IT 775
Database Technology

DataStores

DBMS Functionalities, Administration, and Security

DBMS COMPONENTS

DBMS software is used for:

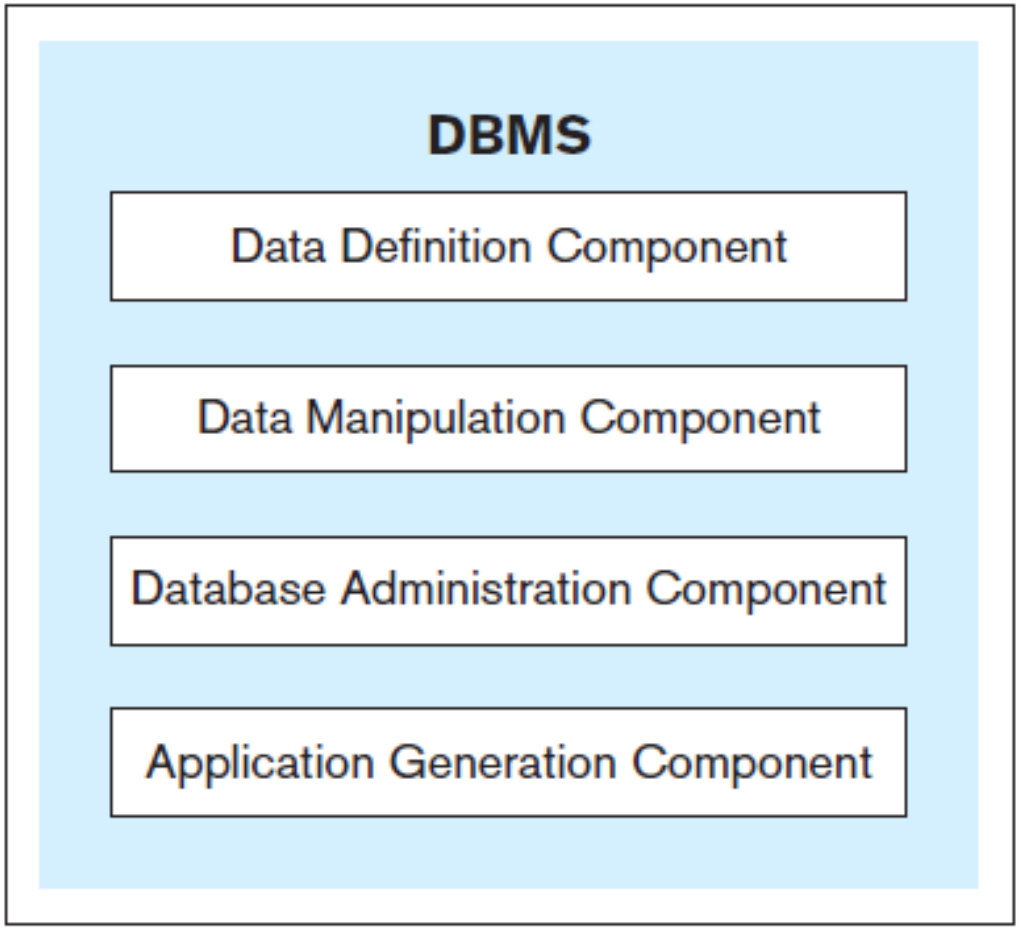
Creation of databases

Manipulation of the data in the databases (i.e. insertion, storage, retrieval, update and deletion)

Maintenance of databases

Creating front-end applications (in some DBMS packages)

DBMS COMPONENTS



DBMS COMPONENTS

Data definition component

Used to create the components of the database

- e.g. database tables, referential integrity constraints connecting the created tables.

Uses DDL (Data Definition Language) SQL commands

DBMS COMPONENTS

Data manipulation component

Used to insert, read, update, and delete information in a database

Uses DML (Data Manipulation Language) SQL commands

Single-user systems

- Data manipulation component used by one user at a time

Multiuser systems

- Data manipulation component used by multiple users at the same time

DBMS COMPONENTS

Data administration component

Used for technical, administrative, and maintenance tasks of database systems

DCL (Data Control Language) and TCL (Transaction Control Language) SQL commands are used during these tasks

DBMS COMPONENTS

Application development component

Used to develop front-end applications

DATABASE ADMINISTRATION

Database administration

Encompasses the activities that are necessary for the proper functioning of a deployed database system, such as:

- Monitoring and maintaining the database system
- Securing the database against unauthorized access
- Providing database backup and recovery
- Ensuring database integrity
- Optimizing database performance
- Developing and implementing database policies and standards

DATABASE ADMINISTRATION

Monitoring and maintaining the database system

Sample activities

- Recognizing instances when maintenance activities are needed
- Observing the usage of tables
- Managing and upgrading the database software and hardware resources

DATABASE ADMINISTRATION

Monitoring and maintaining the database system

Data dictionary

- Repository of the metadata

Catalog

- The data dictionary created by the DBMS
- Can be queried using SQL

Sample entries in data dictionary:

TableName	ColumnName	DataType	DataLength
Vendor	VendorId	Char	2
Vendor	VendorName	VarChar	25

DATABASE ADMINISTRATION

Securing the database against unauthorized access

Preventing unauthorized access to data

Using methods such as:

- **Authentication**
- **Access privileges**
- **Encryption**

DATABASE ADMINISTRATION

Authentication

Login procedure using user ID and password

DATABASE ADMINISTRATION

Access privileges

Assigned to the database user account

Determine user's privileges on database columns, relations and views

Include the following actions:

- SELECT
- UPDATE
- ALTER
- DELETE
- INSERT

DATABASE ADMINISTRATION

Access privileges

Authorization matrix – implements the access privileges

- Provided by the DBMS
- Managed by the DBA
- *Example:*

User	Relation **VENDOR**	Relation **CATEGORY**	…
Bob	SELECT	SELECT, UPDATE	…
Alice	–	SELECT	…
Lee	ALL	ALL	…
…	…	…	…

DATABASE ADMINISTRATION

Access privileges

DCL commands **GRANT** and REVOKE

Example:

```
GRANT SELECT, UPDATE ON vendor TO alice;
REVOKE UPDATE ON vendor FROM alice;
```

DATABASE ADMINISTRATION

Encryption

Encryption key - information scrambling algorithm

Decryption key - reverts the information to its original state

DATABASE ADMINISTRATION

Providing Database Backup and Recovery

Backup - saving additional physical copies of the data

Recovery - recovering the content of the database after a failure

DATABASE ADMINISTRATION

Providing Database Backup and Recovery

Recovery log

- Logs database updates
- Ensures against loss of updates

Checkpoint

- Part of a recovery log
- Indicates a point when updates are written on the disk

DATABASE ADMINISTRATION

Providing Database Backup and Recovery

DBMS actions in the event of a failure

- Rolling back to the checkpoint state
- Redoing the updates in the recovery log since the last checkpoint

TCL command **COMMIT**

- Causes all the updates to be recorded on the disk

TCL command **ROLLBACK**

- Rolls back all the updates since the last COMMIT

DATABASE ADMINISTRATION

Providing Database Backup and Recovery

Complete mirrored backup

- Ensures against complete database destruction

DATABASE ADMINISTRATION

Ensuring Database Integrity

Preventing insertion, modification, or deletion actions that result in invalid, corrupt, or low-quality data in the database

Database integrity can be compromised through events such as:

- Unauthorized malicious data updates
- Update failure
- Accidental misuse

DATABASE ADMINISTRATION

Optimizing database performance

Seeks to minimize the response time for database queries

Involves actions such as:

- Indexing
- Denormalization
- View materialization
- Query optimization

DATABASE ADMINISTRATION

Developing and implementing database policies and standards

Policies and standards for database development

- E.g. naming conventions

Policies and standards for database use

- E.g. business rules

Policies and standards for database management and administration

- E.g. policy for assigning administration tasks

DATABASE ADMINISTRATION

Developing and implementing database policies and standards

Common purpose for database policies and standards is to reflect and support business processes and business logic