Chapter 8

Database Management System

Database is an organized collection of inter-related data stored together with minimum redundancy, which can be retrieved as desirable.

Database Management System (DBMS) is essentially a set of programs which facilitates storage, retrieval and management of database.

Advantages of DBMS:

- Data redundancy (duplication of data) is controlled.
- Data inconsistency is avoided.
- Data are efficiently accessed.
- Data integrity is maintained.
- Data security is ensured.
- Data sharing is allowed.
- Data standardization is enforced.
- Crash recovery of data is possible.

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Components of DBMS:

1. Hardware: This includes computers, storage devices, network devices and other supporting devices for storage and retrieval of data.
2. Software: It consists of the actual DBMS, application programs and utilities.
3. Database: It contains the all the data needed by the organization.
4. Users: People who handle the database.
5. Procedures: It refers to the instructions and rules that govern the design and use of the database.

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Data organisation:

- Field: The smallest unit of stored data.
- Record: A collection of related fields.
- File: A collection of all occurrences of same type of records.
- Database: A collection of files associated with an organisation.

Data abstraction:

It is the process of hiding the complexity of database design from the users. It is implemented through three levels.

a. Physical level: The lowest level of abstraction describes how data is actually stored on secondary storage devices.
b. Logical level: The next-higher level of abstraction describes what data is stored in the database, and what relationships exist among those data.
c. View level: It is the highest level of database abstraction and is the closest to the users. It describes only a part of the entire database.

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Data independence

The ability to modify the schema definition (data structure definition) in one level without affecting the schema definition at the next higher level is called data independence. There are two levels of data independence – physical data independence and logical data independence.

a. Physical data independence: It refers to the ability to modify the schema followed at the physical level without affecting the schema followed at the conceptual level.
b. Logical data independence: It refers to the ability to modify a conceptual schema without causing any changes in the schema followed at view (external) level.

Users of database

The users of a database system can be classified into:

- Database Administrator (DBA): The person who is responsible for the control of the centralized and shared database.
- Application Programmers: Computer professionals who interact with the DBMS through application programs.
- Sophisticated Users: The include engineers, scientists, business analysts, and others who interact with the database through their own queries to generate information.
- Naive Users: People accessing data by invoking one of the application programs. Clerical staff in an office, billing clerk in a supermarket or hotels, bank clerk, etc. are examples.

Relational data model

It is a model of DBMS that represents database as a collection of tables called relations. Most of the database products are based on the relational model and they are known as Relational Data Base Management System (RDBMS). Eg: Oracle, Microsoft SQL Server, MySQL.

Entity: It is a person or a thing in the real world that is distinguishable from others. For example, each student is an entity.

Relation: It is a collection of data organized in the form of rows and columns. A relation is also called Table.

Tuple: The rows (records) of a relation are known as tuples.

Attribute: The columns of a relation are called attributes.

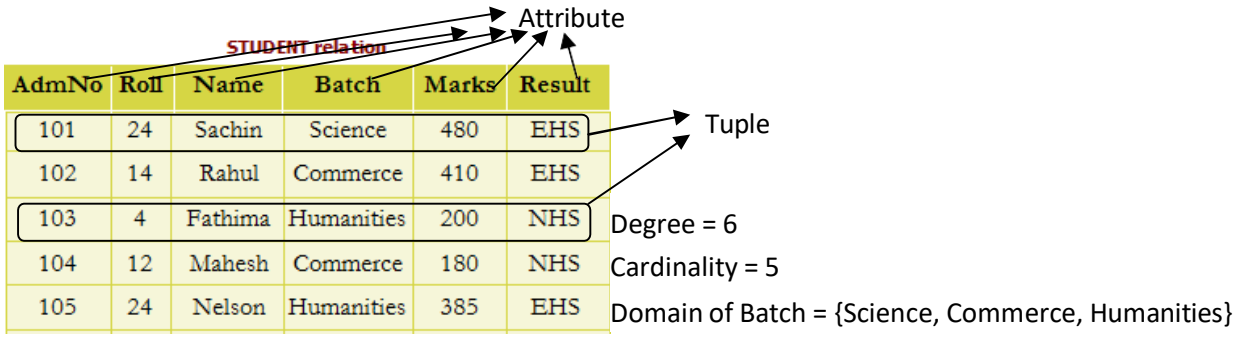
Degree: The number of attributes in a relation determines the degree of a relation.

Cardinality: The number of rows (records) or tuples in a relation is called cardinality of the relation.

Domain: It is a pool of values in a given column of a table.

Schema: The description or structure of a database is called the database schema.

Instance: An instance of a relation is a set of tuples in it.



AdmNo	Roll	Name	Batch	Marks	Result
101	24	Sachin	Science	480	EHS
102	14	Rahul	Commerce	410	EHS
103	4	Fathima	Humanities	200	NHS
104	12	Mahesh	Commerce	180	NHS
105	24	Nelson	Humanities	385	EHS

Key: It is an attribute or a collection of attributes in a relation that uniquely distinguishes each tuple from other tuples in a given relation. There are different types of keys.

- Candidate key: It is the minimal set of attributes that uniquely identifies a row in a relation.
- Primary key: It is one of the candidate keys chosen to uniquely identify tuples within the relation.
- Alternate key: It is A candidate key that is not chosen as the primary key.
- Foreign key: A key in a table can be called foreign key if it is a primary key in another table.

Relational algebra

The collection of operations that is used to manipulate the entire relations of a database is known as relational algebra. These operations are performed with the help of a special language, called query language. The fundamental operations in relational algebra are SELECT, PROJECT, UNION, INTERSECTION, SET DIFFERENCE, CARTESIAN PRODUCT, etc. The SELECT and PROJECT operations are unary operations because they operate on one relation. The remaining operations are binary operations as they operate on pairs of relations.

SELECT operation: It is used to select rows from a relation that satisfies a given condition. This operation is denoted using lower case letter sigma (σ).

The general format of select operation is: $\sigma_{condition}$ (Relation)

The result of SELECT operation is another relation containing all the rows satisfying the given conditions.

PROJECT operation: It selects certain attributes from the table and forms a new relation. It is denoted by lower case letter π . The general format of project operation is: $\pi_{A1, A2,\ldots., An}$ (Relation)

Here A1, A2, , An refer to the various attributes that would make up the relation specified.

UNION operation: It is a binary operation and it returns a relation containing all tuples appearing in either or both of the two specified relations. It is denoted by ∪ . The two relations must be union compatible, which means that the attributes of the relations should be the same in name, number,
type and order.

INTERSECTION operation: It is also a binary operation and it returns a relation containing the tuples appearing in both of the two specified relations. It is denoted by ∩ . The operand relations must be union-compatible.

SET DIFFERENCE operation: It is also a binary operation and it returns a relation containing the tuples appearing in the first relation but not in the second relation. It is denoted by – (minus). The operand relations must be union-compatible.

CARTESIAN PRODUCT operation: It returns a relation consisting of all possible combinations of tuples from the two operand relations. It is a binary operation on relations, which has a degree (number of attributes) equal to the sum of the degrees of the two relations operated upon. The cardinality (number of tuples) of the new relation is the product of the number of tuples of the two relations operated upon. CARTESIAN PRODUCT is denoted by **X** (cross). It is also called CROSS PRODUCT.

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Questions from Previous Years' Question Papers (Computer Science)

1. Discuss the levels of data abstraction in DBMS. (3) (March 2016)
2. In the ACCOUNT relation shown below

Acc. Number	Name	Balance	Type
1000	Simon	1,50,000	SB
1001	Abey	2,00,000	SB
1003	Vishnu	1,00,000	SB
1004	Rahim	2,50,000	SB

   (a) Identify the primary key and candidate keys.
   (b) Select all account holders with balance greater than 2,00,000. (2) (March 2016)
3. What are the major advantages of relational model over other data models? (1) (SAY 2016)
4. (a) Classify the following operations in relational algebra into unary and binary operations:
   (1) UNION (2) SELECT (3) SET DIFFERENCE (4) PROJECT (1) (SAY 2016)
   (b) Explain about SELECT, INTERSECTION and SET DIFFERENCE operations with example. (3) (SAY 2016)
5. (a) Discuss the advantages of DBMS. (3) (March 2017)
   (b) Create a database schema for the relation VEHICLE. (2) (March 2017)
6. _____in a table gives the complete data of a particular entity.
   (a) Tuple (b) Attribute (c) Domain (d) Schema (1) (SAY 2017)
7. As part of your school project you are asked to create a relation STUDENT contains the details of 10 students with the fields RollNo, Name, Date of Borth and Score in IT. The constraints required are – RollNo is the primary key, Name cannot be empty and Score in IT should be less than 60. Based on this table STUDENT answer the following queries in relational algebra.
   (a) Display the details of students whose score is greater than 50.
   (b) Display the name of students whose score lies between 45 and or equal to 60. (5) (SAY 2017)

Questions from Previous Years' Question Papers (Computer Applications)

1. _____level describes only a part of a database.
   (a) View (b) Physical (c) Logical (d) None of these (1) (March 2016)
2. What is relational algebra? Explain any three relational algebra operations. (5) (March 2016)
3. Explain the components of DBMS. (5) (SAY 2016)
4. The number of attributes in a relation is called _____.
   (a) tuple (b) degree (c) cardinality (d) domain (1) (SAY 2016)
5. Is it possible to combine SELECT and PROJECT operations of relational algebra into a single statement? Explain with an example. (2) (March 2017)

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6. In RDBMS a relation contains 10 rows and 5 columns. What is the degree of the relation? (1) (March 2017)
7. Explain different levels of data abstraction in DBMS. (3) (March 2017)
8. _____is the symbol used for select operation in relational algebra.
   (a) σ (b) π (c) ∪ (d) ∩ (1) (SAY 2017)
9. Explain advantages of DBMS over conventional file system. (5) (SAY 2017)

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