

# CM 1603-Database Systems

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## Introduction to DBMS

Week 01 | Prasan Yapa | Dileeka Alwis

# Learning Outcomes

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- Preparing for LO1 of Module
- On completion of this lecture, students are expected to be able to:
  - Define data and information
  - Understand different data processing systems.
  - Understand the importance of the database system
  - Define a data model and different types of data models.
  - Identify and define Relational Data model

# What is Data and What is Information?

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- **Data** can be any [character](#), text, words, number, [pictures](#), [sound](#), or [video](#) and if not put into context means nothing to a human or computer.
- **Information** is useful and can be understood by the human. Below is an example of the same data and information and how they differ.

# Example for Data and Information

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## Example of Data

- JoeSmith,1 234Circle, SLC, UT, 8404, 8015553211

## Example of Information

- Joe Smith  
1234 Circle  
Salt Lake City, UT 84084  
([801](#))555-3211

# Data Storage and Retrieval

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## Manual Processing

- Time Consuming
- Does not support large volumes of data

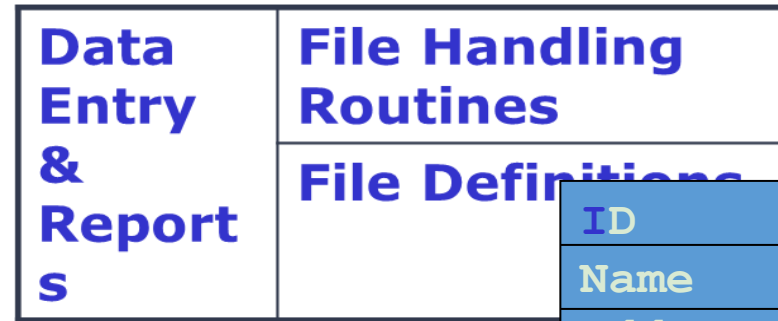
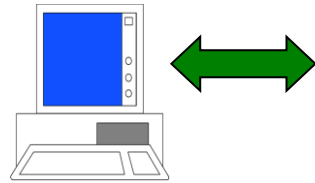
## File based Processing

- Traditional Computer Files
- Inadequate – Lack Of quality

## Database Processing

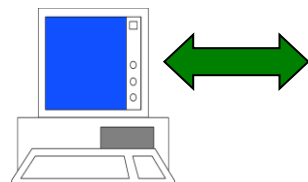
# File based processing

## Data Duplication



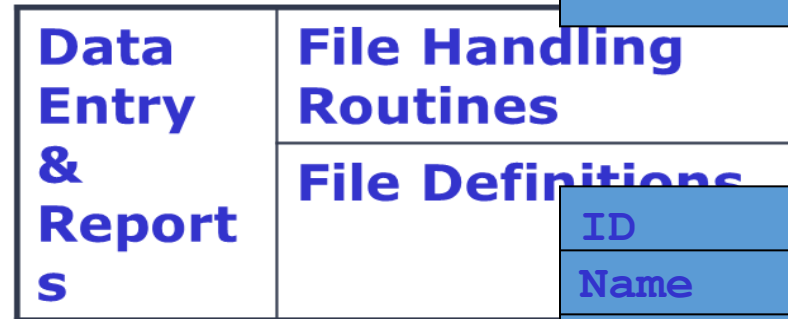
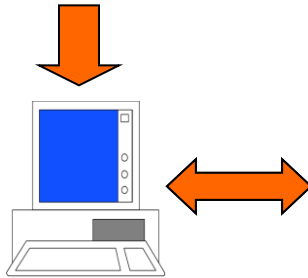
Student System Files

ID	001
Name	Anne
Address	Perth
TelNo	747374
Books-Loan	5



Library System Files

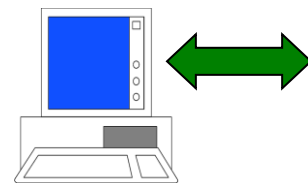
Change request



ID	001
Name	Anne
Address	Perth
TelNo	747374
Marks	75

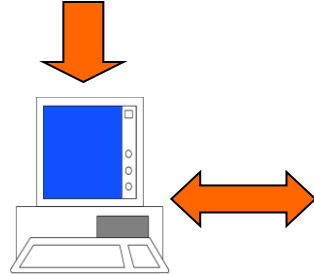
Student System Files

ID	001
Name	Anne
Address	Perth
TelNo	747374
Books-Loan	5



Library System Files

Change request



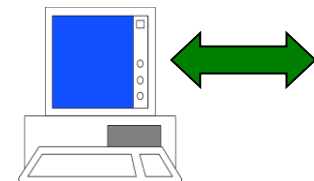
ID	001
Name	Anne
Address	Sydney
TelNo	624875
Marks	75

Student System Files

ID	001
Name	Anne
Address	Perth
TelNo	747374
Books-Loan	5

Library System Files

Inconsistent Data



Data Entry & Reports	File Handling Routines
	File Definitions

Data Entry & Reports	File Handling Routines
	File Definitions



# Limitations of a file based system

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- Data Inconsistency
- Duplication of Data
- Security – Only password security

**How do we resolve these problems?**

# Database

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What is a database?

A **database** is a collection of related data

What is a DBMS (**Database Management System**)

Set of programs to access the data

Is a software package designed to create and maintain databases

# Places Where databases are used

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Banks: ATM

Airlines: reservations, schedules

Universities: registration, grades

Sales: customers, products, purchases

Manufacturing: production, inventory, orders, supply chain

Human resources: employee records, salaries, tax deductions

Databases touch all aspects of our lives

# Database Design

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How do we design a database for an application?

Design in such a way that:

- Records can be reached easily

- Respond to the user's questions easily

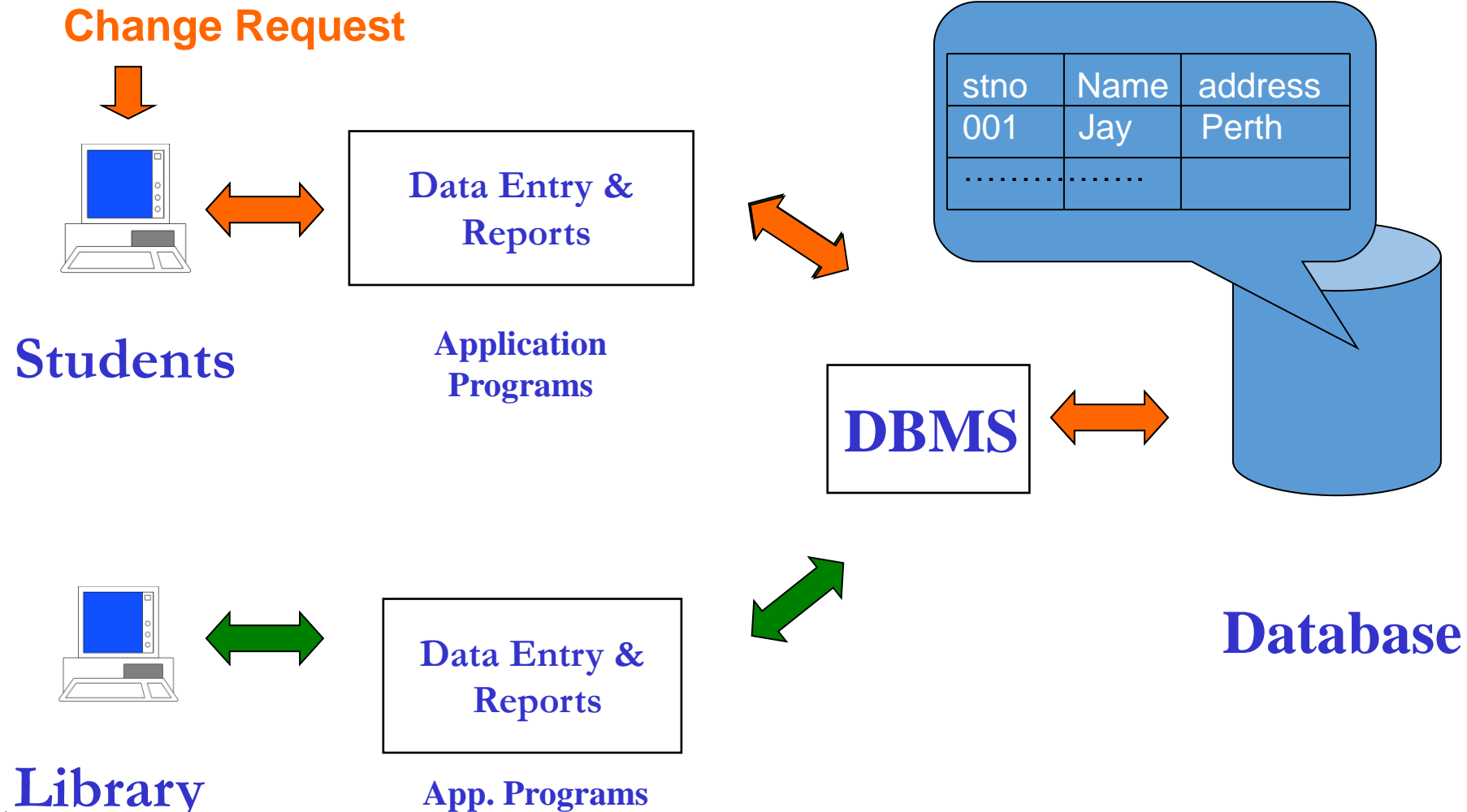
- Occupies minimum storage

- Contains NO unnecessary data

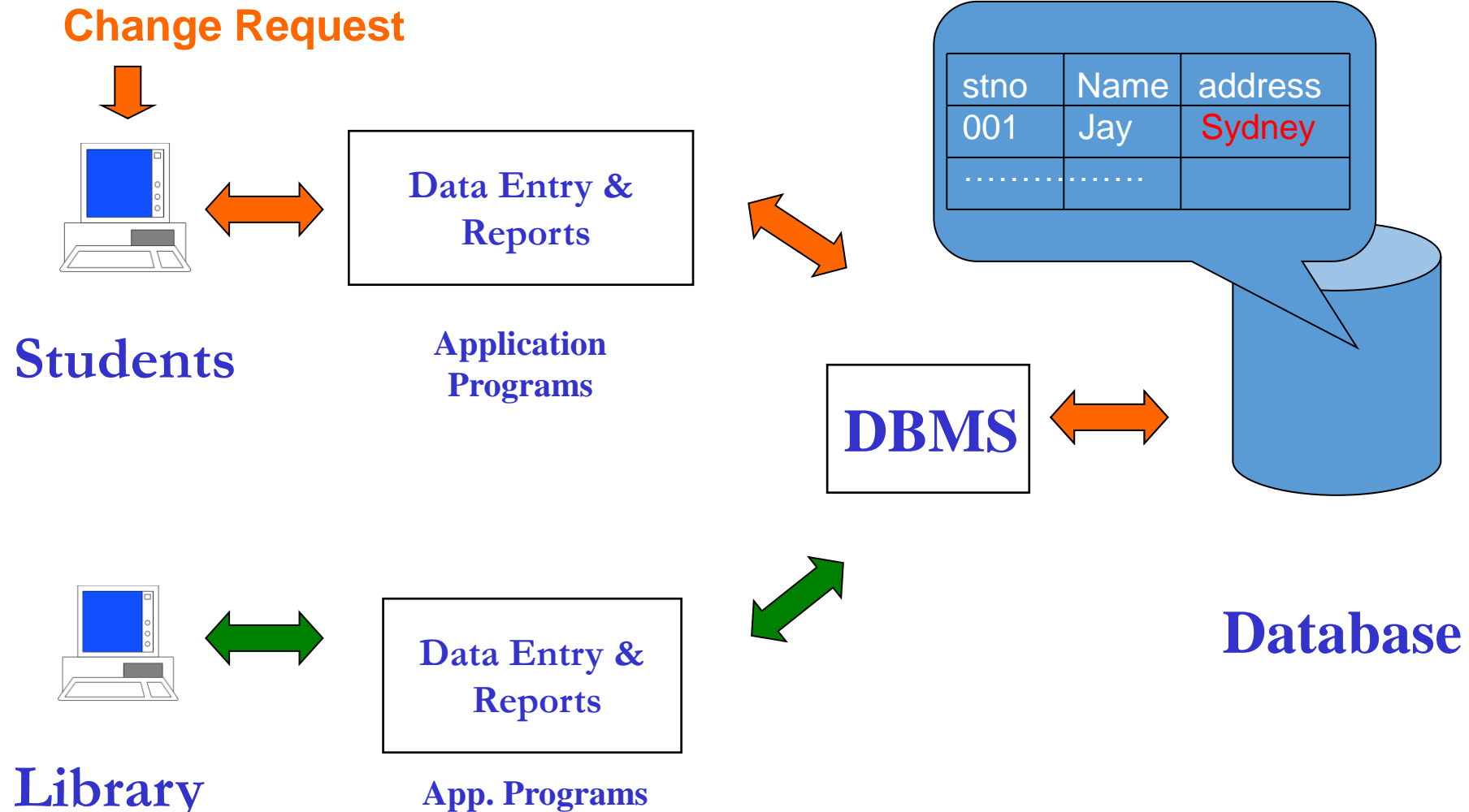
  - (storing the gross salary, calculated from the net salary)

- Adding /Updating of data can be done easily with out causing mistakes

# Database Processing



# Database Processing



# Advantages of database systems

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- Data independence
- Efficient data access
- Data integrity and security
- Data administration
- Concurrent access, recovery from crashes
- Reduced application development time

# Data independence

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Application programs are independent from data representation and storage details.

The structure of data files is stored in the DBMS catalogue separately from the access programs.

E.g. a file access program may be written in such a way that it can access only STUDENT records of the structure.



# Efficient data access

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DBMS utilizes sophisticated techniques to store and retrieve data efficiently, including support for very large files, index structures and query optimization.

Storage methods can be improved without changing the application programs.

# Data integrity and security

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DBMS can enforce integrity constraints on the data.

e.g., checking salary increase against dept budget

Access controls govern what data is visible to different class of users.

[Wider access to well-managed data promotes an integrated view of the organization's operations and a clearer view of the big picture. It becomes much easier to see how actions in one segment of the company affect other segments.]

# Concurrent access and crash recovery

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Concurrent accesses are scheduled by DBMS.

- users can think of the data as being accessed by one user at a time.

DBMS protects users from the effects of system failure

# Improve Data sharing

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The DBMS helps create an environment in which end users have better access to more and better-managed data. Such access makes it possible for end users to respond quickly to changes in their environment.

# When not to use Databases

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High initial investment (DBMS is an expensive software package).

Applications use small amounts of data

Lack of resources (disk space, memory, etc.) to support a database

Single-user applications

Overhead for flexible querying, security, concurrent access & crash recovery is not required

# Describing & Storing Data in a DBMS

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A **data model** is a collection of high-level data description constructs used to model the application domain

Data model hides the low-level storage details

Most commercial database systems are based on the **relational data model**

It is easier to use a **semantic data model** to model an application domain.

Ex: Entity Relationship (ER) Model

# Relational Data Model

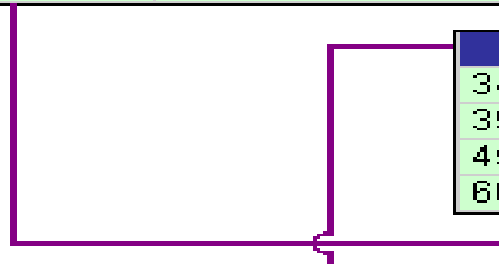
A database structured to recognize relations between stored items of information.

## Hypothetical Relational Database Model

PubID	Publisher	PubAddress
03-4472822	Random House	123 4th Stree, New York
04-7733903	Wiley and Sons	45 Lincoln Blvd, Chicago
03-4859223	O'Reilly Press	77 Boston Ave, Cambridge
03-3920886	City Lights Books	99 Market, San Francisco

AuthorID	AuthorName	AuthorBDay
345-28-2938	Haile Selassie	14-Aug-92
392-48-9965	Joe Blow	14-Mar-15
454-22-4012	Sally Hemmings	12-Sep-70
663-59-1254	Hannah Arendt	12-Mar-06

ISBN	AuthorID	PubID	Date	Title
1-34532-482-1	345-28-2938	03-4472822	1990	Cold Fusion for Dummies
1-38482-995-1	392-48-9965	04-7733903	1985	Macrame and Straw Tying
2-35921-499-4	454-22-4012	03-4859223	1852	Fluid Dynamics of Aquaducts
1-38278-293-4	663-59-1254	03-3920886	1967	Beads, Baskets & Revolution





# Levels of Abstraction in a DBMS

DBMS is described at three levels of abstraction:

External Schema

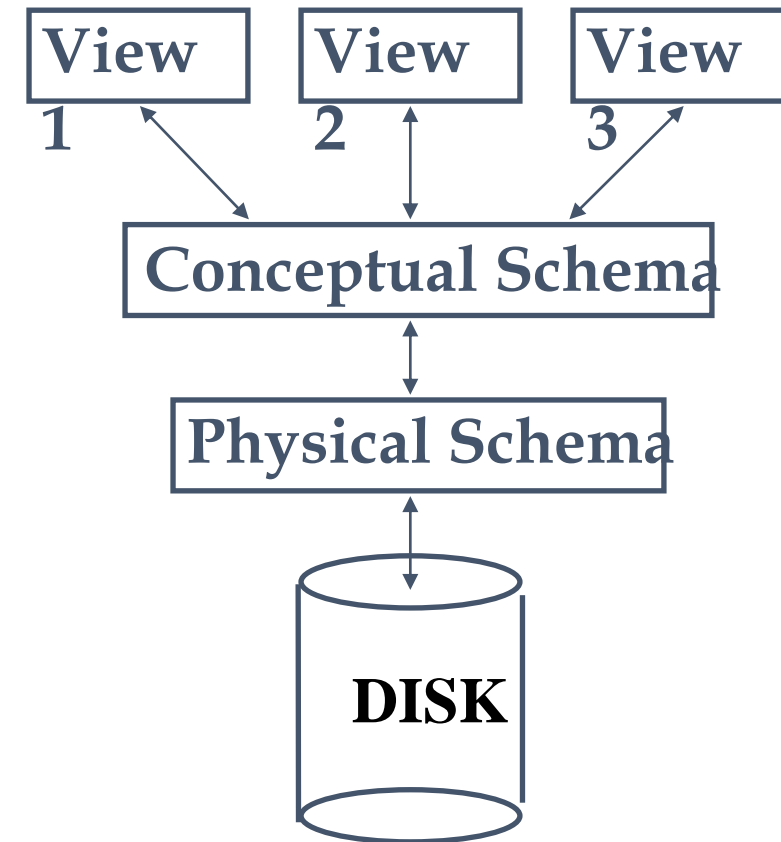
many views describe how  
users see the data

Conceptual Schema

defines logical structure

Physical Schema

describes the files and indexes  
used



Note:

Information about the schemas is stored  
in the system catalog

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## External schemas

allow data access to be customized (and authorized) at the level of individual users or groups of users

any given database has exactly one conceptual schema and one physical schema because it has just one set of stored relations, but it may have several external schemas

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## Conceptual schema

describes the stored data in terms of the data model of the DBMS

in a relational DBMS, the conceptual schema describes all relations that are stored in the database

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## Physical schema

describe storage details

summarizes how the relations described in the conceptual schema are actually stored on secondary storage devices such as disks and tapes

decide what file organizations used to store the relations

create indexes to speed up data retrieval operations

# People who deal with databases

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**End users**- uses applications written by database application programmers

**Application Programmers** – develop packages that facilitates data access for end users.

**Database Administrators** – undertake the task of designing and maintaining the database.

- Design schemas, security & authorization, tuning etc

# READING

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- CONNOLY, T. and BEGG, C. 2014 Database Systems - A Practical Approach to Design, Implementation and Management. 6th edition. Addison Wesley.
- ELMASRI, R. and NAVATHE, S., 2015. Fundamentals of Database Systems. 7th Ed. Addison Wesley.