

Data Base Management System

A database management system (DBMS) is a software tool that enables users to create, store, manage, and retrieve data in a structured and efficient way. It allows users to access and interact with the underlying data in the database. These actions can range from simply querying data to defining database schemas that fundamentally affect the database structure. It acts as an intermediary between the user and the database.

Features DBMS

1. Data integrity

A key characteristic of a DBMS, integrity ensures the quality and reliability of the database system. It protects against unauthorized access and makes the database more secure.

2. Data security

It helps to protect information from unauthorized access and modification. A well-designed DBMS can ensure that data is only accessible to authorized users and that unauthorized changes are prevented or detected.

3.Data backups

A crucial element of DBMS software, DBMS automates recovery and backup. This means that in the event of a system failure or natural disaster, data loss is less of a concern.

4.Data definition

Defining the structure of the database, including tables, columns, data types, and constraints.

5.Data manipulation

Data manipulation involves various operations such as inserting, updating, deleting, and querying data within a database. These operations are essential for managing and maintaining the integrity and relevance of the data stored in the database

6.Concurrency control

Managing access to the database by multiple users simultaneously to prevent conflicts and data inconsistencies.

7.Manages huge amount of data

Efficiently manage large datasets with strategies like partitioning, indexing, compression, and distributed computing, optimizing performance, scalability, and cost-effectiveness.

8.Data Management Using Programming Languages

Utilize programming languages like Python, Java, and R to handle data through libraries and frameworks for tasks such as manipulation, analysis, and visualization, enhancing data management capabilities.

9.Backup and recovery

Providing mechanisms to back up the database and recover data in case of failures.

Relational Data Base Management System

This is the most common type of DBMS. They are used to interact with databases that contain structured data in a table format with predefined relationships. Each table has a specific structure, with rows and columns. Rows represent individual records, and columns represent the attributes or characteristics of those records. Microsoft SQL, MySQL, and Oracle Database are some popular DBMS that come under this category.

Features RDBMS

1. Database structure

Data is stored in a navigational or hierarchical form in DBMS, while RDBMS implements a tabular structure where the headers are used as columns names and the rows comprise the corresponding values.

2. Multiple users

Multiple users can access databases thanks to relational database management systems. A single user is all that a database management system can accommodate.

4. Acid

ACID Compliance. RDBMSes use the ACID model Atomicity, Consistency, Isolation, and Durability to maintain consistency across the database.

5. Data integrity constraints

Enforcing integrity rules like primary keys, foreign keys, and unique constraints.

6.SQL support

Providing a standardized language (SQL) for data definition, manipulation, and querying.

Differences Between RDBMS and DBMS

There are some contrasting differences between RDBMS vs. DBMS. An RDBMS is an advanced version of a DBMS. Unlike a DBMS that manages databases on a computer network and hard disks, an RDBMS database helps maintain relationships between its tables.

Here are some of the main differences between an RDBMS and a DBMS:

Feature	DBMS	RDBMS
Number of Operators	Allows only one operator at a time	Supports multiple concurrent users
Data Modificationt	Altering data is difficul	Easily modify data with SQL queries
Data Volume	Requires few Suitable for low data volumes er resources	Suitable for handling large data volumes
Keys and Indexe	Does not involve keys and indexes	Utilizes keys and indexes for relationships
Data Consistency	May lack consistency	Follows ACID model for consistency
Database Structure	Hierarchical	Relational (tables)

Data Fetching Speed	Relatively slow	Faster retrieval due to relational approach
Distributed Databases	Does not support	Offers full support
Hardware & Software	Requires more resources due to complexity	Requires more resources due to complexity

Advantages of DBMS

DBMS has a wide variety of advantages that make it very desirable for a myriad of companies. These include:

1. Improved data security

Data security measures are very important for any organization. To ensure high data security, companies use DBMS as it provides various levels of security authentication which can be done at the user and admin levels. This helps to avoid security breaches and takes care of the security issues.

2. Data retrieval

DBMS provides a platform that is time-saving and easy to use for organizations. Data can be stored and retrieved quickly and securely within time constraints.

3. Minimum data inconsistency

Data inconsistency occurs when there are different versions of the same data stored at different places. For example, data inconsistency exists when let's say a school's database has the name of the Principal as 'Raman Desai' at one place and it's 'Naman Desai' at the other place. Here, there's an inconsistency as the principal is the same and it should be the

same at all places in a database. Such errors are highly minimized in a properly designed DBMS.

4. Improved decision making

DBMS provides high data quality by minimizing data inconsistency and improving data security. This ensures that there are fewer errors and high accuracy rate is maintained. Thus, DBMS helps businesses to improve upon their decisions that are backed by the data in a DBMS.

5. Better data sharing facility

DBMS ensures that database users have access to the data. They can see the data and the changes happening in that data. Then, the end-users can also respond quickly to such updates in the database.

6. Improved data integration

DBMS gives companies an integrated view of their organization's operations and departments. It helps companies to see how one segment of their company is affecting the other one.

7. Good data back-up

Imagine yourself working on an important task, and suddenly the system crashes. How would you feel? Obviously, you'll get angry and irritated. In the case of organizations, they can't afford such errors. So, in such cases, DBMS comes to their rescue by enabling data recovery and backup.

Disadvantages of DBMS

Apart from the advantages, there are a few demerits of using DBMS. Let's have a look at some of the important ones:

1. DBMS is expensive

DBMS requires highly professional staff, sophisticated hardware and software that makes it quite expensive to implement and maintain. Also, training costs for staff and licensing costs are significant ones that add to the total cost of DBMS operations. Thus, heavy investment in database technology results in DBMS being expensive.

2. Complexity issues

DBMS is very complex to operate and manage. It requires skilled personnel to maintain, so it's difficult for non-technical people to understand its working. If one doesn't use DBMS properly, then there can be system failure issues. These issues can lead to database failure or data loss.

3. Not beneficial for small firms

DBMS is designed to be useful for large organizations. Generally, traditional file systems work better for small-scale firms as compared to DBMS. This is because the performance of DBMS is slow for small firms. Also, it's quite expensive for them to use DBMS.

4. Frequent upgrade issue

As updates occur in a system, new features are added to its functionality. This makes it necessary for staff to learn about these software and hardware upgrades. As in today's world, changes occur rapidly, so it takes time, effort, and cost for organizations to train their staff.

Advantages of RDBMS

1. Ease of Use

This is one of the biggest advantages of a relational database; RDBMS has a user-friendly table format, with data being organized according to a natural structure. This also makes it easy to access, and manipulate, and it's easy to locate entries that match.

2. Network Access

A software program in the RDBMS is designed specially to catch requests sent over a network, facilitating client-database communication. Users need not log in for accessing or using the database, affording them greater convenience.

This feature also makes it possible for developers to build web apps and desktop tools that make database interaction possible.

3. Language

RDBMS supports SQL, a standard and familiar language; it has a simple syntax, and uses English phrases and keywords, making it easy to learn and understand. RDBMS also has the capability to insert non-SQL database-centric keywords, features, and functions.

4. Performance

RDBMS is not intrinsically a fast-performing database, but with the database design, there are several optimizations embedded into it, which actually enhances performance. This eventually translates into fast performance for all data sets and apps.

5. Maintenance

It is easier to maintain RDBMS as the tech support team or database administrators can control, test, maintain, and perform backup for the databases they have within their main system. The functions are automated via inbuilt automation tools on the operating system in the RDBMS.

6. Multi-Person Access

We have already seen that multiple users can access the database at the same time. During data change or updating, users can leverage the inbuilt functionality of transaction management and locking for data access.

This way, the system is protected from crashing due to multiple users working on the data, and users are not allowed to partially modify data.

7. Prevents Data Redundancy

This is one of the most important RDBMS advantages. Data redundancy is prevented as tables with specific data have relations among themselves, and the necessary data is retrieved from prior tables.

8. Privileges and Data Security

Access to the database is controlled and subject to authentication by the database admin, who has the power to grant or reject access to users. This increases the security of the database.

Disadvantages of RDBMS

1. Cost

Setting up and maintaining a relational database can be costly. The software required to create and configure a database can have high licensing fees. Additionally, updating the database with new information can be complex, especially for large organizations with intricate data structures. External assistance from experienced programmers may be necessary to implement SQL and build the database. Moreover, hiring an expert RDBMS administrator is essential for effective management and control of the database.

2. Lack of Speed

Compared to other types of databases, RDBMS extracts results pretty slowly, and therefore, performance is much slower. However, it is not among the biggest disadvantages of RDBMS, as its ease of use and rich functionality trump the speed factor.

3. Memory Space

As an RDBMS stores data in tables that have rows and columns, it occupies a great deal of physical memory. This also means additional cost to have more memory and is a significant drawback.

Normalization

Normalization is a database design technique that reduces data redundancy and eliminates issues caused by anomalies while performing Insertions, Updates and Deletions. Normalization rules divide larger tables into smaller tables and link them using relationships. The purpose of Normalization in SQL is to eliminate redundant (repetitive) data and ensure data is stored logically.

1NF -First Normal Form:

Ensures that each table has a unique primary key and eliminates repeating groups.

2NF -Second Normal Form:

Eliminates partial dependencies by ensuring that non-key attributes are fully functionally dependent on the primary key.

3NF -Third Normal Form:

Eliminates transitive dependencies by ensuring that non-key attributes are not dependent on other non-key attributes.

BCNF - Boyce-Codd Normal Form:

Even when a database is in 3rd Normal Form, still there would be anomalies resulted if it has more than one Candidate Key. Sometimes BCNF is also referred as 3.5 Normal Form

4NF - Fourth Normal Form:

If no database table instance contains two or more, independent and multivalued data describing the relevant entity, then it is in 4th Normal Form

5NF - Fifth Normal Form:

A table is in 5th Normal Form only if it is in 4NF and it cannot be decomposed into any number of smaller tables without loss of data.

6NF - Sixth Normal Form

6th Normal Form is not standardized, yet however, it is being discussed by database experts for some time.

Summary

Database designing is critical to the successful implementation of a database management system that meets the data requirements of an enterprise system. Normalization in DBMS is a process which helps produce database systems that are cost-effective and have better security models. Functional dependencies are a very important component of the normalized data process. Most database systems are normalized databases up to the third normal forms in DBMS.

Conclusion

Database Management Systems, particularly Relational Database Management Systems, play a crucial role in modern information management. They provide a structured and efficient means of storing, retrieving, and managing data, facilitating data-driven decision-making and enabling the development of robust applications and systems. Understanding the advantages, disadvantages, and normalization techniques associated with DBMS and RDBMS is essential for effective database design and management.