Introduction to DBMS

Files and Databases

- File: A collection of records or documents dealing with one organization, person, area or subject (Rowley)
  - Manual (paper) files
  - Computer files
- Database: A collection of similar records with relationships between the records (Rowley)
  - Bibliographic, statistical, business data, images, etc.

What is database?

- <u>Database:</u> An organized collection of logically related data
  - We assume that all databases are computer-based in this class
  - Just a collection of **data**

- <u>Data:</u> Known facts that could be recorded and stored on computer media
  - Facts could be in any format: text, graphics, images...

- <u>Information:</u> Processed data that could be used to increase the knowledge of the user
  - Closely related to data, but different
  - View data as "raw material" and information as "intermediate product"
 - The final product is "knowledge"

Database

- A Database is a collection of stored operational data used by the application systems of some particular enterprise (C.J. Date)
  - Paper "Databases"
    - Still contain a large portion of the world's knowledge
  - File-Based Data Processing Systems
    - Early batch processing of (primarily) business data
  - Database Management Systems (DBMS)

Why DBMS?

- History
  - 50's and 60's all applications were custom built for particular needs
  - File based
  - Many similar/duplicative applications dealing with collections of business data
  - Early DBMS were extensions of programming languages
  - 1970 - E.F. Codd and the Relational Model
  - 1979 - Ashton-Tate and first Microcomputer DBMS

File Based Systems
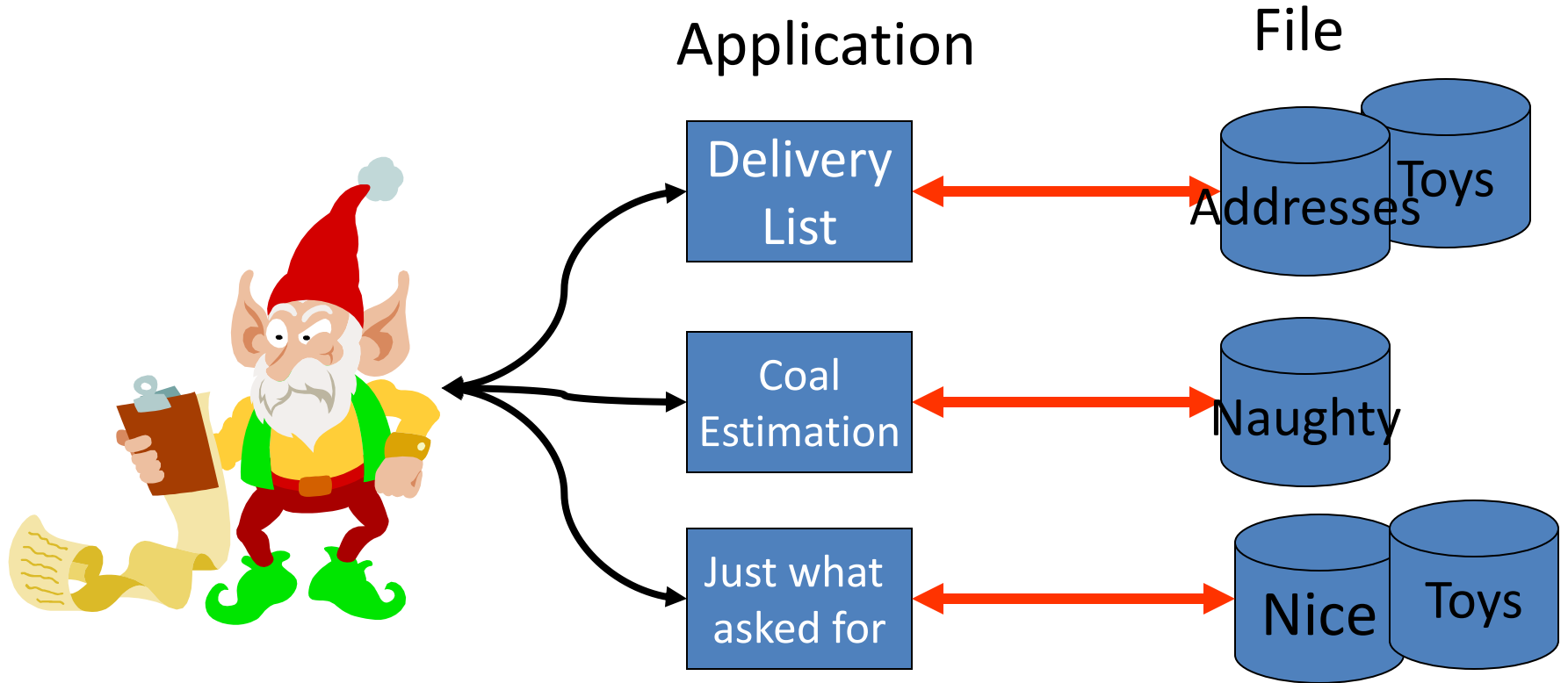
From File Systems to DBMS

- Problems with file processing systems
  - Inconsistent data
  - Inflexibility
  - Limited data sharing
  - Poor enforcement of standards
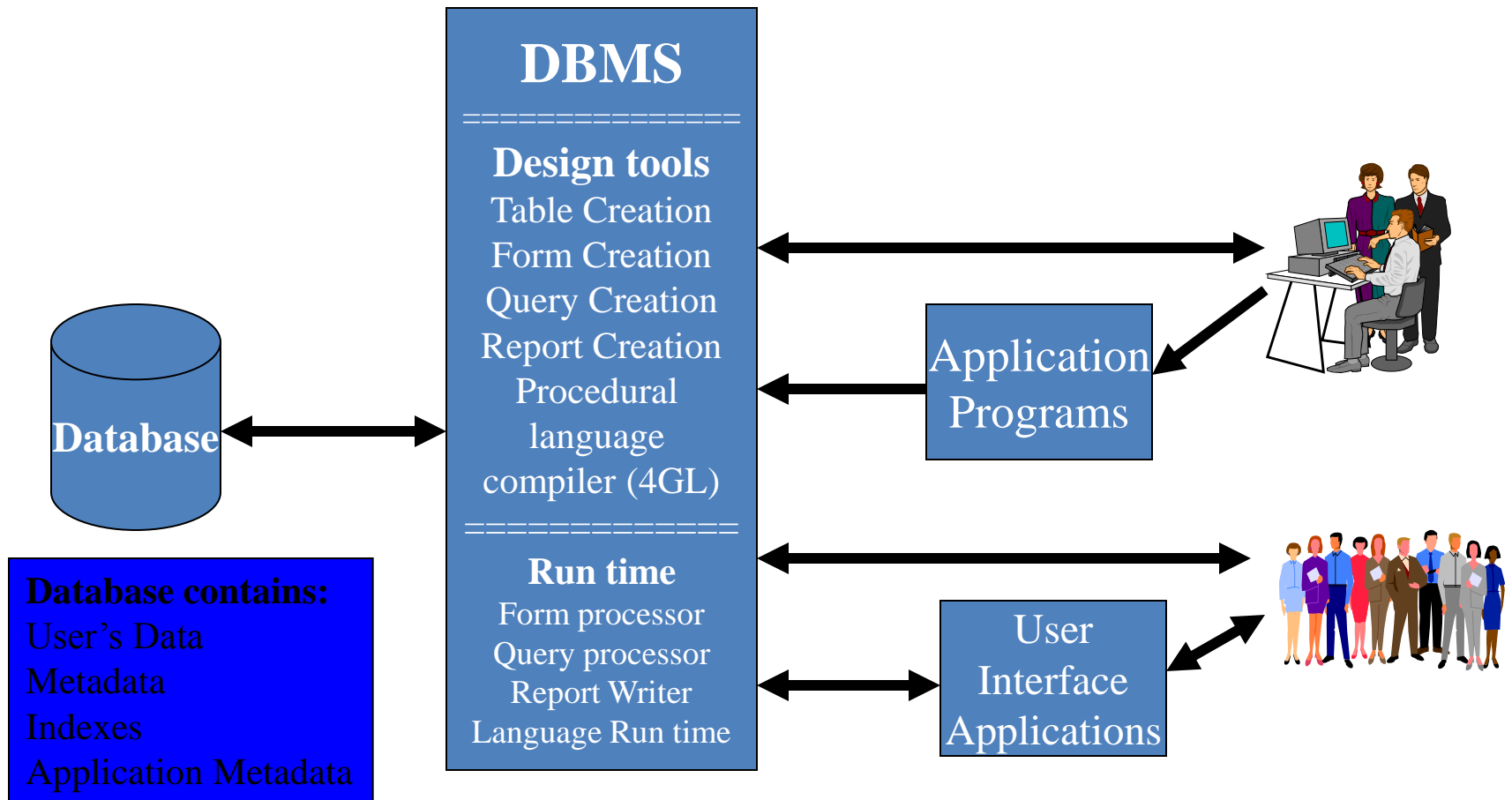 - Excessive program maintenance

DBMS Benefits

- Minimal data redundancy
- Consistency of data
- Integration of data
- Sharing of data
- Ease of application development
- Uniform security, privacy, and integrity controls
- Data accessibility and responsiveness
- Data independence
- Reduced program maintenance
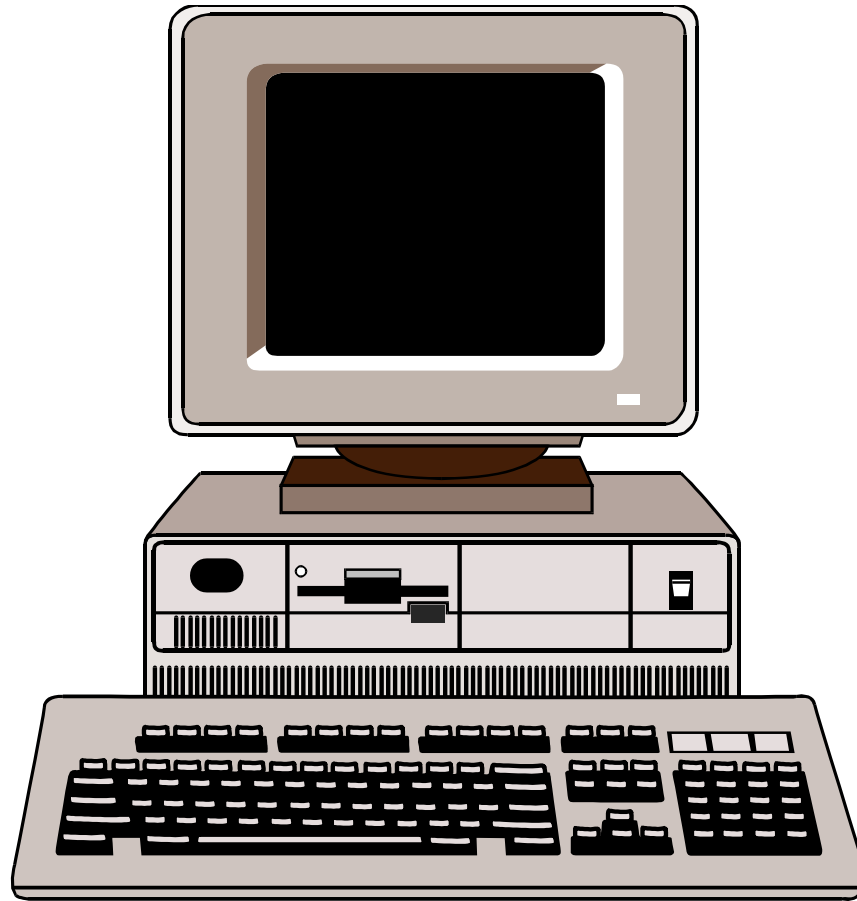
Database Environment
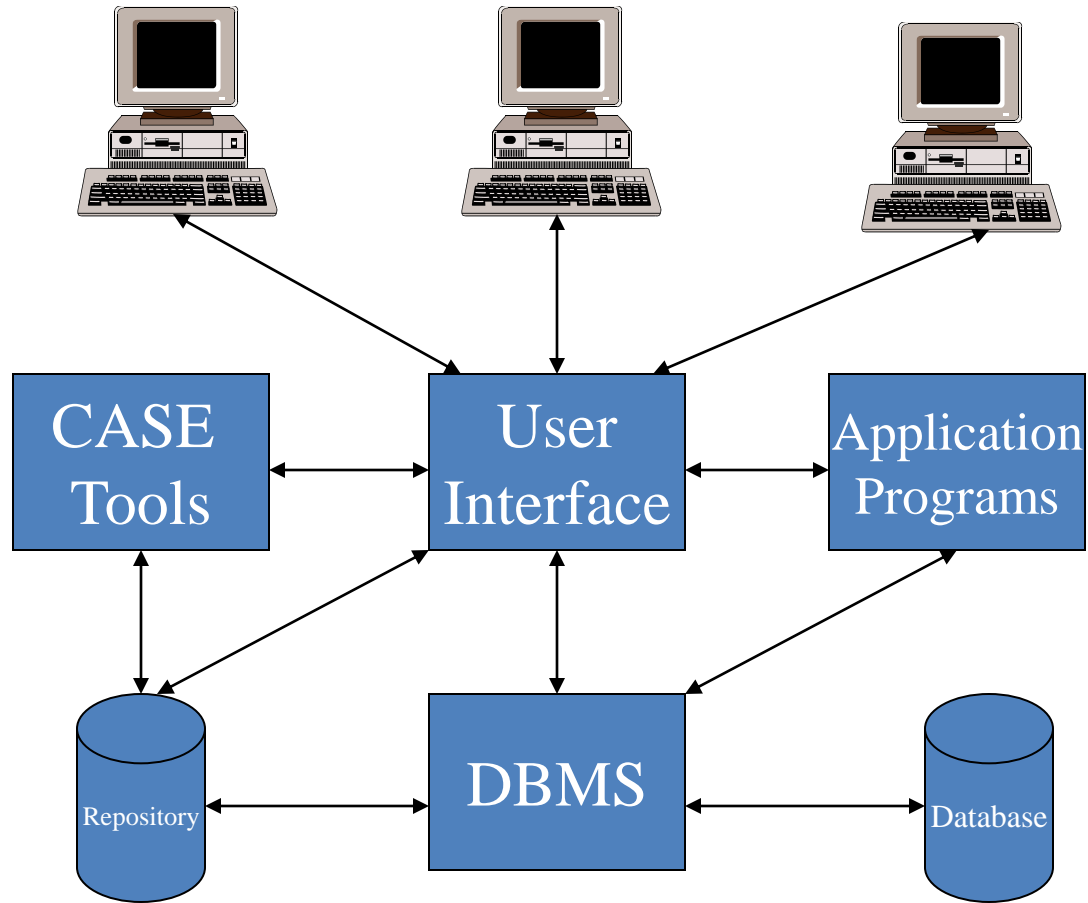
Database Components

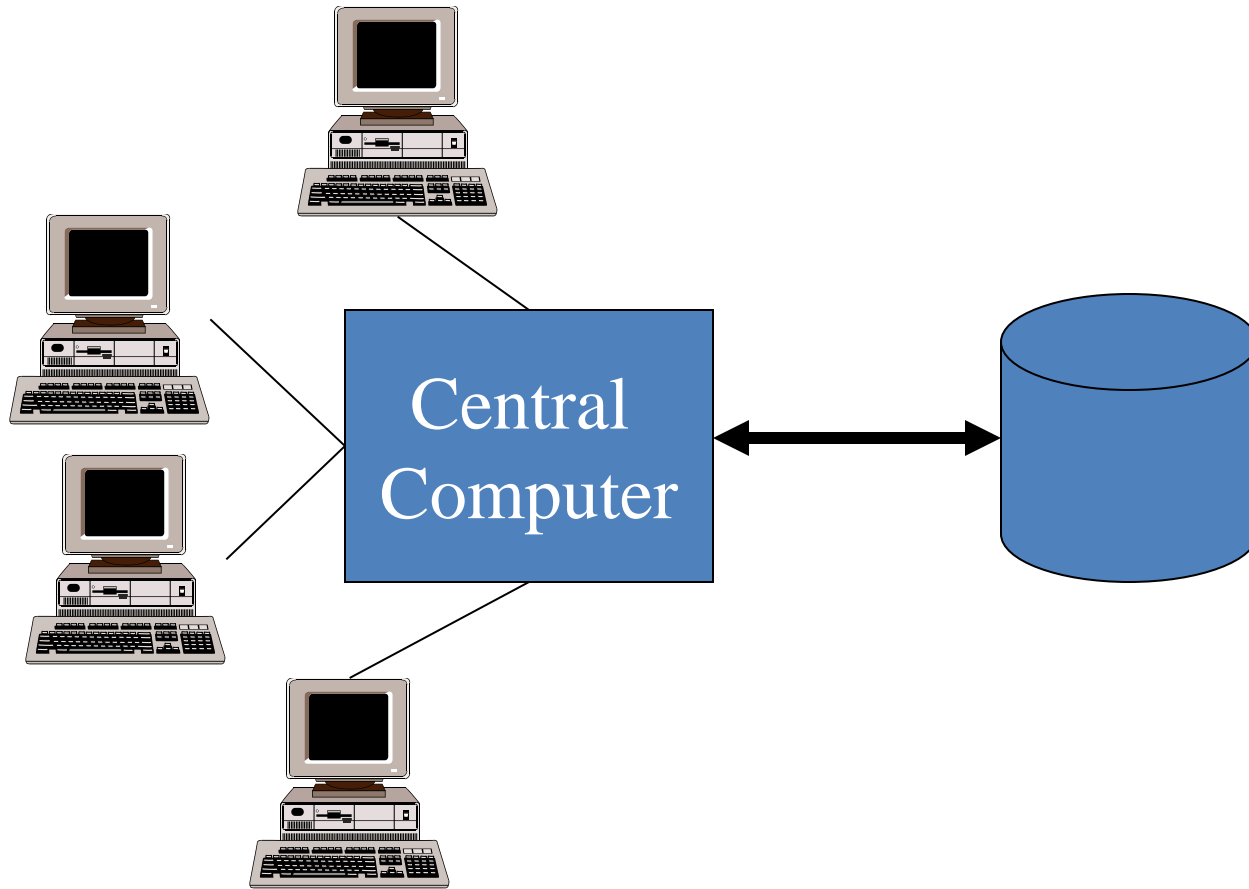# Types of Database Systems

- PC databases
- Centralized database
- Client/server databases
- Distributed databases
- Database models

PC Databases

E.g.:
Access
FoxPro
Dbase
Etc.

Centralized Databases

Client Server Databases

Client

Client

Network

Database Server

Client

Distributed Databases

Location C

Location B

computer

computer

computer

Homogeneous Databases
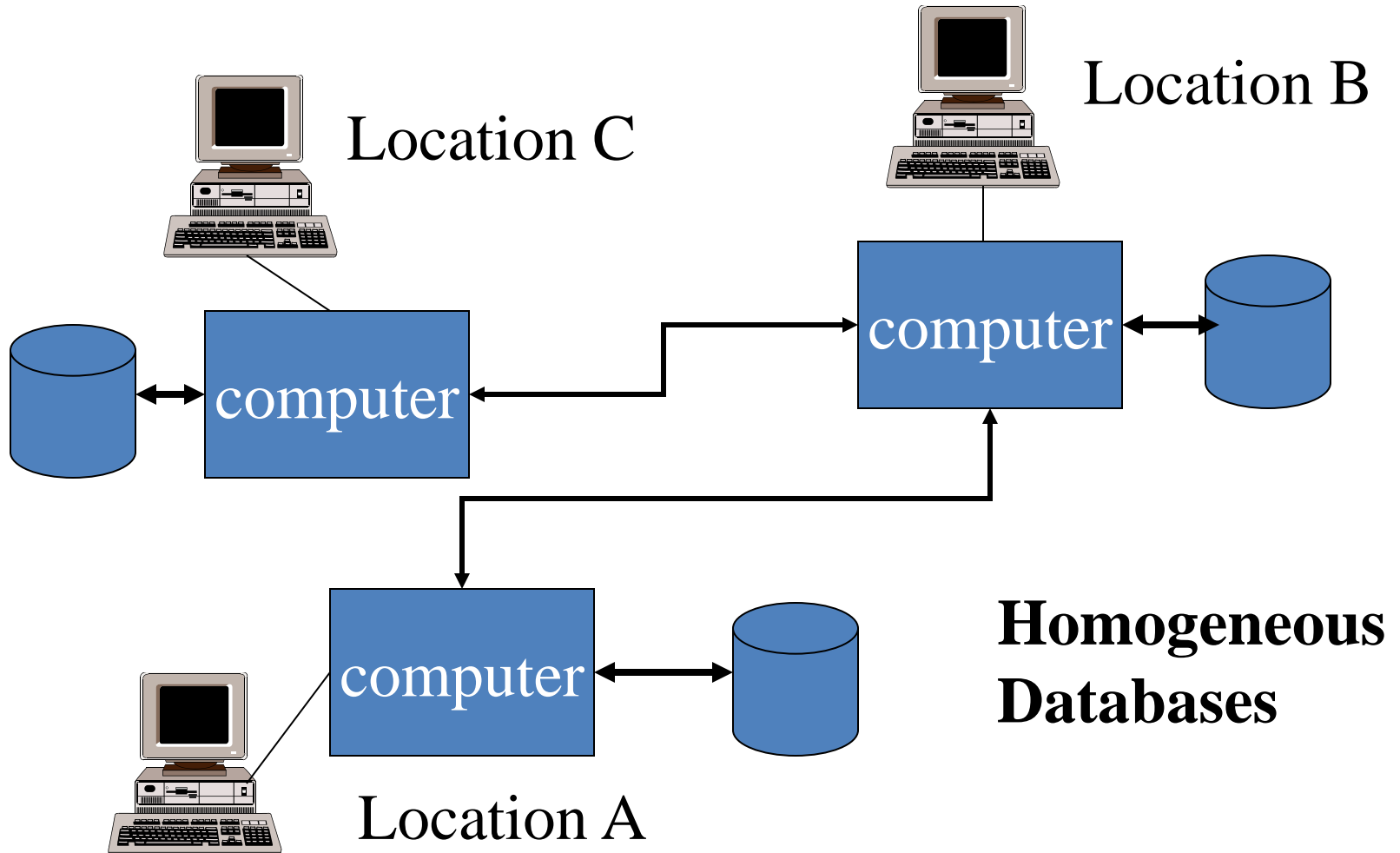
Location A

Distributed Databases

Heterogeneous Or Federated Databases

Database Server

Client

Local Network

Client

Comm Server

Remote Comp.

Remote Comp.
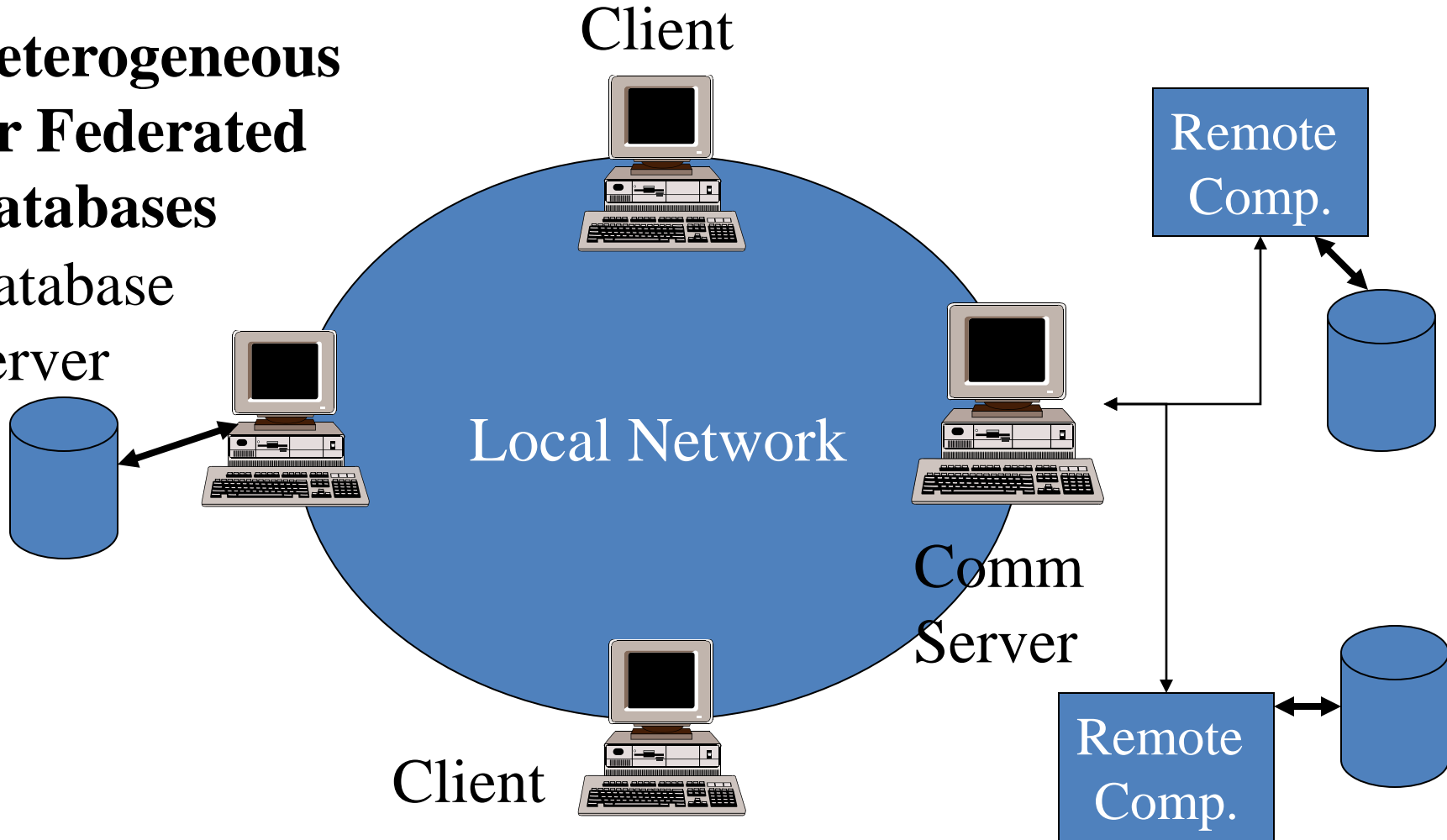
Applications of Databases

- Banking systems that keep information about customers and their account (large databases, real-time response to some queries, peak periods for transactions)

- Point of sales systems in shops that process the purchase of goods

- Reservation systems for booking airline flights and other travel, seats at the theatre or cinema, etc

- Inventory systems ranging from the books in a library to the stock in a furniture shop or car showroom

- Accounting systems that produce bills, statements etc.

Applications of Databases (cont.)

- Telephone-based insurance companies (real-time retrieval customer records)

- Historical records (read-only access, simplified management)

- Human resources or personnel systems that hold employee information

- Payroll systems that process salaries and benefits

- Computer aided manufacture: the products go through a number of different revisions and require financial and technical information to be kept

Architecture for a Database System

database user — End-users

application programs — DBMS-user-written applications
DBMS-vendor-provided applications
applications provided by some third-party vendor

DBMS — supports all of the basic DBMS functions
e.g. data definition, manipulation, security

database — actual or operational data objects
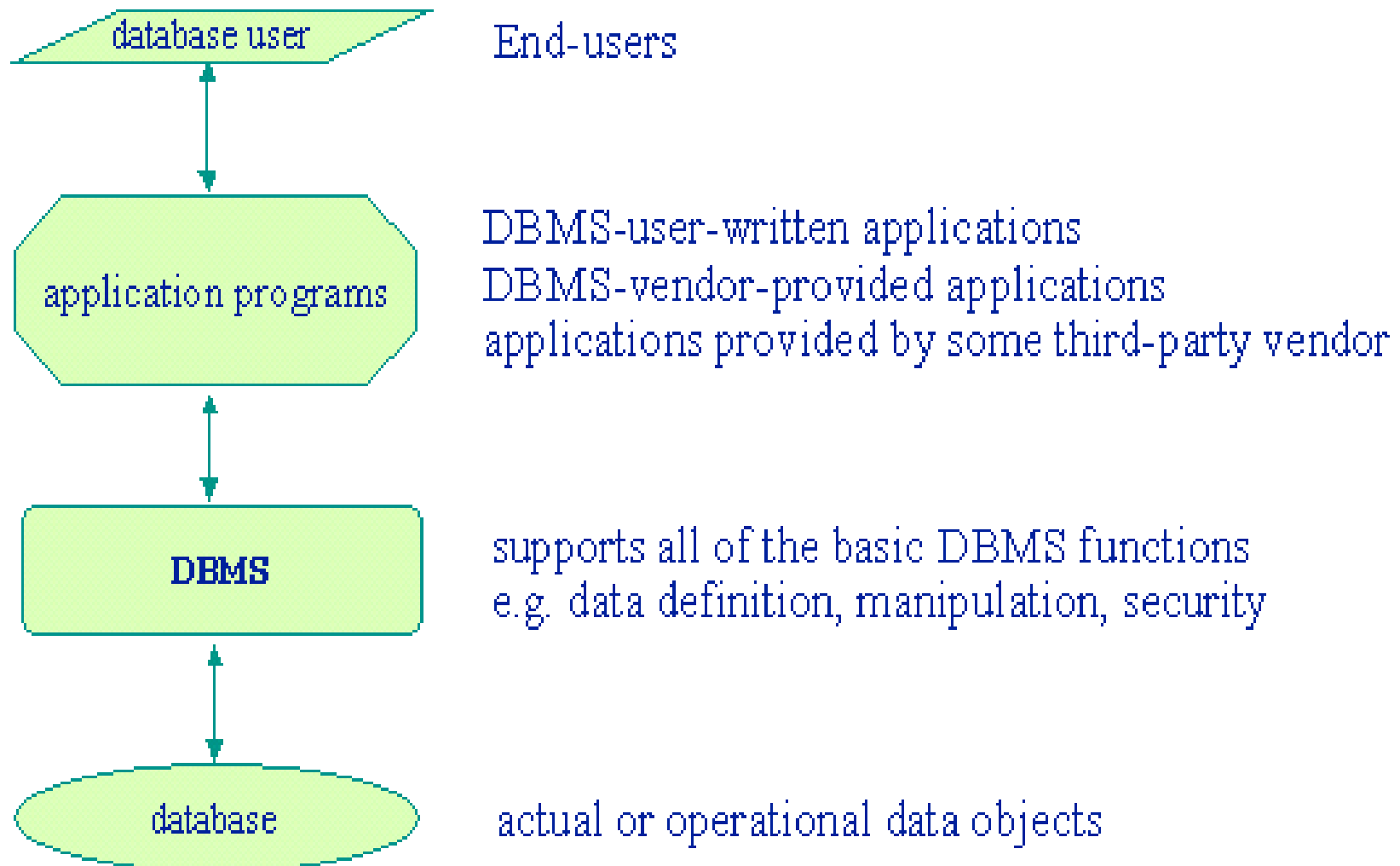
Database Examples

- Database is involved like everywhere in our world

- For example:

If we go to bank to deposit or withdraw

Make hotel and airline reservation

Purchase something on line

Buy groceries in supermarkets

Database Applications

- These examples are what we called **traditional database applications**

(First part of book focuses on traditional applications)

- More Recent Applications:
  - Youtube
  - iTunes
  - Geographic Information Systems (GIS)
  - Data Warehouses
  - Many other applications

Database can be any size and complexity

For example:

- A list of names and address

- IRS

  (assume it has 100 million taxpayers and each taxpayer file 5 forms with 400 characters of information per form=800Gbyte)

- Amazon.com

  (15 million people visit per day; about 100 people are responsible for database update)

Database System

- **Database:**

  A collection of <u>related</u> data.

- **Data:**

  Known facts that can be recorded and have an

  implicit meaning.

- **Database Management System (DBMS):**

  A software package/system to facilitate the

  <u>Define, Construct, Manipulate and Share</u> functions of a
  computerized database.

Simplified database system environment
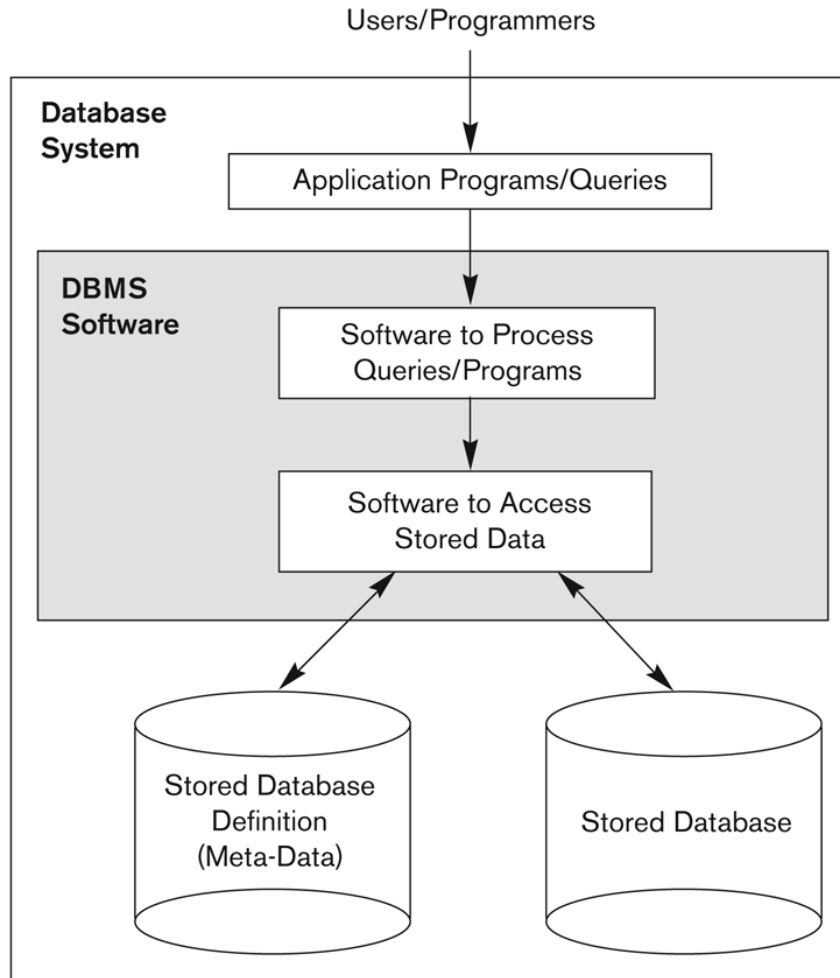
Figure 1.1
A simplified database system environment.

An UNIVERSITY example

- A UNIVERSITY database for maintaining information concerning students, courses, and grades in a university environment

- We have:

STUDENT file stores data on each student

COURSE file stores data on each course

SECTION file stores data on each section of each course

GRADE_REPORT file stores the grades that students receive

PREREQUISITE file stores the prerequisites

Example of a simple database

STUDENT

Name	Student number	Class	Major
Smith	17	1	CS
Brown	8	2	CS

COURSE

Course_name	Course_number	Credit_hours	Department
Intro to Computer Science	CS1310	4	CS
Data Structures	CS3320	4	CS
Discrete Mathematics	MATH2410	3	MATH
Database	CS3380	3	CS

SECTION

Section_identifier	Course_number	Semester	Year	Instructor
85	MATH2410	Fall	04	King
92	CS1310	Fall	04	Anderson
102	CS3320	Spring	05	Knuth
112	MATH2410	Fall	05	Chang
119	CS1310	Fall	05	Anderson
135	CS3380	Fall	05	Stone

GRADE_REPORT

Student_number	Section_identifier	Grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	135	A

PREREQUISITE

Course_number	Prerequisite_number
CS3380	CS3320
CS3380	MATH2410
CS3320	CS1310

Database manipulation

- Database manipulation involves **querying** and **updating**

- Examples of <u>querying</u> are:
Retrieve a transcript
List the prerequisites of the "Database" course

- Examples of <u>updating</u> are:
Enter a grade of "A" for "Smith" in "Database" course

Database V.S. File

- In the database approach, a single repository of data is maintained that is defined once then accessed by various users

- The major differences between DB and File are:
1. Self-describing of a DB
2. Insulation between programs and data
3. Support of multiple views of the data
4. Sharing of data and multiuser transaction processing

Self-describing nature of a database system

- Database system contains **not only** the database itself **but also** a complete definition of the database structure and constrains

- The information stored in the catalog is called **Meta-data (data about data)**, and it describes the structure of the primary database.

Example of a simplified Meta-data

RELATIONS

Relation_name	No_of_columns
STUDENT	4
COURSE	4
SECTION	5
GRADE_REPORT	3
PREREQUISITE	2

COLUMNS

Column_name	Data_type	Belongs_to_relation
Name	Character (30)	STUDENT
Student_number	Character (4)	STUDENT
Class	Integer (1)	STUDENT
Major	Major_type	STUDENT
Course_name	Character (10)	COURSE
Course_number	XXXXNNNN	COURSE
….	….	…..
….	….	…..
….	….	…..
Prerequisite_number	XXXXNNNN	PREREQUISITE

Figure 1.3
An example of a database catalog for the database in Figure 1.2.

Note: Major_type is defined as an enumerared type with all known majors. XXXXNNNN is used to define a type with four alpha characters followed by four digits

DBMS definition

- A database management system (DBMS) is a collection of programs that enables you to store, modify, and extract information from a database. There are many different types of DBMSs, ranging from small systems that <u>run</u> on <u>personal computers</u> to huge systems that run on <u>mainframes</u>. The following are examples of <u>database applications</u>:
- computerized library systems automated teller machines flight reservation systems computerized parts inventory systems

**The DBMS Manages the Interaction
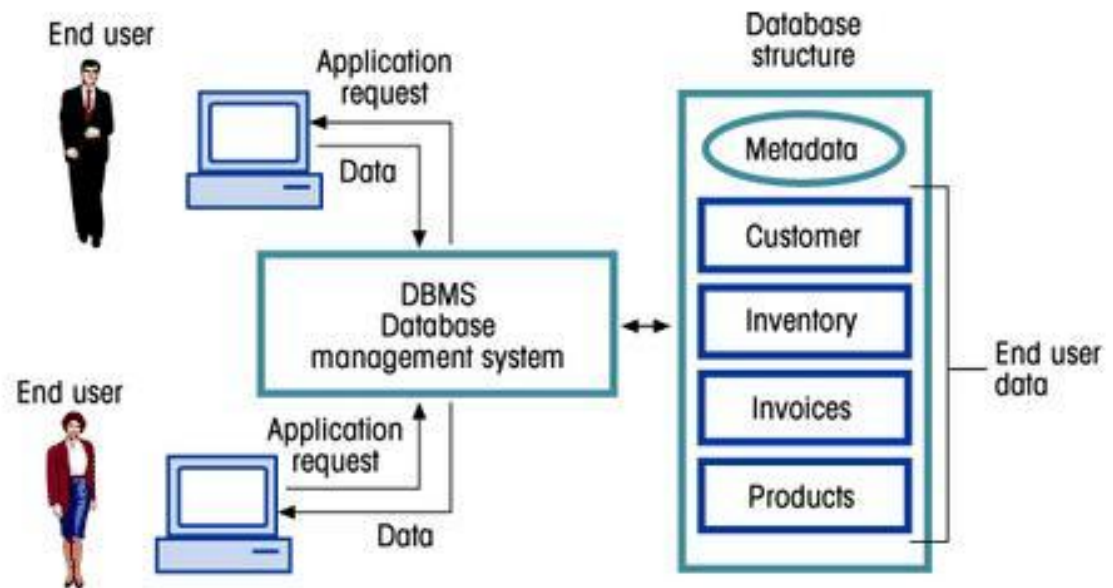Between the End User and the Database**

FIGURE 1.2 THE DBMS MANAGES THE INTERACTION BETWEEN THE END USER AND THE DATABASE

Figure 1.2