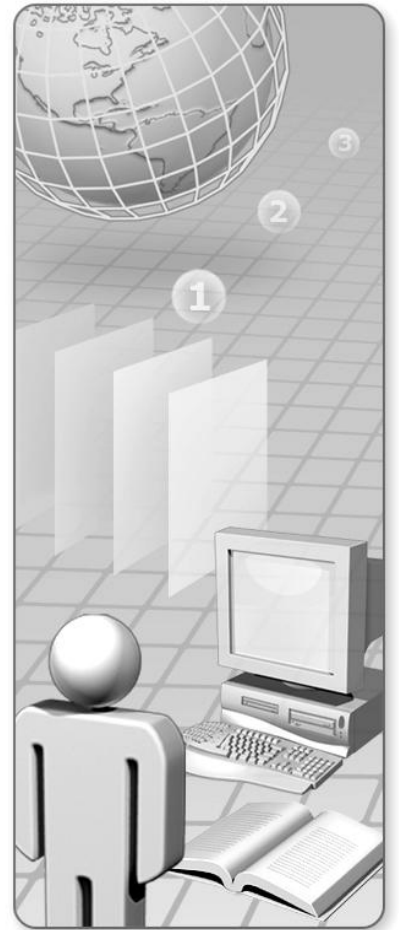


Plan Freezing

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Before You Begin

Estimated time to complete this lab

60 minutes

Objectives

After completing this lab, you will be able to:

- Prevent query plan regression after a server upgrade.
- Use plan freezing to optimize query performance.
- Copy query plans between servers.

Prerequisites

Before working on this lab, you must have:

- Experience of Transact-SQL programming and SQL Server Management Studio.

Lab scenario

The Adventure Works Cycles bicycle manufacturing company has previously encountered performance issues when query plans have changed. This has happened during Microsoft® SQL Server® upgrades and unexpectedly during production. You have decided to implement plan freezing to alleviate these problems during an upgrade to SQL Server 2008. You want to use plan freezing on a test system initially and then deploy it to a production system if tests are successful.

Virtual PC

This lab makes use of Microsoft Virtual PC 2007, which is an application that allows you to run multiple virtual computers on the same physical hardware. During the lab, you will use a virtual machine running Windows Server® 2003.

Before you start the lab, familiarize yourself with the following basics of Virtual PC:

- To switch the focus for your mouse and keyboard to the virtual machine, click inside the virtual machine window.
- To remove the focus from a virtual machine, move the mouse pointer outside the virtual machine window.
- To mimic the CTRL+ALT+DELETE key combination inside a virtual machine, use RIGHT-ALT+DELETE. In Virtual PC, the RIGHT-ALT key is called the host key.
- To enlarge the size of the virtual machine window, drag the lower-right corner of the window as seen in the screenshot.



- To switch to and from full-screen mode, press RIGHT-ALT+ENTER.

Computers in this lab

This lab uses one computer as described in the following table. Before you begin the lab, you must start the virtual machines and then log on to the computer. In each exercise, you only have to start the virtual machine that is needed.

Virtual Machine	Computer Name	User Name	Password
SQL2008CTP6HOLs	CHICAGO	Administrator	Pass@word1

Start the virtual machine

1. Launch Microsoft Virtual PC from the **Start** menu or desktop. If the Virtual PC console does not appear, double-click its icon in the notification area.
2. Select SQL2008CTP6HOLs, and then click **Start**.
3. When the virtual server is running, in the virtual server window, on the **Action** menu, click **Ctrl+Alt+Del** (or press RIGHT-ALT+DELETE on your keyboard) to send a CTRL+ALT+DEL sequence to the logon dialog box within the virtual server window.
4. Type the following information, and then click **OK**:
 - User name: **Administrator**
 - Password: **Pass@word1**

Exercise 1: Preventing Query Plan Regression

In this exercise, you will create a query plan that you can use if performance is affected by a SQL Server upgrade. During an upgrade of SQL Server query plans are often updated and, although most plan changes are beneficial, some plan changes cause performance degradation. To prevent this problem, plan guides can be stored for mission-critical queries. To enable performance analysis after upgrades, the plan guides are typically disabled. If performance is degraded, you can enable the plan guides to return to the previous query plan.

Run a query to generate a query plan

1. Start SQL Server Management Studio. When prompted, connect to the **(local)\SQLDEV01** instance of the database engine by using Windows Authentication. If you are unable to connect, verify if service is started.
2. Open and execute the CustomerSales.sql script from the C:\SQLHOLS\Plan Freezing\Starter folder. This script queries tables in the **AdventureWorks** database, causing a query plan to be generated.
3. Open and execute the InspectQueryPlan.sql script from the C:\SQLHOLS\Plan Freezing\Starter folder to view the query plan that has been generated for the customer sales query.

Note: You can use this syntax for any query, but the query text must match the original query exactly.

Create a plan guide

1. Open the CreatePlanGuide.sql script from the C:\SQLHOLS\Plan Freezing\Starter folder.
2. Under the comment **Insert code to execute sp_create_plan_guide_from_cache here**, add the following code.

```
EXEC sp_create_plan_guide_from_cache
    @name = N'CustomerSales',
    @plan_handle = @plan_handle,
    @statement_start_offset = @offset
```

3. Execute the script to create the plan guide.

Disable the plan guide until it is needed

1. Create a new query, and add the following code.

```
USE AdventureWorks
GO
EXEC sp_control_plan_guide N'DISABLE', N'CustomerSales'
```

Note: By disabling the plan guide, you benefit from the performance improvements that upgrading provides. However, you can return to the previous query plan if performance degrades.

2. Execute the code to disable the plan guide.
3. Execute the following code to confirm that the plan has been disabled by checking the value of the **is_disabled** column.

```
USE AdventureWorks
GO
SELECT * FROM sys.plan_guides
```

Enable the query plan

1. Create a new query, and add the following code.

```
USE AdventureWorks
GO
EXEC sp_control_plan_guide N'ENABLE', N'CustomerSales'
```

Note: You can use this technique to return to a previous, known query plan if performance degrades after an upgrade.

2. Execute the code to enable the plan guide.
3. Execute the following code to confirm that the plan has been enabled.

```
USE AdventureWorks
GO
SELECT * FROM sys.plan_guides
```

4. Keep SQL Server Management Studio open for the next exercise.

Exercise 2: Optimizing Query Performance

In this exercise, you will create a plan guide and test the effect it has on query plans when you enable and disable it. Sudden and unexpected changes in query plans can cause unpredictable performance. This causes particular problems for independent software vendors and with applications that use SQL Server as their database engine. By creating plan guides and disabling them, you enable queries to benefit from statistics-based recompiles, but you can enable the plan guide at any time if the query regresses in production.

Run mission-critical queries and create a plan guide for them

1. In SQL server Management Studio, open the OptimizePerformance.sql script from the C:\SQLHOLS\Plan Freezing\Starter folder.
2. Under the comment **Enter your code here**, add the following code to define the cursor.

```
SELECT qs.plan_handle, qs.statement_start_offset
FROM sys.dm_EXEC_query_stats qs
CROSS APPLY sys.dm_EXEC_sql_text(sql_handle) st
WHERE text LIKE N'SELECT * FROM
    Sales.SalesOrderHeader s1 INNER JOIN Sales.Individual i1
        ON s1.CustomerID = i1.CustomerID AND s1.ContactID = i1.ContactID
    INNER JOIN Person.Contact c1
        ON c1.ContactID = i1.ContactID%'
```

Note: If you insert the following statement, all plans in the cache are frozen. This can be useful for independent software vendors (ISVs) and applications that need predictable query performance.

```
SELECT qs.plan_handle, qs.statement_start_offset
FROM sys.dm_exec_query_stats qs
```

3. Execute the script.
4. Wait until the query has completed, and then execute the following code to confirm that a plan guide with a name beginning with **MissionCritical** has been created and enabled (previous plan guides for the same statement are disabled automatically).

```
USE AdventureWorks
GO
SELECT * FROM sys.plan_guides
```

Inspect the execution plan that the query uses

1. Open the CustomerSales.sql script from the C:\SQLHOLS\Plan Freezing\Starter folder, click the **Include Actual Execution Plan** button, and then click **Execute**.
2. When the query has completed, click the **Execution Plan** tab to view the execution plan.

3. Right-click anywhere in the execution plan, and then click **Save Execution Plan As**. Save the execution plan as C:\SQLHOLS\Plan Freezing\Starter\FullData.sqlplan.

Remove records and confirm that the same execution plan is used

1. Open the DeleteSales.sql script from the C:\SQLHOLS\Plan Freezing\Starter folder, and then execute it to delete a substantial number of sales from the database and update the statistics.
2. Return to the CustomerSales.sql script, ensure that the **Include Actual Execution Plan** button is clicked, and click **Execute**.
3. When the query has completed, click the **Execution Plan** tab to view the execution plan.
4. Right-click anywhere in the execution plan, and then click **Save Execution Plan As**. Save the execution plan as C:\SQLHOLS\Plan Freezing\Starter\ReducedData.sqlplan.

Disable the plan

1. Execute the following code to inspect each enabled plan guide.

```
USE AdventureWorks
GO
SELECT * FROM sys.plan_guides
WHERE is_disabled = 0
```

2. Create a new query, and then execute **sp_control_plan_guide** with relevant parameters to disable each plan. Copy the name of each enabled plan from the results of the query that you executed in the previous step. You should execute the stored procedure once for each enabled plan, and your code should resemble the following example.

```
USE AdventureWorks
GO
EXEC sp_control_plan_guide N'DISABLE', N'<name_of_plan_guide>'
```

Note: By using **sys.plan_guides** and **sp_control_plan_guide**, you can capture a history of query plans and revert to a previous plan if your current plan is not performing optimally.

3. Return to the CustomerSales.sql script, ensure that the **Include Actual Execution Plan** button is clicked, and click **Execute**.
4. When the query has completed, click the **Execution Plan** tab to view the execution plan.
5. Right-click anywhere in the execution plan, and then click **Save Execution Plan As**. Save the execution plan as C:\SQLHOLS\Plan Freezing\Starter\WithoutPlan.sqlplan.
6. Open the three *.sqlplan files that you have saved, and then compare them.

Note: The execution plans for ReducedData.sqlplan and WithoutPlan.sqlplan differ because ReducedData.sqlplan had plan freezing enabled and WithoutPlan.sqlplan had plan freezing disabled.

7. Keep SQL Server Management Studio open for the next exercise.

Exercise 3: Copying Query Plans Between Servers

In this exercise, you will create a script for an existing plan guide and a script for the entire database. Most organizations use test systems to experiment with physical design to achieve optimum performance. After the physical design is decided, the database administrator of the production system needs a script to create the relevant query plans. To reproduce query plan–related issues on a test system, database clones are required. The ability to use SQL Server Management Studio to script objects enables the creation of plan guide scripts to deploy to production servers and complete database scripts to create database clones to reproduce query plan–related issues on a test system.

Generate a plan script on the test server

1. In SQL Server Management Studio, open and execute the TestPlan.sql script from the C:\SQLHOLS\Plan Freezing\Starter folder.
2. In Object Explorer, expand **Databases**, expand **AdventureWorks**, expand **Programmability**, and then expand **Plan Guides**.
3. Right-click the **TestPlan** plan guide, point to **Script Plan Guide as**, point to **CREATE To**, and then click **New Query Editor Window**. SQL Server generates a script for the plan guide in a new query editor window.

Deploy the script onto a production server

1. Right-click anywhere in the query editor window that contains the script generated by SQL Server, point to **Connection**, and then click **Change Connection**.
2. Connect to the **(local)\SQLDEV02** instance of the database engine by using Windows authentication.
3. Click **Execute** to run the script on the **(local)\SQLDEV02** SQL Server instance.

Note: By using this method, the plan guide can be fully tested on a test system and then quickly deployed to a production server.

Verify that the query plan is on the production server

1. In Object Explorer, click **Connect**, and then click **Database Engine**.
2. Connect to the **(local)\SQLDEV02** instance of the database engine by using Windows authentication.
3. In Object Explorer, under the **(local)\SQLDEV02** instance, expand **Databases**, expand **AdventureWorks**, expand **Programmability**, and then expand **Plan Guides**.
4. Verify that the **TestPlan** plan guide is listed.

Generate a database clone

1. In Object Explorer, under the **(local)\SQLDEV01** instance, expand **Databases** if it is not already expanded.
2. Right-click **AdventureWorks**, point to **Tasks**, and then click **Generate Scripts**.
3. On the **Welcome to the Generate SQL Server Scripts Wizard** page, click **Next**.
4. On the **Select Database** page, ensure that **AdventureWorks** is selected, and then click **Next**.
5. On the **Choose Script Options** page, review the default settings, and then click **Next**.
6. The wizard will now show a sequence of pages, one for each type of object to be scripted. On each page, click **Select All**, and then click **Next**.
7. On the **Output Option** page, select **Script to file**, and then change the file name to **C:\SQLHOLS\Plan Freezing\Starter\DatabaseClone.sql**. Ensure that **Single file** is selected, and then click **Next**.
8. On the **Script Wizard Summary** page, click **Finish**.
9. After the script has been generated, view it in SQL Server Management Studio and verify that it contains Transact-SQL code to create all objects in the database, including plan guides.

Note: Database clones are useful to reproduce query plan–related issues for troubleshooting purposes.

10. Close SQL Server Management Studio without saving any script files.
11. Close Virtual PC and discard changes.