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| This learning guide is developed to provide you the necessary information regarding the following content coverage and topics.   * Identifying Diagnose Tool based on organizational database requirements * determining and recording inappropriate use of database | |
| This guide will also assist the trainee to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, the trainee will be able to:   * Identify Diagnose Tool based on organizational database requirements * Determine and recording inappropriate use of database | |
| **Learning Instructions:**   1. Read the specific objectives of this Learning Guide. 2. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask your teacher for assistance if you have hard time understanding them. 3. Accomplish the “Self-check 1”. 4. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1). 5. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is not satisfactory, see your teacher for further instructions, 6. Submit your accomplished Self-check. This will form part of your training portfolio. | |

MODULE TITLE: **Identify and Resolve Database Performance Problems**

**MODULE CONTENTS:**

**MODULE CONTENTS:**

**LO1. Diagnose problems**

1. Identify Diagnose Tool based on organizational ***database***requirements
   * 1. Obtain Diagnose Tool
     2. run diagnostic tools
        1. Identify latch contentions
        2. Identify events causing waits and record outcomes
2. determining and recording inappropriate use of database

1.4 Fixing The Database based on diagnostic results

* **Identify Diagnose Tool based on organizational *database* requirements**

Diagnosis is the process of identification of the nature and cause of a certain phenomenon.

It is used in many different [disciplines](http://en.wikipedia.org/wiki/Academic_discipline) with variations in the use of [logics](http://en.wikipedia.org/wiki/Logics), [analytics](http://en.wikipedia.org/wiki/Analytics), and [experience](http://en.wikipedia.org/wiki/Experience) to determine "[cause and effect](http://en.wikipedia.org/wiki/Causality)".

In database system, it is typically used to determine the causes of the database problem, and the solutions.

Database problems can be detected and solved by using:

* **Performance monitoring** for physical and virtual databases
* **Query monitoring** to see the causes of blocks and deadlocks
* **History browsing** to find and troubleshoot past issues
* **Predictive alerting** with settings to avoid false alerts
* **Capacity Planning** to minimize server collapse
* **Obtain Diagnose Tool**

Microsoft SQL Server is a database management system designed to store massive amounts of data for use in other applications. This set of applications gives you additional tools for working with SQL Server and its databases.

The tools include:

* Monitoring tools,
* Comparison tools,
* Search tools,
* Query builders, etc.

1. MS **SQL** Maestro is an excellent Microsoft **SQL** database administration tool. It has all the functions that you would ever need such as: managing your **SQL** server, creating and dropping databases, managing data inside the tables, executing **SQL** queries, and more.
2. SQL Server Comparison Tool is a Windows program for analyzing, comparing and documenting SQL Server databases.
3. SQL Server Comparison Expert is a database software tool which provides you with very useful comparison functionality, such as database analysis, repairing, comparison and synchronization, backup and restore.
   * + 1. **Identify latch contentions**

Latches are low level serialization mechanisms used to protect shared data structures system global area.

The implementation of latches is operating system dependent, particularly in regard to whether a [process](http://www.geekinterview.com/question_details/13127) will wait for a latch and for how long.

A latch is a type of a lock that can be used to prevent more than one process from executing the same piece of code at a given time.

* + - 1. **Identify events causing waits and record outcomes**

SQL Server Extended Events (Extended Events) is a general event-handling system for server systems.

The Extended Events infrastructure supports the correlation of data from SQL Server, and under certain conditions, the correlation of data from the operating system and database applications. In the latter case, Extended Events output must be directed to Event Tracing for Windows (ETW) in order to correlate the event data with operating system or application event data.

1. **Determining and recording inappropriate use of database**

1.4 **Fixing The Database based on diagnostic results**

When problems occur with a system, it is important to perform accurate and timely diagnosis of the problem before making any changes to a system. Often a database administrator (DBA) simply looks at the symptoms and immediately starts changing the system to fix those symptoms. However, long-time experience has shown that an initial accurate diagnosis of the actual problem significantly increases the probability of success in resolving the problem.

## Automatic Database Diagnostic Monitor

The types of problems that ADDM considers include:

* CPU bottlenecks
* Undersized Memory Structures
* I/O capacity issues
* Database configuration issues
* Concurrency issues

In addition to problem diagnostics, ADDM recommends possible solutions. When appropriate, ADDM recommends multiple solutions for the DBA to choose from.

The recommendations include:

* Hardware changes - Adding CPUs or changing the I/O subsystem configuration
* Database configuration - Changing initialization parameter settings
* Schema changes
* Application changes

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| **Instruction Sheet-1** | **Learning Guide #1** |
| This learning guide is developed to provide you the necessary information regarding the following content coverage and topics.   * Adopting Distributed files architecture to minimize I/O (input/output) contention * Database back-up procedures * Configuring and testing database performance | |
| This guide will also assist the trainee to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, the trainee will be able to:   * Adopt Distributed files architecture to minimize I/O (input/output) contention * Database back-up procedures * Configure and test database performance | |
| **Learning Instructions:**   1. Read the specific objectives of this Learning Guide. 2. Read the information written in the “Information Sheets 2”. Try to understand what are being discussed. Ask your teacher for assistance if you have hard time understanding them. 3. Accomplish the “Self-check 2. 4. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2). 5. If you earned a satisfactory evaluation proceed to “Information Sheet 3”. However, if your rating is not satisfactory, see your teacher for further instructions, 6. Submit your accomplished Self-check. This will form part of your training portfolio. | |

**LO2. Configure database**

* 1. Adopting Distributed files ***architecture*** to minimize I/O (input/output) contention.
     1. Ensuring Database back-up procedures
  2. Database back-up procedures
     1. Backup Option/Tool
        1. Recovery Manager (RMAN)
        2. Secure Backup
        3. A user Managed Backup
     2. Backup type
     3. Full Backup
     4. Incremental Backup
     5. Backup Mode
        1. Offline
        2. Online
  3. Reconfiguring rollback segments
  4. Configuring and testing database performance
* **Adopting Distributed files *architecture* to minimize input/output contention.**

# Distributed file system is a method of storing and accessing [files](http://www.webopedia.com/TERM/F/file.html) based in a [client/server architecture](http://www.webopedia.com/TERM/C/client_server_architecture.html).

In a distributed file system, one or more central servers store files that can be accessed, with proper authorization rights, by any number of remote clients in the network.

Like an [operating system](http://www.webopedia.com/TERM/O/operating_system.html) organizes files in a [hierarchical](http://www.webopedia.com/TERM/H/hierarchical.html) [file management system](http://www.webopedia.com/TERM/F/file_management_system.html), the distributed system uses a uniform naming convention and a mapping scheme to keep track of where files are located.

When the client device retrieves a file from the [server](http://www.webopedia.com/TERM/S/server.html), the file appears as a normal file on the client machine, and the user is able to work with the file in the same ways as if it were stored [locally](http://www.webopedia.com/TERM/L/local.html) on the [workstation](http://www.webopedia.com/TERM/W/workstation.html).

Distributed file systems can be advantageous because they make it easier to distribute documents to multiple clients and they provide a centralized storage system so that client machines are not using their resources to store files.

* **Ensuring Database back-up procedures**

**Backup** is the process by which you make a copy of your work for safekeeping in an alternate location, in case your current work becomes lost or corrupt. The backup copy is only as recent as the last time it was modified. The more work you do, the more frequently you should back up your work.

Before creating databases and schema repositories, administrators should establish procedures and schedules for regular backups.

* Backups can be performed using backup tools provided by the database vendors and third parties.
* Backups should also be performed before moving schema repositories or user databases.

Backup all databases at the same time, including schema repositories and all associated user databases preserves both data and customizations, and ensures that schema repositories and user databases are synchronized in case they need to be restored from a backup.

* **Backup Option/Tool**

There are only two commands for backup, the primary is BACKUP DATABASE.  This allows you to do a complete backup of your database as well as differential, file, etc.The BACKUP DATABASE command gives you many options for creating backups.

* **Create a full backup to disk**

The command is BACKUP DATABASE databaseName.  The "TO DISK" option specifies that the backup should be written to disk and the location and filename to create the backup is specified.

Example: BACKUP DATABASE DatabaseName TO DISK = 'D:\backupFileName.BAK'

* **Create a differential backup**

This command adds the "WITH DIFFERENTIAL" option.

Example: BACKUP DATABASE databaseName TO DISK = 'D:\BackupFileName.BAK' WITH DIFFERENTIAL

* **Create a full backup to multiple disk files**

This command uses the "DISK" option multiple times to write the backup to three equally sized smaller files instead of one large file.

Example: BACKUP DATABASE databaseName TO DISK = 'C:\backupfileName.BAK',

DISK = 'D:\backupfileName.BAK',

DISK = 'E:\backupfileName.BAK'

* **Create a full backup with a password**

This command creates a backup with a password that will need to be supplied when restoring the database.

Example: BACKUP DATABASE databaseName TO DISK = 'D:\backupfileName3.BAK'

WITH PASSWORD = 'Abc\123'

* **Create a mirrored backup**

This option allows you to create multiple copies of the backups, preferably to different locations.

Example: BACKUP DATABASE databaseName TO DISK = 'C:\backupFileName.BAK'

MIRROR TO DISK = 'D:\backupFileName\_mirror.BAK' WITH FORMAT

* **Specifying multiple options**

This next example shows how you can use multiple options at the same time.

Example: BACKUP DATABASE databaseName TO DISK ='C:\backupFileName.BAK'MIRROR TO

DISK = 'D:\backupFileName\_mirror.BAK' WITH FORMAT, STATS, PASSWORD = 'abc/123!'

* **Secure Backup**

Passwords are not required to perform backup operations, but they provide an added level of security. You can use them in addition to using SQL Server security roles. The use of password protection helps guard against unauthorized or unintentional actions such as:

* Restoration of databases
* Appends to the media
* Overwriting of the media

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* **A user Managed Backup**

In order to select a proper backup type, a SQL Server administrator needs to understand the difference between the major backup types clearly.

You should always have proper backup plan in place to protect your database from failures.

* **Backup type**

SQL Server has different types of backups

* Full Backup
* Incremental Backup
* Transaction Log backup
* Differential backup
* File and file group backup

**Difference between: Full, Differential, and Incremental Backup**

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| **Type** | **Definition** | **Benefits** | **Drawbacks** |
| **Full Backup** | A complete backup of everything you want to backup. | Restoration is fast, since you only need one set of backup data. | The backing up process is slow. High storage requirements. |
| **Differential Backup:** | The backup software looks at which files have changed since you last did a full backup.  For restoring all the data, you will only need the last full backup, and the last differential backup. | Faster to create than a full backup.  Restoration is faster than using incremental backup.  Not as much storage needed as in a full backup. | Restoration is slower than using a full backup.  Creating a differential backup is slower than creating an incremental backup. |
| **Incremental Backup** | The backup software creates copies of all the files, or parts of files that have changed since previous backups of any type (full, differential or incremental). | This method is the fastest when creating a backup.  The least storage space is needed. | Restoring from incremental backups is the slowest because to restore the data would require you to process the full backup |

**Note:** The database must have full back up in order to take a differential backup, it only backups the changes since

last full backup.

**Full/Differential/Transaction Log Backup using SQL Server Management Studio**

* Right click on the database name
* Select Tasks > Backup
* Select backup type either "Full" or "Differential" or” Transaction Logl”
* Select the appropriate Backup Destination and click "OK"

**File or File Groups Backup using SQL Server Management Studio**

* + Right click on the database name
  + Select Tasks > Backup
  + Select backup type either "Full" or "Differential"
  + Select Backup component as "Files and file groups"
  + Select the appropriate file group
  + Select the appropriate Backup Destination and click "OK"
* **Backup Mode**
* **Offline**

Offline backup is a way to store files from a network so that they will be accessible even when the user is not connected to the network they are stored on.

* **Online**

Online backup, also known as remote backup, is a method of offsite data storage in which files, folders, or the entire contents of a hard drive are regularly backed up on a remote server or computer with a network connection.

Online [backup](http://www.webopedia.com/TERM/B/backup.html) means to back up data from your hard drive to a [remote](http://www.webopedia.com/TERM/R/remote.html) server or computer using a network connection.

* **Configuring and testing database performance**

You need to configure the SQL server database to work with the application properly.

You can improve performance by considering the following items when configuring the database and log files.

1. Pre-allocating the space required for database files and log files will improve performance.
2. Allowing the log files to grow automatically is required to ensure that unexpected errors do not occur.
3. Placing the data files and log files on separate physical disk drives will improve performance substantially. Make sure that these physical disk drives have enough free space to allow for database growth.
4. The database must be backed up regularly, and other database maintenance tasks must be performed from time to time.

## Database maintenance

After the application has been successfully installed, a database maintenance plan must be established.

Use the 'Maintenance Plan Wizard' to create the plan and schedule it. In the wizard, select these options:

* Check database integrity
* Shrink the database
* Reorganize the index
* Update statistics
* Do a full backup of the database

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| **Instruction Sheet-1** | **Learning Guide #1** |
| This learning guide is developed to provide you the necessary information regarding the following content coverage and topics.   * + Monitoring and tuning efficiency of structured query language   + monitoring and measuring Performance of shared pool, blocks and buffers   + Detecting, identifying and resolving contentions that arise in the real-time operation of the database   + Reconfiguring the database according to specifications | |
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| **Learning Instructions:**   1. Read the specific objectives of this Learning Guide. 2. Read the information written in the “Information Sheets 3”. Try to understand what are being discussed. Ask your teacher for assistance if you have hard time understanding them. 3. Accomplish the “Self-check 3. 4. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 3). 5. If you earned a satisfactory evaluation proceed to “next Information Sheet”. However, if your rating is not satisfactory, see your teacher for further instructions, 6. Submit your accomplished Self-check. This will form part of your training portfolio. | |

**LO3. Tune database**

* + Monitoring and tuning efficiency of structured query language
    1. Tune I/O
  + monitoring and measuring Performance of shared pool, blocks and buffers
    1. Check the SQL query optimization
    2. Tune memory
  + Detecting, identifying and resolving contentions that arise in the real-time operation of the database
  + Reconfiguring the database according to specifications

**LO3. Tune database**

**Database tuning** describes a group of activities used to optimize and homogenize the performance of a [database](http://en.wikipedia.org/wiki/Database). Database tuning aims to maximize use of system resources to perform work as efficiently and rapidly as possible.

* + **Monitoring and tuning efficiency of structured query language**

Microsoft SQL Server provides a comprehensive set of tools for monitoring events in SQL Server and for tuning the physical database design. The choice of tool depends on the type of monitoring or tuning to be done and the particular events to be monitored.

* **Tune I/O**

Hardware and [software](http://en.wikipedia.org/wiki/Computer_software) configuration of disk subsystems MUST examine:

* RAID levels and configuration,
* [Block](http://en.wikipedia.org/wiki/Block_storage) and [stripe](http://en.wikipedia.org/wiki/Data_striping) size allocation,
* The configuration of disks, [controller cards](http://en.wikipedia.org/wiki/Expansion_card), storage cabinets, and external storage systems.

Frequently accessed tables and indexes are placed on separate disks to balance I/O and prevent read queuing.

* **Monitoring and measuring Performance of shared pool, blocks and buffers**
* **Check the SQL query optimization**

**Query optimization** is a function of many [relational database management systems](http://en.wikipedia.org/wiki/Relational_database_management_system). The **query optimizer** attempts to determine the most efficient way to execute a given query by considering the possible [query plans](http://en.wikipedia.org/wiki/Query_plan).

Indexing a column is a common way to optimize the search result.

### SQL Tuning/SQL Optimization Techniques:

* 1. The SQL query becomes faster if you use the actual columns names in SELECT statement.

**Example:** SELECT Id, FirstName, LastName, Age, subject FROM student\_details; Instead of:

SELECT \* FROM student\_details;

* 1. Use operator EXISTS, IN and table joins appropriately in your query.   
     **a)** IN is efficient when most of the filter criteria is in the sub-query, but Usually IN has the slowest performance.   
     **b)** EXISTS is efficient when most of the filter criteria is in the main query.

**Example:** Select \* from product p

where EXISTS (select \* from order\_items o

where o.product\_id = p.product\_id)

Instead of:

Select \* from product p

where product\_id IN(select product\_id from order\_items

* **Tune memory**

Each process running on a computer requires a certain amount of memory to temporarily store its machine code and data. Database management systems (DBMS) also employ shared memory to store data used by many client applications. Memory tuning involves the allocation of the memory resource to the various components of the database management system.

Memory management is all about allocation of objects. A correctly tuned memory management system minimizes the overhead inflicted by garbage collection and makes object allocation fast.

**Note**: - Contentions are detected, identified and resolved that may arise in the real-time operation of the database.

- Database *must be* reconfiguredaccording to organizational specifications