

Database Management System

Daw Lay Myat Myat Thein
Associate Professor
Faculty Of Information Science
email: laymyatmyatthein@uit.edu.mm

UNIVERSITY OF INFORMATION TECHNOLOGY

Text Book

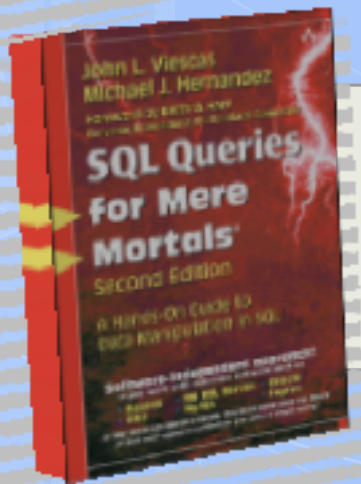


“Database Management System, Third Edition”, By
Raghu Ramakrishnan

Reference Books

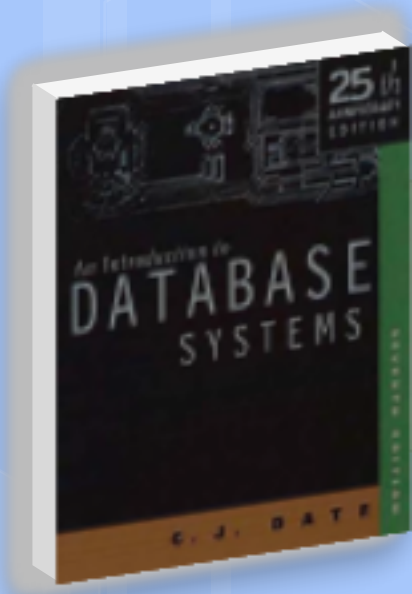


“Modern Database Management,” Eleventh Edition By
Jeffrey A. Hoffer. V.Ramesh, Heikki Topi






“SQL Queries for Mere Mortals, Second Edition ,
A Hands -on Guide to Data Manipulation in SQL”,
By
John L.Viescas Michael J.Hernandez

Reference Books



“An Introduction to DATABASE SYSTEMS, Seventh Edition By C.J.DATE

Overview of Database Systems

-  Introduction to Database
-  Understanding the Database Management System(DBMS)
-  Database System Architecture and Transaction Management



Basic concepts

Data: stored **representations** of meaningful **objects and events**.

- Structured: numbers, text, dates
- Unstructured :images, video, documents

Information: **data processed** to increase knowledge in the person using the data



✓ E.g consider list of facts

Baker, Kenneth D. 324917628
Doyle, Joan E. 476193248
Finkle, Clive R. 548429344
Lewis, John C. 551742186
McFerran, Debra R. 409723145

✓ (useless in their present form)/**Raw Facts**

✓ Satisfy **data**

Class Roster			
Course:	MGT 500	Semester: Spring 2010	
	Business Policy		
Section:	2		
<u>Name</u>	<u>ID</u>	<u>Major</u>	<u>GPA</u>
Baker, Kenneth D.	324917628	MGT	2.9
Doyle, Joan E.	476193248	MKT	3.4
Finkle, Clive R.	548429344	PRM	2.8
Lewis, John C.	551742186	MGT	3.7
McFerran, Debra R.	409723145	IS	2.9
Sisneros, Michael	392416582	ACCT	3.3

Figure 1: **information** of Class Roster



- ✓ **Metadata:** data that describes **the properties and context of user data.**

TABLE 1 Example Metadata for Class Roster

Data Item		Metadata				
Name	Type	Length	Min	Max	Description	Source
Course	Alphanumeric	30			Course ID and name	Academic Unit
Section	Integer	1	1	9	Section number	Registrar
Semester	Alphanumeric	10			Semester and year	Registrar
Name	Alphanumeric	30			Student name	Student IS
ID	Integer	9			Student ID (SSN)	Student IS
Major	Alphanumeric	4			Student major	Student IS
GPA	Decimal	3	0.0	4.0	Student grade point average	Academic Unit



What is database ?

- ✓ organized **collection of logically related data**, usually designed to meet the information needs of multiple users in an organization.



- ✓ For example, A university database contain:
- ✓ **Entities** :students, faculty, courses, classrooms.
- ✓ **Relationships** :students' **enrollment** in courses, faculty **teaching** courses, the **use of** classrooms for courses.



Types of Database

Category	Types of Database	Description
Number of Users	<ul style="list-style-type: none">• Single-user database• Multi-user database	<ul style="list-style-type: none">• Supports one user at a time• Supports concurrent users at a time
Data Location	<ul style="list-style-type: none">• Centralized database• Distributed database	<ul style="list-style-type: none">• Data located in a single site• Data distributed across different sites
Data Usage	<ul style="list-style-type: none">• Operational Database• Data warehouse	<ul style="list-style-type: none">• Supports day-by-day operation for the organization (OLTP)• Sorting data used to generate information for analyses (OLAP)
Data Availability	<ul style="list-style-type: none">• Standalone database• Clustering database	<ul style="list-style-type: none">• Supports no faults tolerant mechanism• Supports fault tolerant mechanism



File Processing System

- ✓ Program-Data Dependency
- ✓ All programs maintain metadata for each file they use
- ✓ Makes **duplicate data**, causes maintenance headaches.
- ✓ **The biggest problem:**
 - **Data changes in one file could cause data inconsistencies**
 - Compromises in ***data integrity***



Duplicate Data

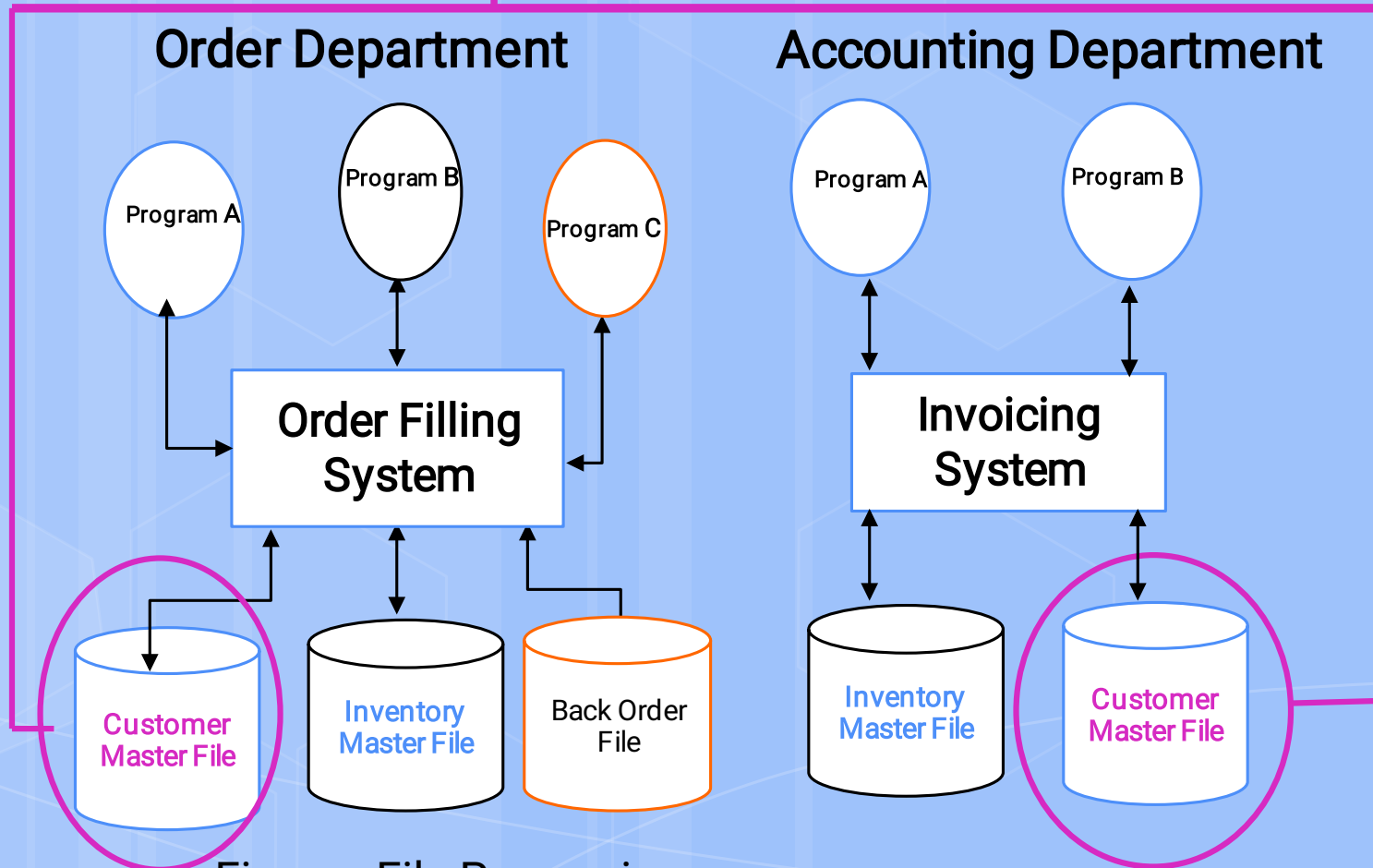


Figure : File Processing System



File System Versus Database

- ✓ To resolve file system problem, databases were proposed.
 - ✓ A comparison of traditional files and databases is as shown below:

Item	File	Database
Impact of changes to data format on program	Large	Small
Redundancy of data	Data is sometimes redundant on a task-by-task basis	No redundancy
Consistency between related data	Hard to maintain	Can be maintained
Sharing of data between tasks	Sharing is difficult	Sharing is easy
Data backup	Complicated	Simple and easy



Data Model

- ✓ stored data in terms of *a data model*.
- ✓ data model is **a collection of high-level data description**
- ✓ A *description of data in terms of a data model is called a schema*.

Types of Data Models

1. The relational data model (Oracle, Sybase, Microsoft's Access)
2. The hierarchical model (IBM's IMS DBMS)
3. The network model (IDS and IDMS)
4. The object-oriented model
5. The object-relational model



The Relational Model

- ✓ Data Model in the relational model
- ✓ **Schema** : **relation's name, field's name (attribute or column), and data type**
 - ✓ Data is represented in rows and columns:
- ✓ Students(sid: string, name: string, login: string, age: integer, gpa: real)

An attribute (column) describes same domain information

sid	name	login	age	gpa
53666	Jones	jones@cs	18	3.4
53688	Smith	smith@ee	18	3.2
53650	Smith	smith@math	19	3.8
53831	Madayan	madayan@music	11	1.8
53832	Guldu	guldu@music	12	2.0

a record (row)
describes a student
complete information



The Network Model

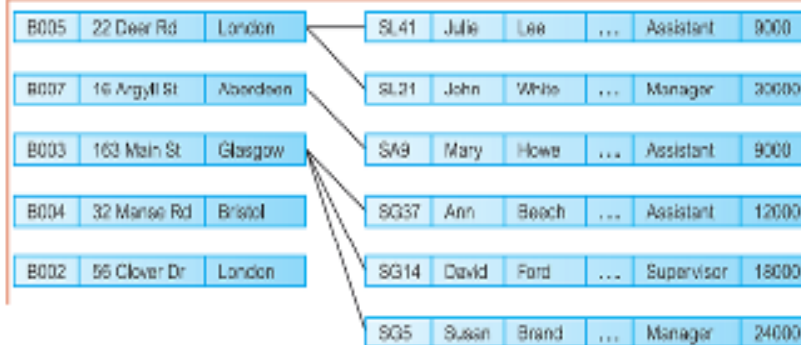
- ✓ Data Model in the network model.
- ✓ Data is represented as **collections of records**
- ✓ Relationships are represented by **sets**.
- ✓ (Many-to-many parent-child relationships)

Branch

branchNo	street	city	postCode
B005	22 Deer Rd	London	SW1 4EH
B007	16 Argyll St	Aberdeen	AB2 3SU
B003	163 Main St	Glasgow	G11 9QX
B004	32 Manse Rd	Bristol	BS99 1NZ
B002	56 Clover Dr	London	NW10 6EU

Staff

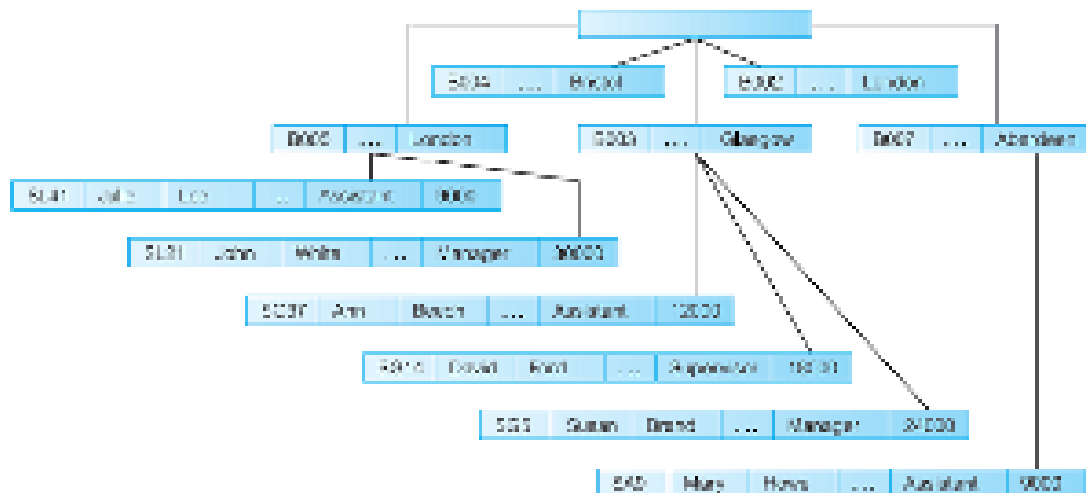
staffNo	fName	lName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000	B003
SG14	David	Ford	Supervisor	M	24-Mar-58	18000	B003
SA9	Mary	Howe	Assistant	F	19-Feb-70	9000	B007
SG5	Susan	Brand	Manager	F	3-Jun-40	24000	B003
SL41	Julie	Lee	Assistant	F	13-Jun-65	9000	B005



A sample instance of a network schema.

Hierarchical Model

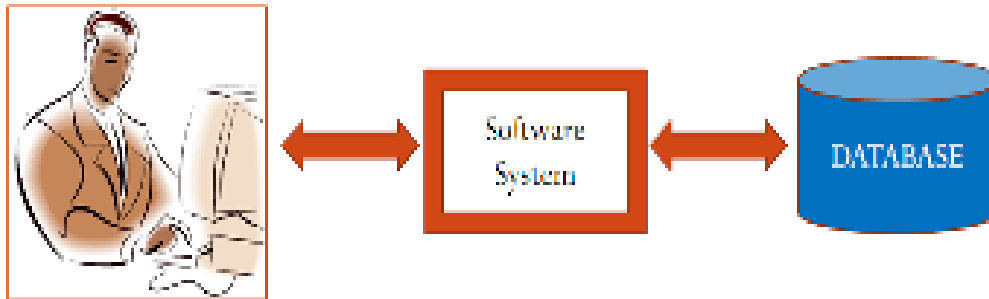
- ✓ restricted type of network model.
- ✓ Data is represented as collections of records
- ✓ relationships are represented by sets.
(One-to-many parent-child relationships)
- ✓ can be represented as a tree graph.





What is DBMS?

- ✓ **software designed** to assist in maintaining and utilizing large collections of data.
- ✓ enables users to define, create, maintain, and control access to the database.





- ✓ A computer program that interacts with the database by issuing **an appropriate request (an SQL statement)** to the **DBMS**.

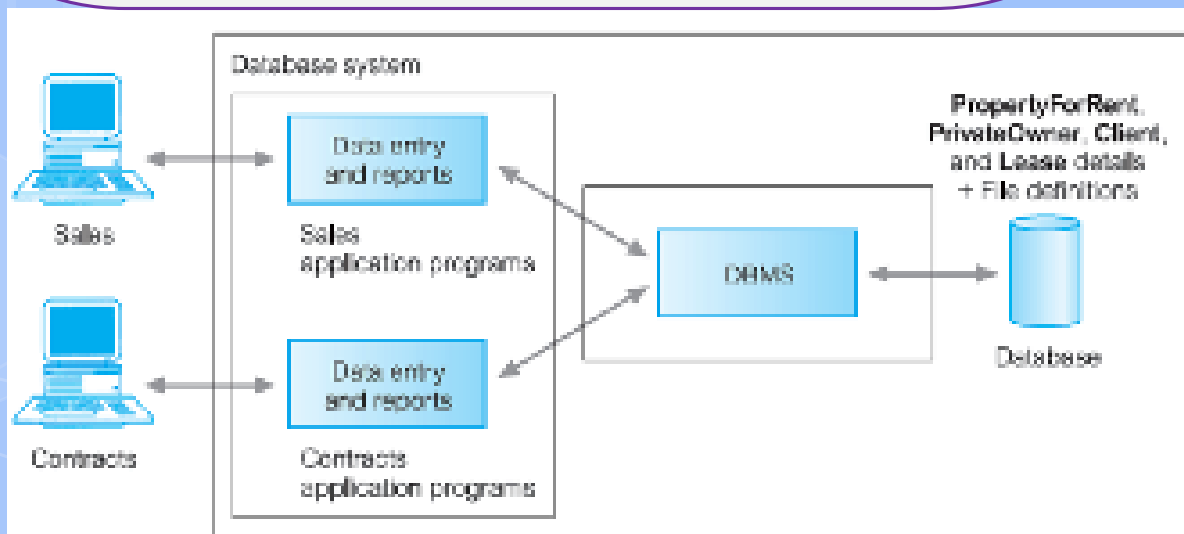


Figure Database processing



DBMS facilities(Function of DBMS)

- ✓ **Data Definition Language (DDL)**: to specify the data types and structures and the constraints on the data to be stored in the database.
- ✓ **Data Manipulation Language (DML)**: to insert, update, delete, and retrieve data from the database using the Structured Query Language (SQL)
- ✓ It provides **controlled access to the database**.



Understanding the Database Management System(DBMS)



- ✓ **a security system:** prevents unauthorized users accessing the database;
- ✓ **an integrity system:** maintains the consistency of stored data;
- ✓ **a concurrency control system:** allows shared access of the database ;
- ✓ **a recovery control system:** restores the database to a previous consistent state following a hardware or software failure



Advantages of a DBMS

- ✓ **Data Independence:** provides **an abstract view** of the data that hides such details.
- ✓ **Efficient Data Access:** provides **techniques** to store and retrieve data efficiently.
- ✓ **Data Integrity and Security:**
 - ✓ can enforce **integrity constraints**.
 - ✓ can enforce access **controls** that govern what **data is visible** to different classes of users.



- ✓ **Data Administration**

- ✓ centralizing the administration of data
- ✓ minimize redundancy
- ✓ retrieval efficient

- ✓ **Concurrent Access and Crash Recovery**

- ✓ Provides concurrent accesses to the data
- ✓ protects users from the effects of system failures.

- ✓ **Reduced Application Development Time**

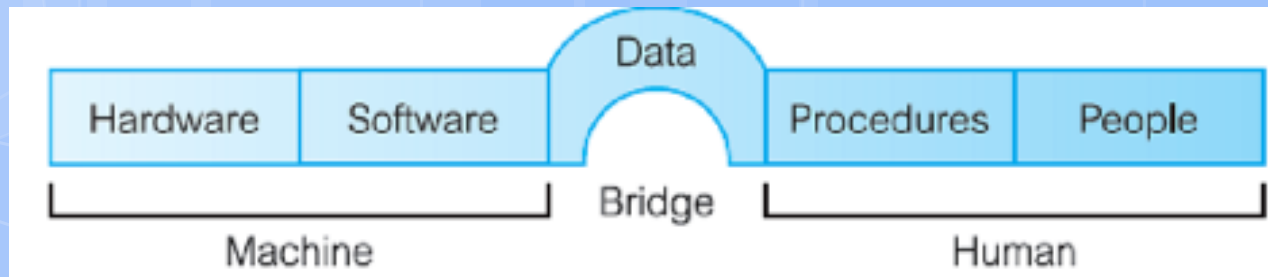
- ✓ supports important functions that are common to many applications



Components of DBMS

✓ **Five major components in the DBMS environment:**

1. **Hardware**
2. **Software**
3. **Data**
4. **Procedures**
5. **People**





✓ Hardware

- ✓ can range **from** a single personal computer **to** a network of computers.
- ✓ **depends** on the organization's requirements and the DBMS used.
- ✓ **DBMS requires** a minimum amount of main memory and disk space to run.

✓ Software

- ✓ **DBMS software itself**

(Oracle, Sybase, MS Access, MySQL, etc.)



✓Data

✓The database contains both **the operational data and the metadata**, the 'data about data'

✓Procedures

✓The **instructions and rules** that govern the design and use of the database.

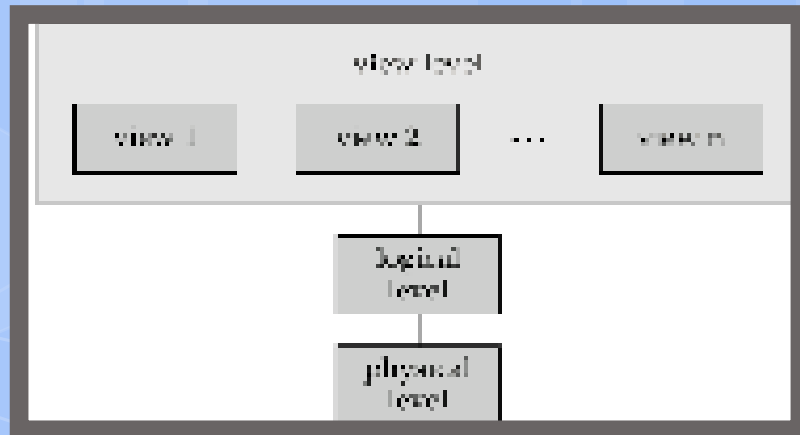
✓People

- ✓1. Database administrators (DBA),
- ✓2. Database designers,
- ✓3. Application developers, and
- ✓4. End-users.



Database System Architecture

- ✓ described as three levels:
 - ✓ External level (Individual user view)
 - ✓ conceptual or logical level (community user view)
 - ✓ physical level or internal level (storage view).
- ✓ At each of these three levels of abstraction has its **own schema**.



A logical architecture for a database system

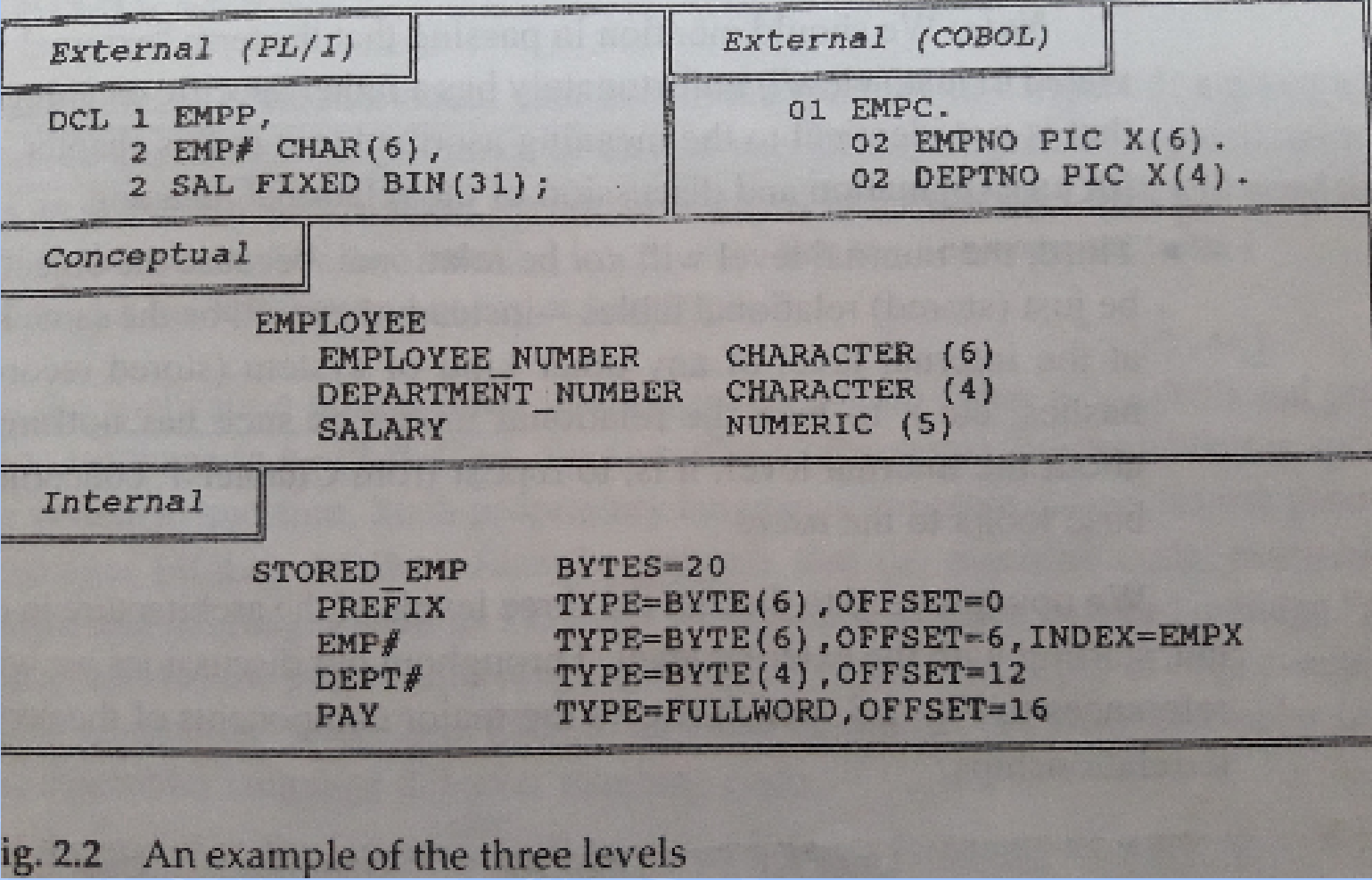
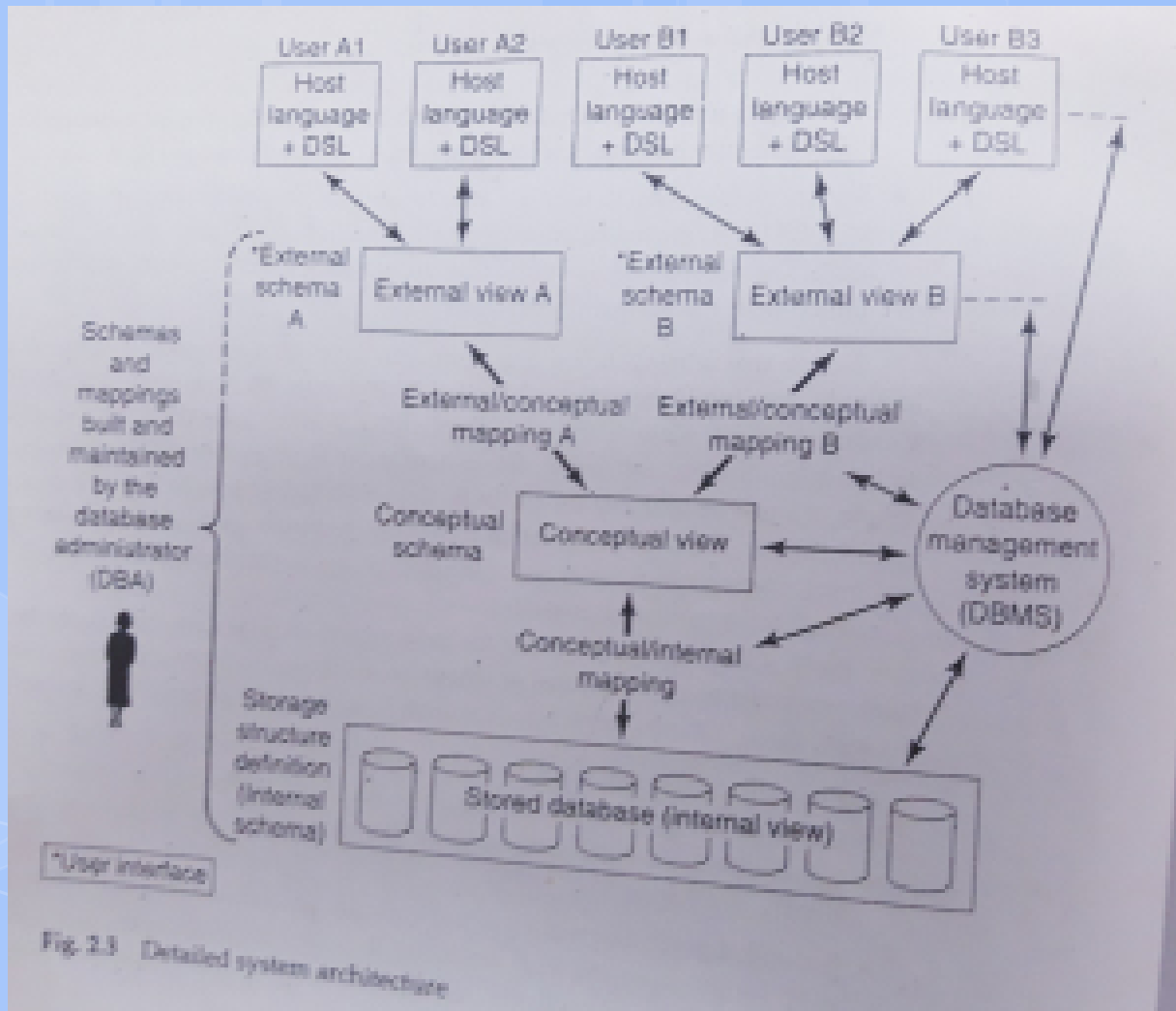


fig. 2.2 An example of the three levels



Host language is responsible for providing various nondatabase facilities
Such as local variables, computational operations, branching logic and so on.

Data sublanguage(DSL) is said to be embedded within the corresponding host language

Mappings

- External conceptual mapping
- Conceptual internal mapping



Transaction Management

- ✓ A transaction is **any one execution** of a user program in a DBMS.
- ✓ Executing the same program several times will generate **several transactions**.
- ✓ Partial transactions are not allowed
- ✓ **ACID Properties**. (Atomicity, Consistency, Isolation, Durability)



Concurrent Execution of Transactions

- ✓ concurrent accesses to data
- ✓ A lock is a mechanism used to control access to database objects.
- ✓ Two kinds of locks are
 - ✓ Shared lock (S Lock), (Read Lock)
 - ✓ An exclusive lock (X Lock), (Write Lock)
 - ✓ releases all its locks after completing all actions (COMMIT or ROLLBACK)



Incomplete Transactions and System Crashes

- ✓ Transactions can be **interrupted** before running to completion **e.g., a system crash**.
- ✓ DBMS changes incomplete transactions are **removed** from the database.
- ✓ DBMS maintains a log of all writes to the database.
- ✓ This property is called **Write-Ahead Log**.