

Chapter 2

BASIC CONCEPTS AND TERMINOLOGY OF DATABASES

Q1. What is a field, record and file? Also explain that how data is handled (stored and accessed) in file management system (FMS)?

Ans.

- **Field**
 - A field is a single unit of data stored as part of a database record.
 - Each record is made up of one or more fields, which correspond to the columns in a database table.
 - Fields are often referred to as attributes.
- **Record**
 - A database record consists of one set of fields for a given relational table.
 - In a relational database, records correspond to rows in each table.
- **File**
 - A collection of related records treated as a single unit is called a file or a data set.

Data Handling in File Management Systems

- In a file management system data can only be read or written sequentially.
- A file consists of one or more records.
- Each record contains one or more field instances.
- Each field instance can contain a data value.
- Records can be specified in two different ways in file management system.
- The fields have fixed length or they have variable lengths.
- These stored records can be accessed sequentially or randomly by their address.

While storing and retrieving data in FMS following steps are followed.

- Each file is given a unique name.
- This unique name is used to access the file, additions, deletions and modifications.

- Records in a file are placed next to each other. These records may be of fix length or variable length.
- Each field is given a unique name.
- The starting address of each field and its length is used to identify its storage location.
- To access the contents of the field its name is used.

Fixed length fields

- In this technique length of fields are fixed and specified in application programs.
- For example a name field is specified a length of 15 characters.
- This field will occupy 15 bytes in memory even if the name is of less than 15 characters.
- When the fields in a record are of fix length then the record is also of fix length.

Variable length fields

- A variable length field takes as much space as the data required e.g. if a person name is Ali it will take 3 characters in memory.
- In this method storage space is not wasted.
- In a variable length record the fields are separated using a special character such as the tab character, the comma, or the pipe character.
- Sometimes field values are enclosed in quotation marks, and any internal quotation marks are doubled.
- The most common record delimiter is the newline.

Q2. What is relational database system? Also describe its different data elements.

Ans.

Relational Database System

- In relational databases a file structure is defined as a two dimensional array or table having a unique name in a particular database.
- All the columns of table are called its fields.
- Each record is placed in table in the form of row.
- Row is also called tuple or occurrence of the table.
- Here are a few important definitions regarding database and file management concepts.

Data Elements:**Field, Data Element, Data Item, Attribute or Column:**

The fields or data items in databases are termed as data items, items, attributes or columns.

Record, Row or Tuple:

Records in file management structures are termed as rows or tuples in database structures.

File, Table, Relation or Data Object:

Files or datasets in databases are termed as tables, relations or data objects in database structures.

Database:

The collection of tables with some traditional files and some other necessary data objects is termed as a database.

Q3. What is a relation (table)? Also describe its different properties.

Ans.

Relation / Table

- Table contains the descriptive information about an entity. Table is also called relation.
- Collection of rows and columns is called table. Each intersection of a row and column is called a cell.
- Each record in a file system becomes a row of a relation in database.
- Each record of file management system is called tuple or occurrence of the table in database management system.
- Each entity is composed of attributes (fields) and each attribute (field of a table) has only one value.
- Each file in a file management system corresponds to a table in database management system.
- File management system corresponds to a database management system.

Entity:

- Anything about which you want to keep the information in database is called an entity.
- Entity can be a person, object, concept or anything about which you can think of.
- Name of an entity is written in capital letters.

Entity can be defined in a database model like

STUDENT (ROLL_NO, NAME, GENDER, ADDRESS, TEL)

Here STUDENT is the name of entity and the attributes of this entity are ROLL_NO, NAME, GENDER, ADDRESS and TEL. This entity is converted into a table to store data in database.

		Column				
		↓				
STUDENT						
		ROLL_NO	NAME	GENDER	ADDRESS	TEL
ROW →						

In above diagram all the attributes are called columns of the table and all the rows are called records.

STUDENT

ROLL_NO	NAME	GENDER	ADDRESS	TEL
ST001	Adil	Male	Lahore	23435
ST002	Nida	Female	Karachi	25482
ST003	Qamar	Male	Gujranwala	32654
ST004	Khalid	Male	Sialkot	78452

Properties of Relation

Relation or table is the basis of relational DBMS. A relation must have the following characteristics.

- **No Duplicate Rows**
 - In a relation no two rows can be the same.
 - Actually there is no need to repeat a row.
 - There must be one field which uniquely identifies the row from others which is called primary key.
- **Order of Rows is not significant**
 - There is no order of rows in a table.
 - At the time of query order can be defined.
 - While inserting data order doesn't matter.
 - It enables many uses to share same table without concern how data is organized.
- **Order of Columns is not significant**
 - Order of column like row is not significant.
 - New columns can be inserted at the end and columns can be accessed by their names.
- **Attributes have to be Atomic**
 - All the cells or intersection of a row and columns must have atomic value. An atomic value cannot be further sub divided.
 - Multiple values in a cell are not allowed. e.g. name and address should be placed in two different fields or cells.

Q4. What are views? Also discuss their uses.

Ans.

Views

- In database theory, a view is a virtual or logical table composed of the result set of a query. i.e. views are created using SQL statements.
- It is a dynamic, virtual table computed from data in the database.
- In a relational database, a view is not part of the physical schema.
- Changing the data in a table alters the data shown in the view.

Views can provide advantages over tables;

- They can subset the data contained in a table
- They can join and simplify multiple tables into a single virtual table
- Views can act as aggregated tables, where aggregated data (sum, average etc.) are calculated and presented as part of the data
- Views can hide the complexity of database, for example a view can represent Sales data of different years after getting it from the different complex tables.
- Views do not incur any extra storage overhead
- Views can provide extra security from unauthorized users and illegal access.
- Limit the exposure to which a table or tables are exposed to outer world

View can be created by using SQL statement e.g.

```
CRREATE VIEW    STUDENT_VIEW AS
SELECT          STUD_NO, STUD_NAME, STUD_ADDR
FROM            STUDENT
WHERE           STUD_GENDER="F";
```

The above statement will create a view named STUDENT_VIEW. The view will retrieve the record of only female students from STUDENT table.

Q5. What is a key? Also different types of keys?

Ans.

Keys

- A key is a field or set of fields of a database (typically a relational database) table which together form a unique identifier for a database record (a table entry).
- The aggregate of these fields is usually referred to simply as "the key".
- A Key field also defines searches.
- Keys are used to establish relationship among tables.
- Keys are helpful to enforce data integrity.

Types of Keys

- **Primary Key**
 - In a table the attribute or combination of columns that uniquely identify all possible rows in a table.

- A table can have only one primary key.
- Primary key cannot be null.
- Each value in primary key attribute must be unique.
- Primary key cannot be changed or removed during database operations.
- A primary key is identified by underline the attribute name in the relation.

STUDENT (ROLLNO, NAME, GENDER, ADDRESS, TELL)

Example: A Social Security number (associated with a specific person), ISBN (associated with a specific book) student roll number (associated with only one student in a class).

- In the following example TEACHER_CODE is primary key field which uniquely identifies each row in the table.

TEACHER

TEACHER_CODE	NAME	PHONE	ADDRESS
TE004	Prof. Ijaz Ahmad	74581	Lahore
TE005	Dr. Aslam Elahi	54821	Karachi
TE007	Dr. Zahid	32547	Islamabad
TE009	Prof. Arslan	74985	Lahore

- **Secondary Key**
 - Secondary key may or may not be unique field. Some times records are required to access by a field other than the primary key. In these situations another key that is used is called secondary key.
- **Candidate Key/Alternate Key**
 - A table can have more than one attribute to be qualified as primary key. One of them is selected as primary key and remaining keys are called candidate keys.
 - Sometimes a relation has more than one attribute that can be used as the primary key. In these situations, it is difficult to select a primary key. There can be more than one unique field or combinations of unique fields in a relation. These keys are termed as candidate keys or alternate keys.
- **Composite/Concatenate Key**
 - Composite key consists of two or more than two fields.
 - Composite key is also designated as a primary key.
 - It is created in a situation when no single field fulfills the property of uniqueness. To make unique more than one field are combined and used as primary key.

- **Sort/Control Key**

- A field or a set of fields in a record that dictate the sequence of the file according to our requirement.

Example: The sort keys STATE and NAME arrange the table data alphabetically by name within state. STATE is the major sort key, and NAME is the minor sort key.

- **Foreign Key**

- A foreign key is a referential constraint between two tables.
- Foreign key is an attribute of a relation that is used as a primary key another table.
- The table that contains a foreign key is called dependent table or child table.
- The table from where foreign key is referred is called parent table or independent table.
- The foreign key identifies a column or a set of columns in parent table that refers to a column or set of columns in child table.
- The columns in the parent table must form a primary key or unique key.
- The values in one row of the child table columns must occur in a single row in the parent table.
- A row in the child table cannot contain values that don't exist in the parent table.
- Foreign key and primary key are used to establish relationship between two tables.
- It is also helpful to maintain data integrity.

In the following example teacher table is parent table and student table is child table. In parent table TEACHER_CODE is primary key which is referenced in STUDENT table as foreign key.

TEACHER

TEACHER_CODE	NAME
TE004	Prof. Ijaz Ahmad
TE005	Dr. Aslam Elahi
TE007	Dr. Zahid Mahmood
TE009	Prof. Arslan

STUDENT

ROLL_NO	NAME	TEACHER_CODE	PHONE	STATUS
ST001	Adil	TE009	58555	Y

ST007	Tahir	TE004	74542	Y
ST008	Imran	TE007	78541	N
ST012	Adnan	TE004	74542	Y
ST034	Qasim	TE005	74646	N
ST038	Zahid	TE009	58555	Y

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Q6. Define the term user? Also explain the role of data and database administrator?

Ans.

The User

- It is the person who uses the database management system for his need.
- He must have knowledge of information technology.
- He doesn't need to have the detail knowledge of the database system.
- He should be aware of the usage details of the installed software.
- He interact with the database through application program.

The Data Administrator

- The Data Administrator is the head of the Data Administration (DA) department. He is responsible for the entire data of an organization.
- The DA department is responsible for the definition, organization, supervision, and protection of data in order to provide good quality, shareable, and accessible data throughout the enterprise.
- The DA establishes and implements policies and procedures.
- The Data Administrator manages a staff that is responsible for establishing and implementing the Data Administration Program.

Responsibilities of Data Administrators may include the following:

- Coordinate management and users to develop the information models, diagrams and reports that contribute to the data architecture;
- Maintain the documentation of all components of the data architecture (conceptual, logical and physical models) through a central data repository;
- Develop policies on data-related activities such as data dictionary, data integrity, data security, data inventory and data standards.
- Assist Database Administration with backup and recovery, integrity checks, etc.
- DA serves as bridge between user and data processing staff and he is responsible for user training.

The Database Administrator

A database administrator (DBA) is a person who is responsible for the environmental aspects of a database. He is responsible for the design, implementation, operation, management and maintenance of the database. He must be technically competent.

Responsibilities of the DBA:

- Installation of software.
- Monitoring of database system.
- Solution of every problem.

- Recoverability - Creating and testing Backups
- Integrity - Verifying or helping to verify data integrity
- Security - Defining and/or implementing access controls to the data
- Availability - Ensuring maximum uptime
- Performance - Ensuring maximum performance given budgetary constraints
- Development and testing support - Helping programmers and engineers to efficiently utilize the database.

The role of a database administrator has changed according to the technology of database management systems (DBMSs) as well as the needs of the owners of the databases. For example, although logical and physical database designs are traditionally the duties of a database analyst or database designer, a DBA may be asked to perform those duties.

Q.7 What are indexes? What is their usage in FMS & DBMS?

Ans.

Indexes

- A database index is a data structure that improves the speed of operations in a table.
- Indexes can be created using one or more columns, providing the basis for both rapid random lookups and efficient ordering of access to records.
- The disk space required to store the index is typically less than the storage of the table (since indexes usually contains only the key-fields according to which the table is to be arranged, and excludes all the other details in the table).

In a relational database an index is part of a table created by the system developer/DBA.

Usage

- An index is used to locate a record in a file more quickly.
- It is also used to speed up the sorting and searching procedures
- Some indexes are created automatically when relationships are created in related tables.
- The index may be created on primary key, secondary key and foreign key etc.
- The indexes are stored in index file.
- DBMS uses these files to improve their performance.

Disadvantage:

- Indexes can slow down the data entry and editing because index file is also updated each time data is added or modified.

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Q.8 Discuss data manipulation in a database management system.

Ans.

Data Manipulation in a DBMS

Data manipulation in a database management system is different from data manipulation in traditional file management system.

- Data is stored and manipulated in a data structure known as relation or table.
- A database may have one or more relations. In a relational database management system, these relations are related through primary-foreign key pairs.
- DBMS uses indexes to quickly find data stored in relations.
- There are different types of users of a database. Each type of user has a distinct role in a DBMS. End-users usually access and view data. Data Administrator organizes, supervises, and protects data. Database Administrator maintains the database system.
- SQL is usually used for data manipulation operations. DBMS provides facilities to insert update and delete the records in the database.