

CHAPTER 8: DATABASE CONCEPTS AND MANAGEMENT

8.1 DATABASE CONCEPTS

8.1.1 Limitations of File-Based Systems

Disadvantages:

- No enforcing control on organization/structure
- Data repeated in different files
- Manual changes required in all files
- Sorting must be done manually or by program
- Data may be in different formats
- Cannot be multi-user (chaotic)
- Security not sophisticated

8.1.2 Database Approach

Database:

- Collection of non-redundant interrelated data
- Organized for efficient access

DBMS (Database Management System):

- Software programs that allow databases to be defined, constructed, and manipulated

8.1.3 Relational Database Terminology

Term	Definition
Entity	Object/event that can be distinctly identified
Table	Contains related entities in rows and columns
Tuple	Row/record in relational database
Attribute	Field/column in relational database
Primary Key	Attribute that uniquely identifies each tuple
Candidate Key	Attribute that can potentially be primary key
Foreign Key	Attribute that relates two different tables
Secondary Key	Candidate key not chosen as primary
Referential Integrity	Prevents inconsistent data in relationships

8.1.4 Entity-Relationship Diagrams

Relationships:

- **One-to-Many:** One record relates to many records
- **One-to-One:** One record relates to one record
- **Many-to-Many:** Many records relate to many records (requires intermediate table)

8.2 DATABASE MANAGEMENT SYSTEMS (DBMS)

8.2.1 Features of DBMS

Data Management:

- Data stored in relational tables
- Secondary storage

Data Dictionary:

- List of all files
- Number of records
- Names and types of fields

Data Modelling:

- Analysis of data objects
- Identifying relationships

Logical Schema:

- Overall view of database
- Entities, attributes, relationships

Data Integrity:

- Block copied when changed
- Saved back when done

Data Security:

- Password allocation
- Automatic backups
- Access rights control

Data Change Handling:

- Exclusive mode (impractical for multiple users)
- Lock all records in table
- Lock current record only
- Warn of simultaneous change

Deadlock:

- Two locks at same time
- One user must abort

8.2.2 DBMS Tools

Developer Interface:

- Creates and manipulates database in SQL

Query Processor:

- Handles high-level queries
- Parses, validates, optimizes
- Creates query plan

8.3 NORMALIZATION

8.3.1 First Normal Form (1NF)

Requirements:

- No repeating attributes
- Intersection of each tuple and attribute contains only one value

8.3.2 Second Normal Form (2NF)

Requirements:

- In 1NF
- Every non-primary key attribute fully dependent on primary key
- Remove incomplete dependencies

8.3.3 Third Normal Form (3NF)

Requirements:

- In 1NF and 2NF
- All non-key elements fully dependent on primary key
- No inter-dependencies between attributes

8.3.4 Many-to-Many Relationships

- Cannot be directly normalized to 3NF
- Must use intermediate table (two-step process)

8.4 SQL (STRUCTURED QUERY LANGUAGE)

8.4.1 Data Definition Language (DDL)

CREATE DATABASE:

```
<SQL>
```

```
CREATE DATABASE database-name
```

CREATE TABLE:

<SQL>

```
CREATE TABLE table-name (  
  field1 data-type,  
  field2 data-type,  
  ...  
)
```

ALTER TABLE:

<SQL>

```
ALTER TABLE table-name ADD field-name data-type
```

PRIMARY KEY:

<SQL>

```
PRIMARY KEY (field)
```

FOREIGN KEY:

<SQL>

```
FOREIGN KEY (field) REFERENCES table(field)
```

8.4.2 Data Manipulation Language (DML)

SELECT (Query):

<SQL>

```
SELECT field-name  
FROM table-name  
WHERE condition
```

Operators: =, >, <, >=, <=, <>, IS NULL

ORDER BY: Sort ascending

<SQL>

```
ORDER BY field-name
```

GROUP BY: Group identical data

<SQL>

GROUP BY field-name

INNER JOIN: Combine fields from different tables

<SQL>

INNER JOIN table **ON** condition

INSERT:

<SQL>

INSERT INTO table (field1, field2)
VALUES (value1, value2)

DELETE:

<SQL>

DELETE FROM table **WHERE** condition

UPDATE:

<SQL>

UPDATE table
SET field = value
WHERE condition

Data Types:

- CHARACTER(n)
- VARCHAR(n)
- BOOLEAN
- INTEGER
- REAL
- DATE

- TIME

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