DATABASE SYSTEMS

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Ch 1. Databases and Database Users

- Database: a collection of data with the following properties

  (a) it represents some aspect of the real world;
  changes to the real world are reflected in the database

  (b) logically coherent collection of data (inter-related)

  (c) it is designed, built and populated with data for
  a specific purpose (intended users and applications)

  (d) typically large in size

- Database Management System (DBMS): collection of programs that enables users to create and maintain a database. Activities: **Defining** the database (structure), **Constructing** the database (populating), **Manipulating** the database (query, applications, updates)
  Figure 1.1
  Figure 1.2

Database Approach vs. Traditional File Processing

- Self contained nature of database systems (database contains both data and meta-data).
- Data Independence: application programs and queries are independent of how data is actually stored. (Figure 1.3 add Birthdate)
- Data sharing.
- Controlling redundancies and inconsistencies.
- Secure access to database; Restricting unauthorized access.
- Enforcing Integrity Constraints.
- Backup and Recovery from system crashes.
- Support for multiple-users and concurrent access (data sharing).
- Support for multiple views of data (Figure 1.4)

Actors on the scene

- Database Administrator (DBA)
- Database Designers
- End Users:

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Casual users  (managers using SQL)
Naive (or parametric end users)  (bank tellers/clerks)
Sophisticated end users (engineers, scientists, analysts)
Stand-alone users (personal db, single user, ex. tax package)
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- System Analysts and Application Programmers

Workers behind the Scene

- DBMS designers and implementors
- Tool developers
- System administrators

Intended uses of a DBMS

-- Controlling redundancy (Figure 1.5)
-- Restricting unauthorized access
-- Persistent storage of program objects and data
-- Deductive inferences of data
-- Multiple user interfaces (SQL, C-SQL, Forms, Menus, Web)
-- Complex relationships among data (1-many, many-many, 1-1)
-- Enforcing integrity constraints
-- Backup and recovery

Implications of Database approach

-- potential for enforcing standards (naming/formatting convention,
display formats, report structures)

-- reduced application development time (once database is up and running)

-- flexibility (changing database structure)

-- Up-to-date information (e.g. airline reservations)

-- Economies of scale (invest in one server, centralized database)

Data Models, Schemas, Instances

Data Model: set of concepts used to describe the structure
of a database (abstraction tool); It may also include
a set of operations for specifying updates and queries

- High-level or Conceptual Data Model (ER)

- Representational or Implementation Data Model
(Record-based; Value-based/object-based)
Relational, Object-Oriented, Deductive, Hierarchical, Network

- Low-level or Physical Data Model (access paths)

Database Schema vs Database Instance

Schemas (Intension) and Instances (Extension)

Schema: structure (meta-data; schema diagram; schema constructs)
Figure 2.1

Instances: actual data (occurrences or instances) database state

2.2 DBMS Architecture and Data Independence

Figure 2.2

Internal Level (physical structure)
Conceptual Level (logical structure)
External Level (Views)

mappings: from one level to another

Data Independence:
  Logical Data Independence: ability to change conceptual
    schema without having to change external views or
    application programs

  Physical Data Independence: ability to change internal schema
    without having to change conceptual or external schema.

2.3 Database Languages and Interfaces

DBMS Languages: DDL (for conceptual level)
SDL (Storage) and VDL (Views) when three
levels are separated by system.
DML (for queries and manipulation)
- Query Language (non-procedural/declarative)
set at a time
- procedural DML
record at a time
host language (embedding)
User Interfaces (Menu-based,GUI,Forms-based,
Natural-language))

2.4 Database System Environment

Figure 2.3

Classification of DBMS

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-- Based on Data Model
    Relational, Network, Hierarchical, Object-Oriented, Others

-- Based on number of users
    Single-user, Multi-user

-- Based on number of sites
    Centralized, Distributed (Homogenous/Heterogenous)
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