBXSQL	DBXSQL	CHARACTER	
DBXTYP	DBXTYP	CHARACTER	
DBXNFL	DBXNFL	NUMERIC	
DBXNKF	DBXNKF	NUMERIC	

Selected columns:

Order	Column Name
Ascending	DBXREL
Ascending	DBXLFI
Ascending	DBXATR

Buttons: Add -->, Remove <--

Buttons: Move Up, Move Down, Set Ascending, Set Descending

Index type:

Number of distinct values:

Text:

Buttons: Show SQL, OK, Cancel, Help, ?

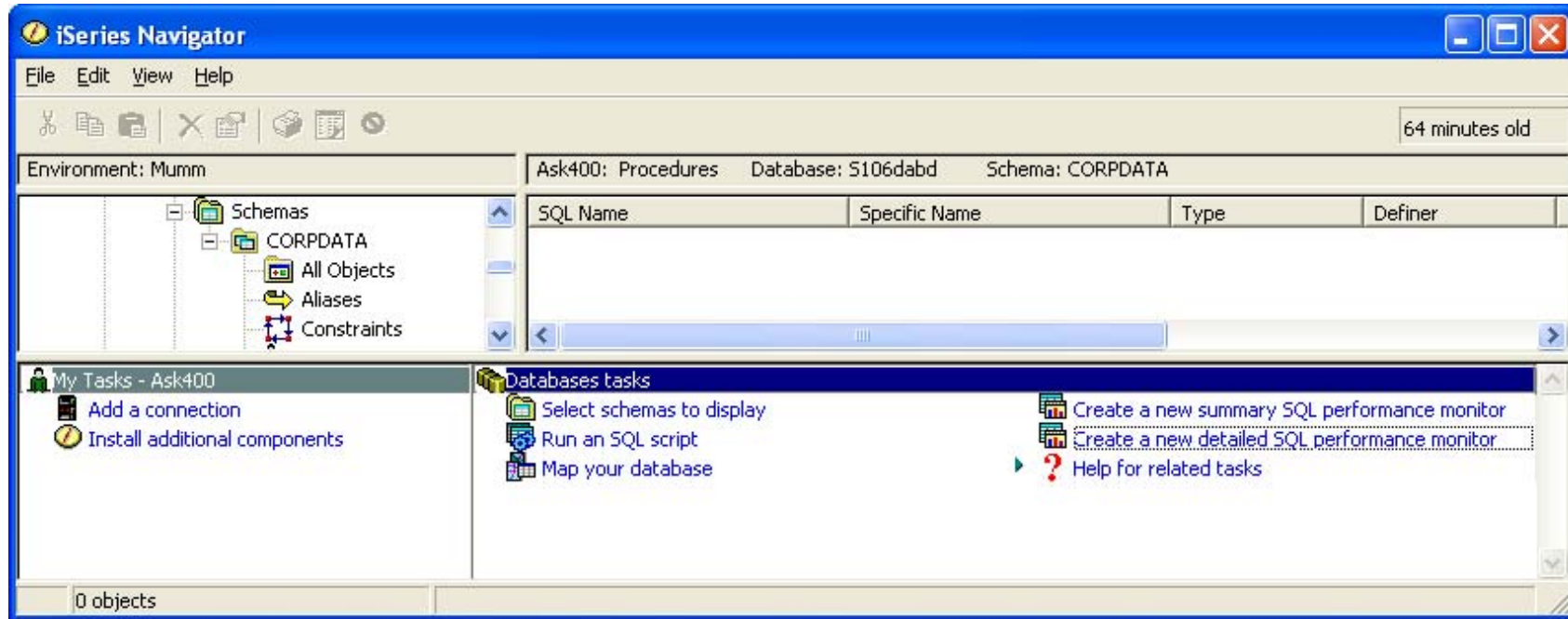
If you're curious click the Show SQL button to see the SQL used to create the index.

## ISeries Navigator and Database Functions

Repeat the process for each access path which is recommended by the Advisor.

What if you need to understand the performance of an application and you can't run the SQL statements individually?

Use the SQL Performance Monitor, this is in the Databases tasks pane.

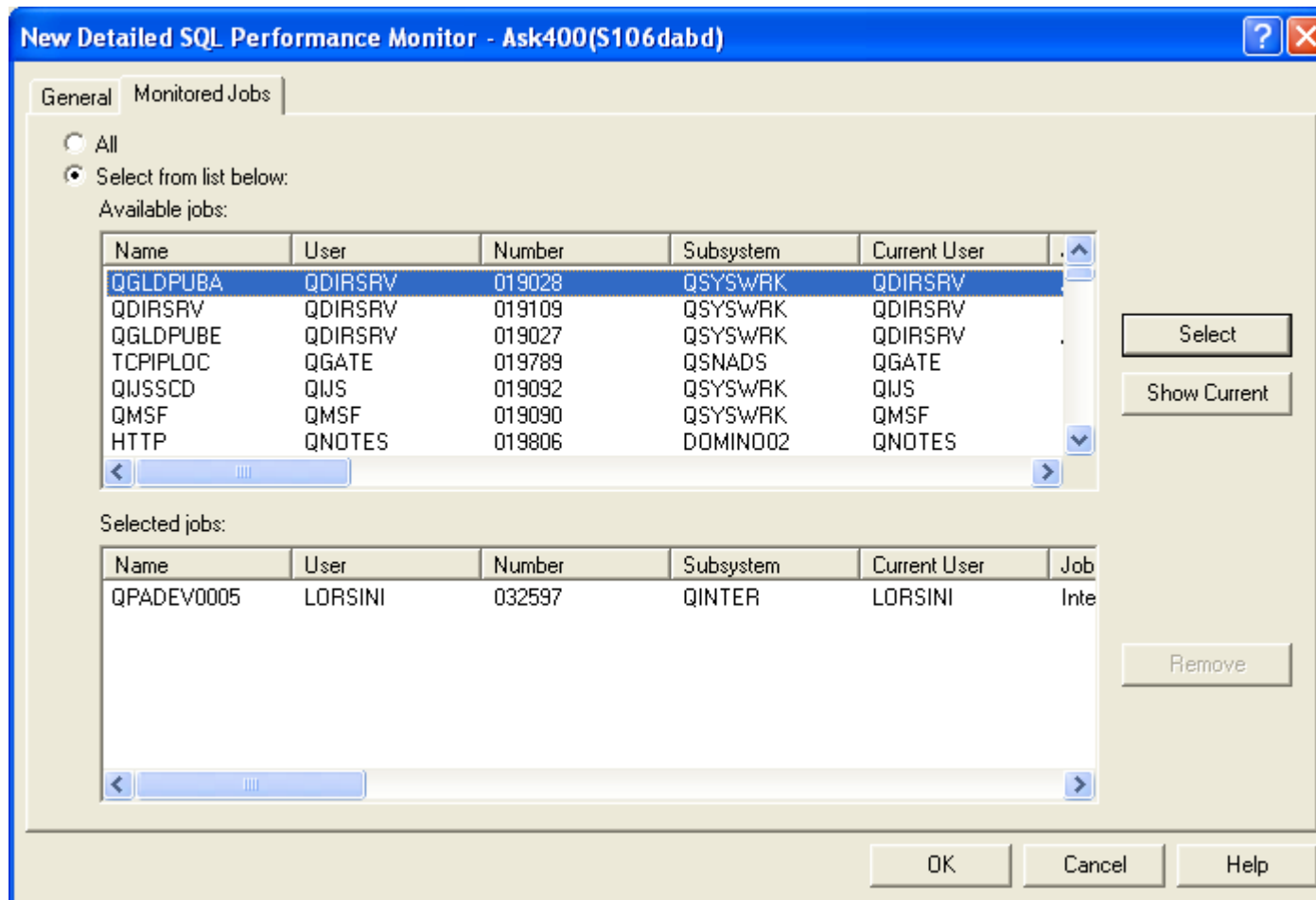


## ISeries Navigator and Database Functions

Enter a Name and Schema (library) for the Monitor, then select the Monitored Jobs Tab.

The screenshot shows a dialog box titled "New Detailed SQL Performance Monitor - Ask400(S106dabd)". It has two tabs: "General" and "Monitored Jobs", with "Monitored Jobs" being the active tab. The "Name:" label is followed by a text input field containing "MummMonitor". Below it, the "Schema for saved data:" label is followed by a dropdown menu with "CORPDATA" selected. At the bottom right, there are three buttons: "OK", "Cancel", and "Help".

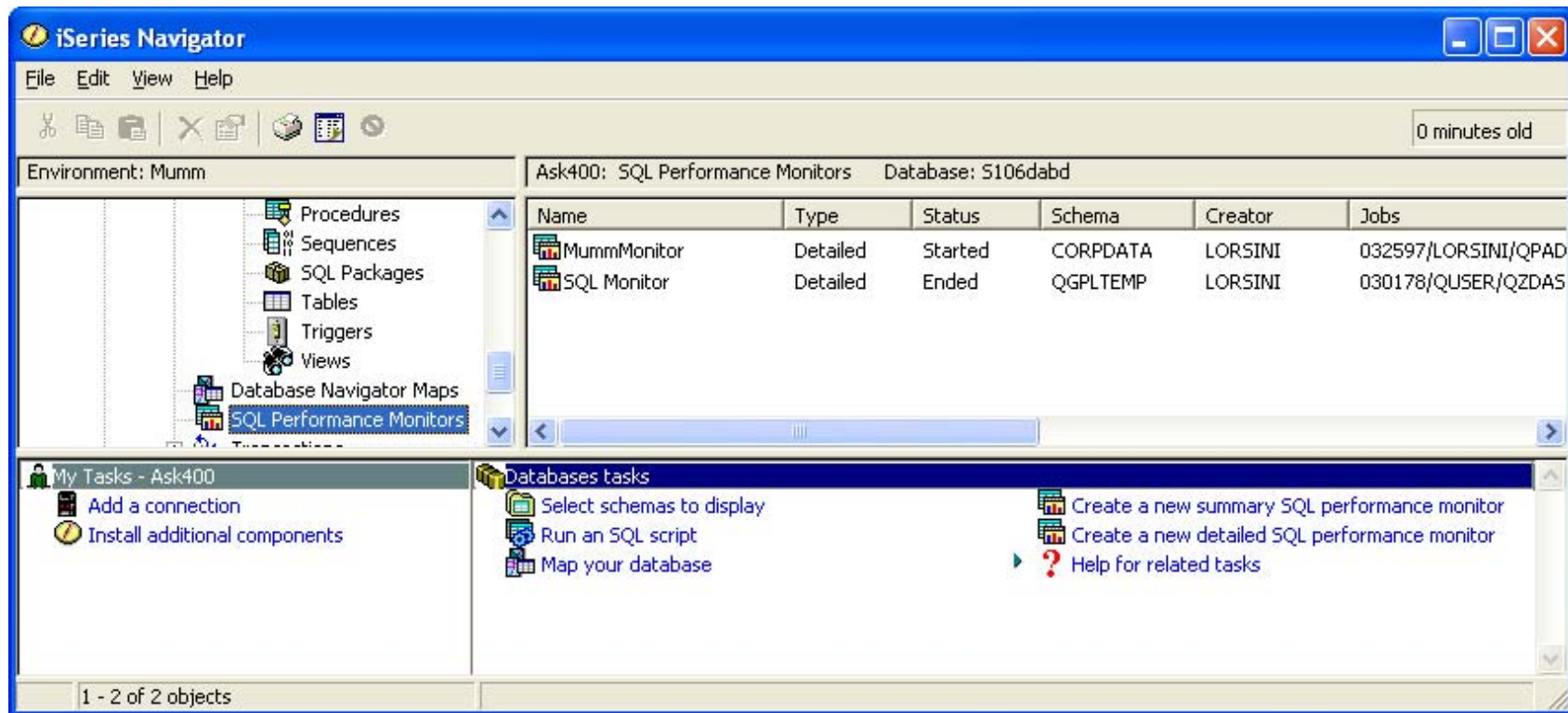
## I Series Navigator and Database Functions



The job fields will act as sort columns to aid you in finding the job(s) you want to monitor. In this case I have selected QPADEV0005.

To check on the status of the monitor Click SQL Performance Monitors in the left hand pane of the iSeries Navigator.

## iSeries Navigator and Database Functions



Right click on the Monitor and select List Explainable Statements. This will open a window which allows you to select the statements you wish to review.

## I Series Navigator and Database Functions

MummMonitor Explainable Statements - Ask400(S106dabd)

SQL statements monitored:

Date	Time	Job	Job number	User	Processing ti...	SQL Text
1/17/05	5:47:20 PM	QPADEV0005	032597	LORSINI	84.0 ms	select * from s...
1/17/05	5:47:45 PM	QPADEV0005	032597	LORSINI	120.0 ms	SELECT DBXL...
1/17/05	5:47:45 PM	QPADEV0005	032597	LORSINI	7.0 ms	SELECT DBXL...
1/17/05	5:47:46 PM	QPADEV0005	032597	LORSINI	120.0 ms	HARD CLOSE ...
1/17/05	5:47:46 PM	QPADEV0005	032597	LORSINI	7.0 ms	HARD CLOSE ...
1/17/05	5:48:34 PM	QPADEV0005	032597	LORSINI	84.0 ms	HARD CLOSE ...
1/17/05	5:48:34 PM	QPADEV0005	032597	LORSINI	297.0 ms	SELECT TABL...

SQL statement selected:

Refresh

Run Visual Explain

Close Help ?

Select the statement you want to analyze and click the Run Visual Explain button, the Visual Explain window will open.

## I Series Navigator and Database Functions

If you want to learn more about database performance you can take a look at the manual *DB2 Universal Database for iSeries - Database Performance and Query Optimization*, which can be found at URL:

<http://publib.boulder.ibm.com/infocenter/series/v5r3/ic2924/info/rzajq/rzajqmst.pdf>

Or Type DB2 Universal Database for iSeries - Database Performance and Query Optimization into Goggle and select the first match.

Other SQL References:

iSeries specific SQL manual, the examples in this manual can be used with the CORPDATA schema created using the examples in this document. *DB2 Universal Database for iSeries SQL Programming Concepts* this can be found at URL:  
<http://publib.boulder.ibm.com/infocenter/series/v5r3/ic2924/info/sqlp/rbafy.pdf>

The IBM Publications home page: Access to DB2, Cloudscape and iSeries information Centers

<http://www.ibm.com/support/publications/us/library/>

SQL Tutorial - The person who wrote this manual claims it doesn't apply to OS/400, but many of the examples are applicable. A lot of time was spent on this and the end result is a very good reference.

[http://ourworld.compuserve.com/homepages/Graeme\\_Birchall/HTM\\_COOK.HTM](http://ourworld.compuserve.com/homepages/Graeme_Birchall/HTM_COOK.HTM)