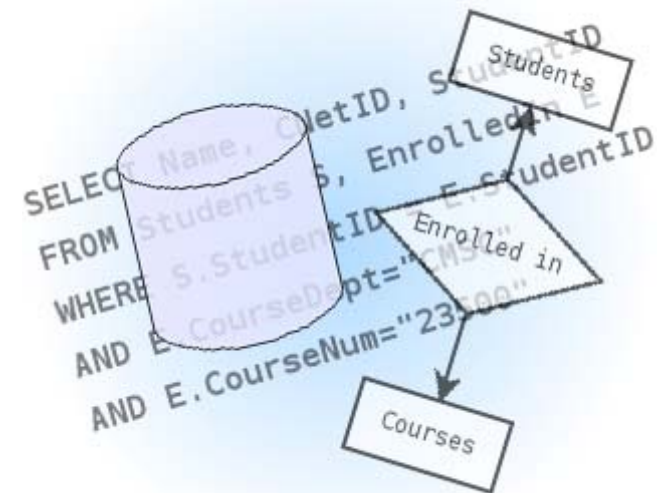


Database Management Systems

Sumayyea Salahuddin (Lecturer)
Dept. of Computer Systems Eng.
UET Peshawar

Overview

- Introduction to the Database
 - Database Definitions
 - Databases & Traditional File Processing Systems
 - Advantages of Database Approach
 - Costs & Risks of the Database Approach
 - Functions of Database Management Systems (DBMS)
 - Range of Database Applications
 - Components of the Database Environment
 - Evolution of Database Systems



Definitions

- Data:
 - Meaningful facts, text, graphics, images, sound, video segments
 - Usually in certain context e.g. Class Roster

Class Roster			
Course:	MGT 500 Business Policy	Semester:	Spring 2010
Section:	2		
Name	ID	Major	GPA
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 1-1a: Data in Context

Definitions

- Information:
 - Data processed to be useful in decision making and interpretation

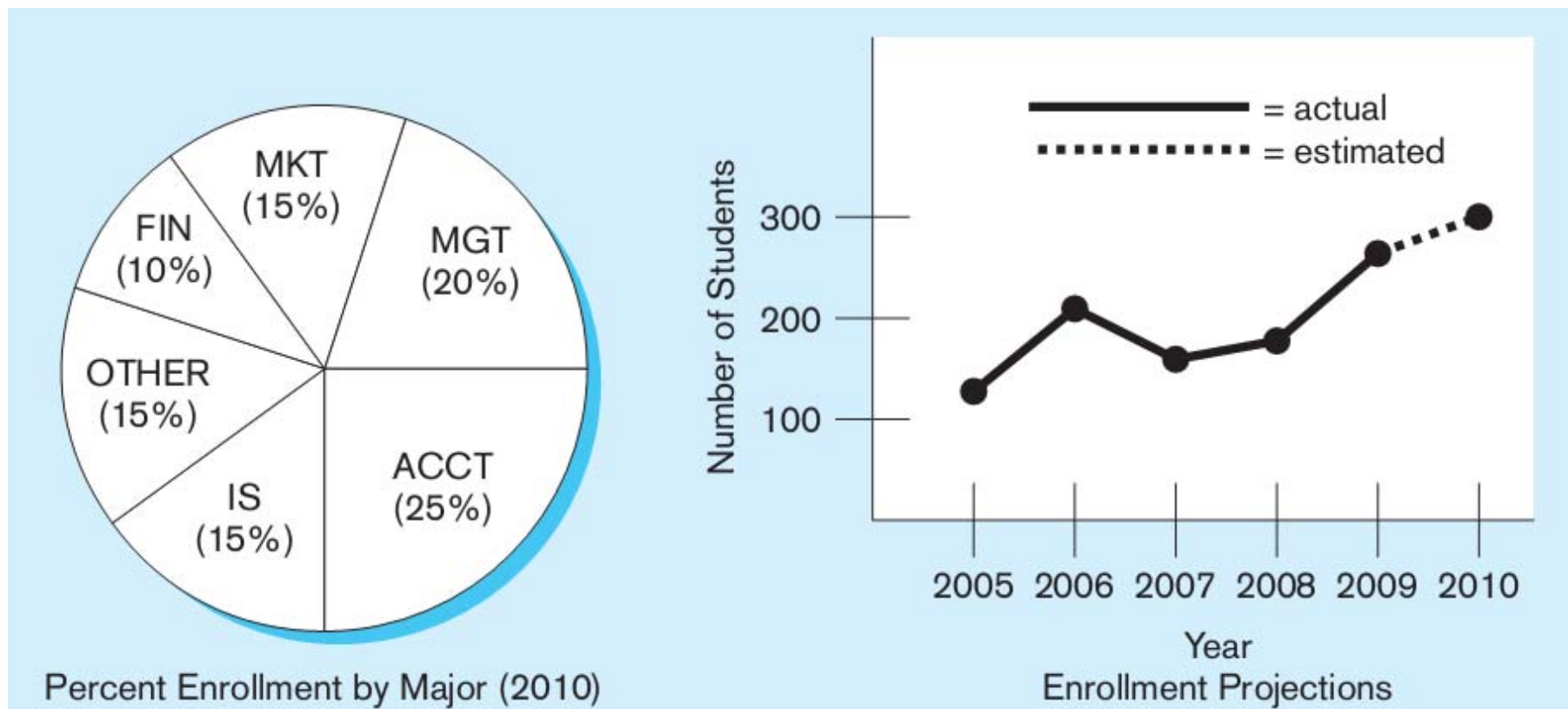
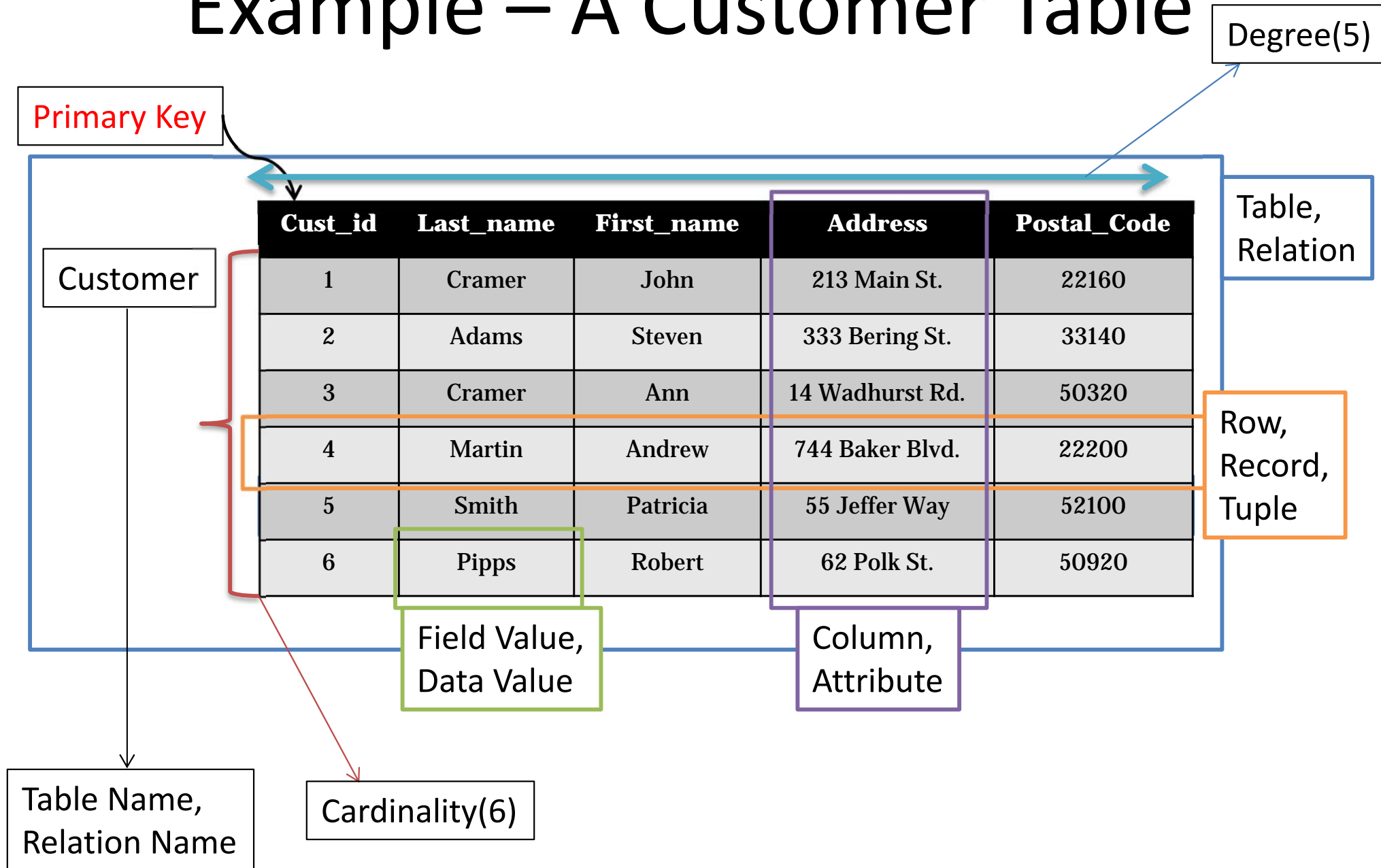


Figure 1-1b: Summarized Data/Information

Database & Its Terminologies

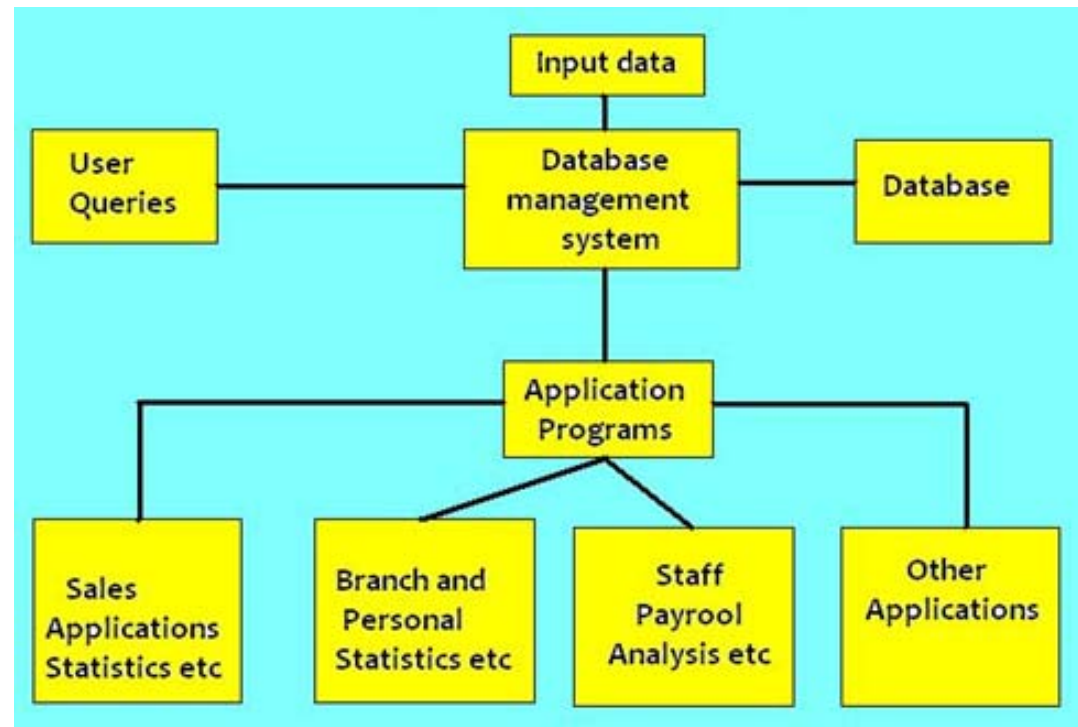
- Database: An organized collection of logically related data
- Field (data item):
 - Smallest unit of information in database
 - It is collection of related characters (numeric or alphabetic) that define a characteristic of an entity (person, place or thing)
- Record:
 - Fields are grouped together to form records.
 - It is collection of related (logically connected) fields
- File: collection of similar types of records

Example – A Customer Table



Definitions (Cont.)

- Database Management System (DBMS): a system software that facilitates the management of a database and controls the access to the data stored in the database



Definitions (Cont.)

- Database System: system consisting of a database, a DBMS, hardware and people
- Database Design: The design of the database structure that will be used to store and manage data (not the design of the DBMS)
- Data Dictionary (DD) or Metadata: describes the characteristics of data stored in a database and the inter-relationships among data

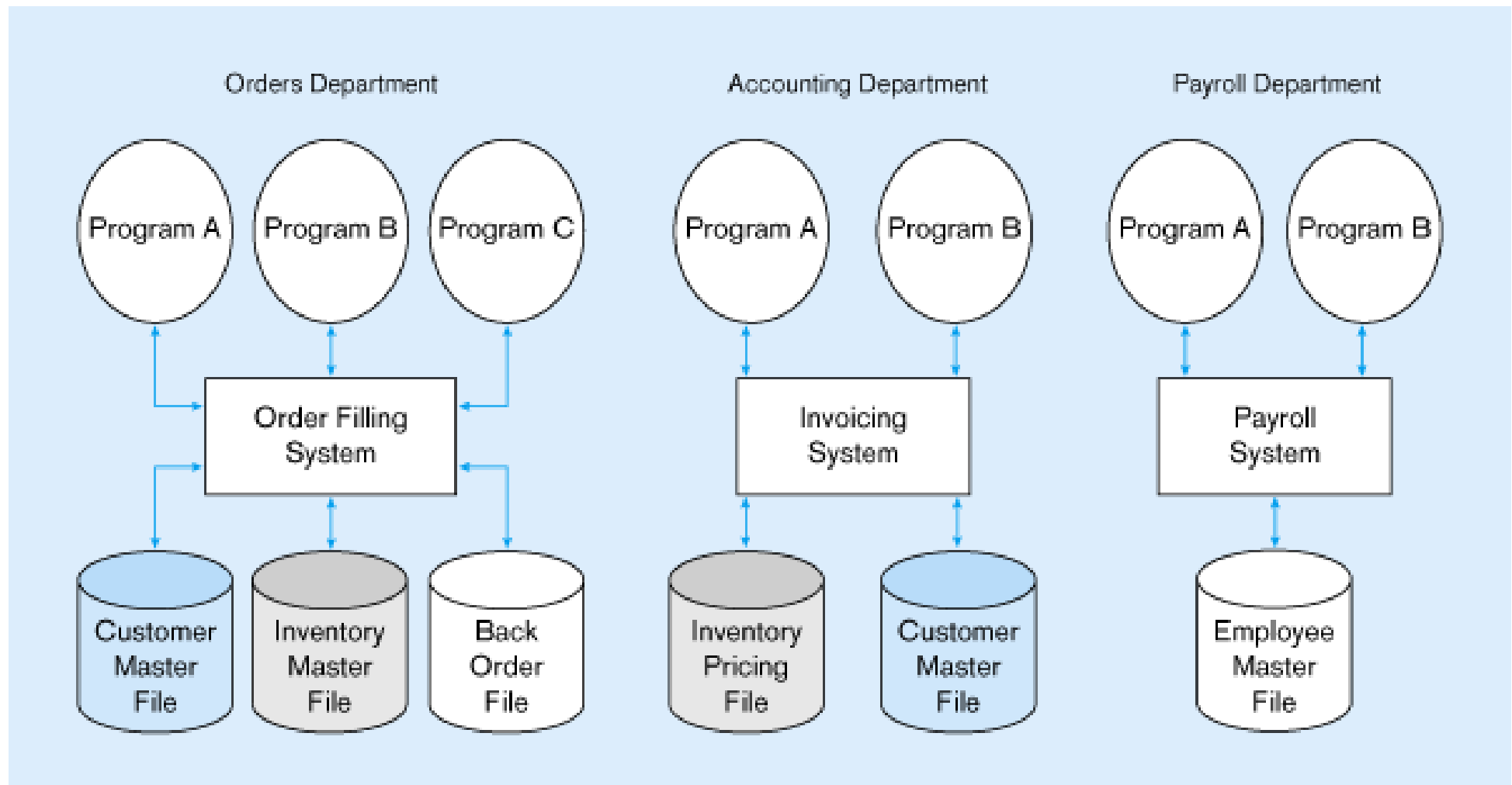
Table 1-1: Metadata

Description of the properties or characteristics of the data, including data types, field sizes, allowable values, and documentation

TABLE 1-1 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

Figure 1-2: Three File Processing Systems at Pine Valley Furniture

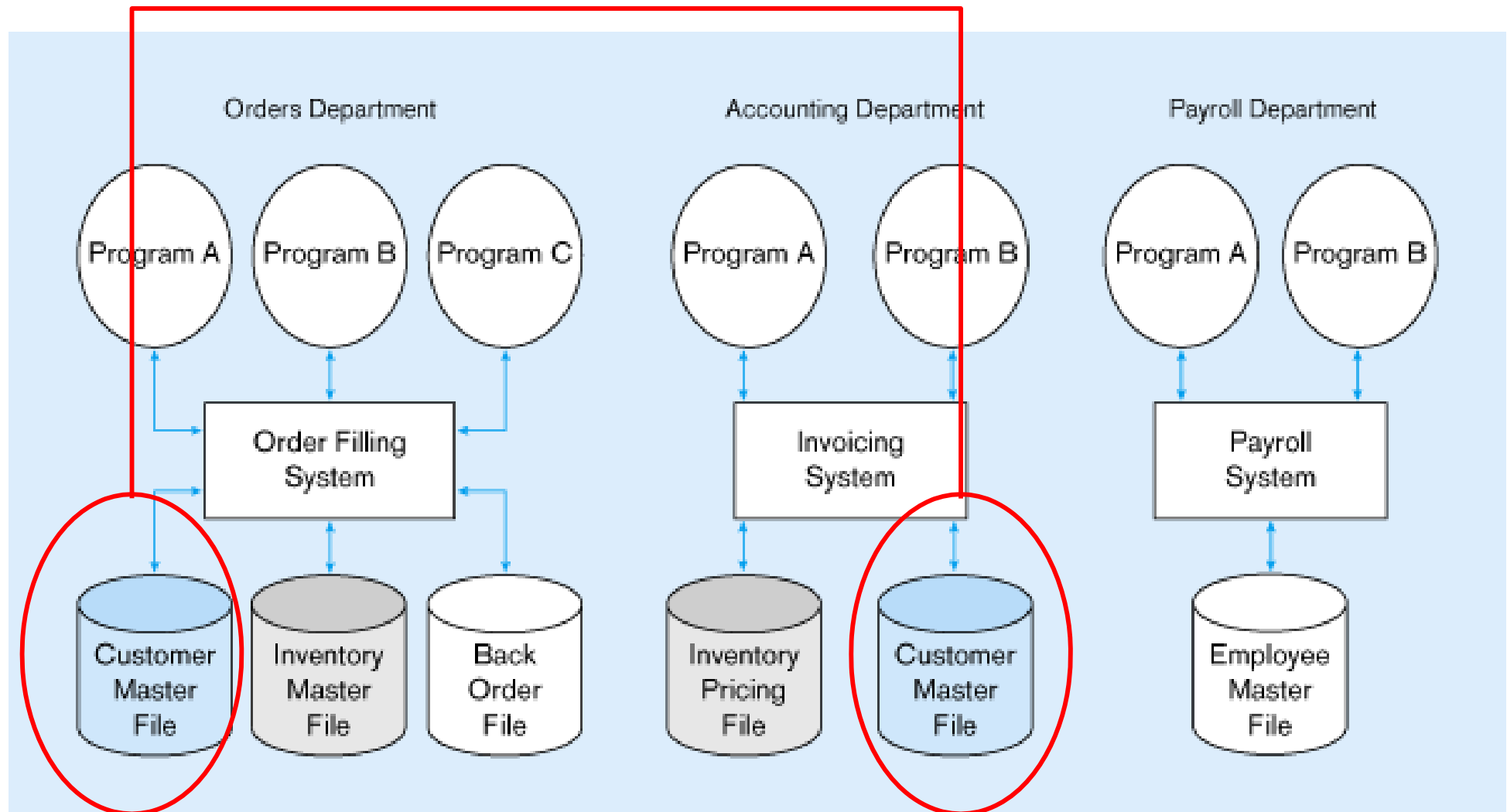


Disadvantages of File Processing

- Program-Data Dependence
 - All programs maintain metadata for each file they use
- Data Redundancy (Duplication of data)
 - Different systems/programs have separate copies of the same data
- Limited Data Sharing
 - No centralized control of data
- Lengthy Development Times
 - Programmers must design their own file formats
- Excessive Program Maintenance
 - 80% of information systems budget

Figure 1-2: Three File Processing Systems at Pine Valley Furniture

Duplicate Data



Problems with Data Dependency

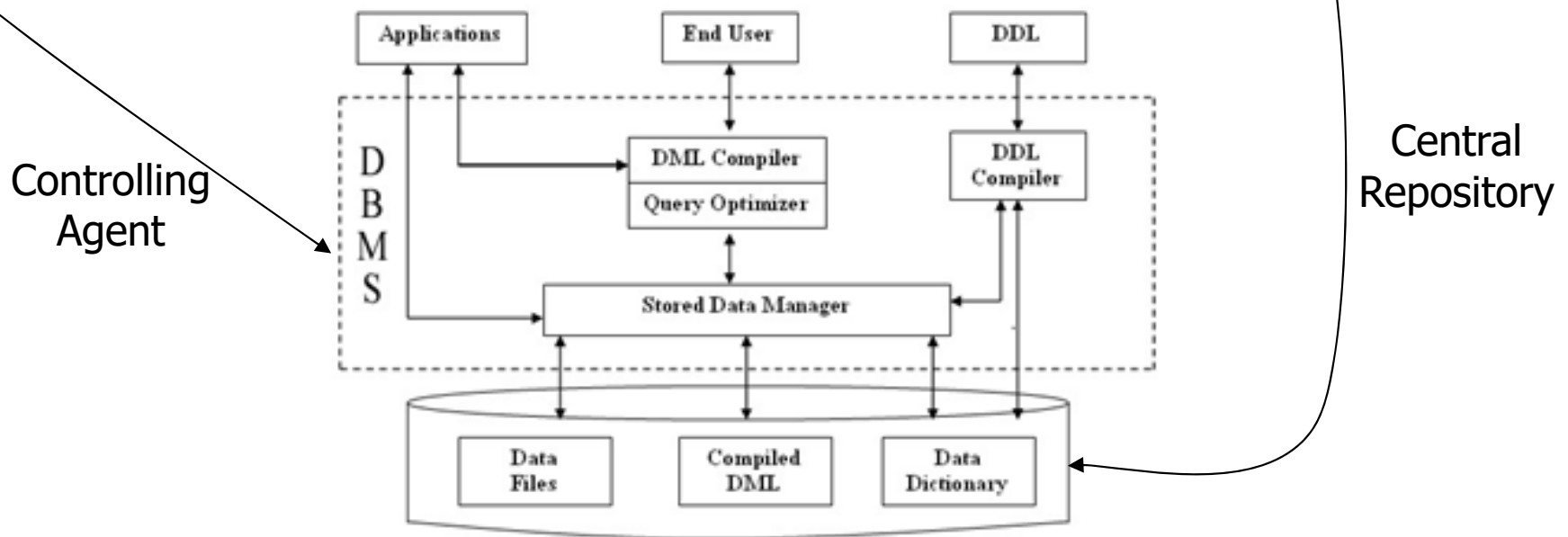
- Each application programmer must maintain their own data
- Each application program needs to include code for the metadata of each file
- Each application program must have its own processing routines for reading, inserting, updating and deleting data
- Lack of coordination and central control
- Non-standard file formats

Problems with Data Redundancy

- Waste of space to have duplicate data
- Causes more maintenance headaches
- The Biggest Problem
 - When data changes in one file, could cause inconsistencies
 - Compromises *data integrity*

Solution: The DATABASE Approach

- Central repository of shared data
- Data is managed by a controlling agent
- Stored in a standardized, convenient form

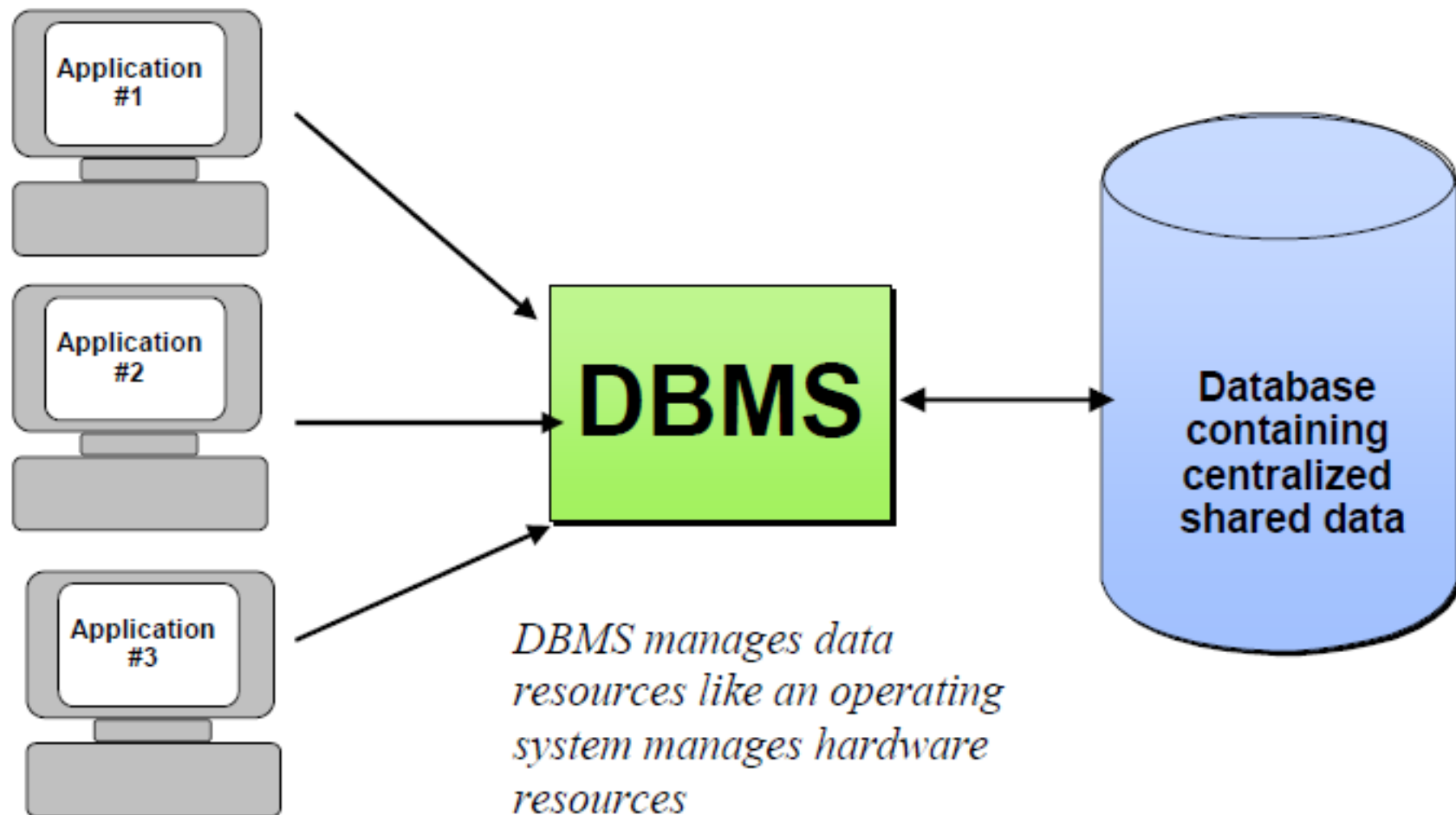


Requires a Database Management System (DBMS)

Database Management System

- A DBMS is a data storage and retrieval system which permits data to be stored non-redundantly while making it appear to the user as if the data is well-integrated.

Database Management System



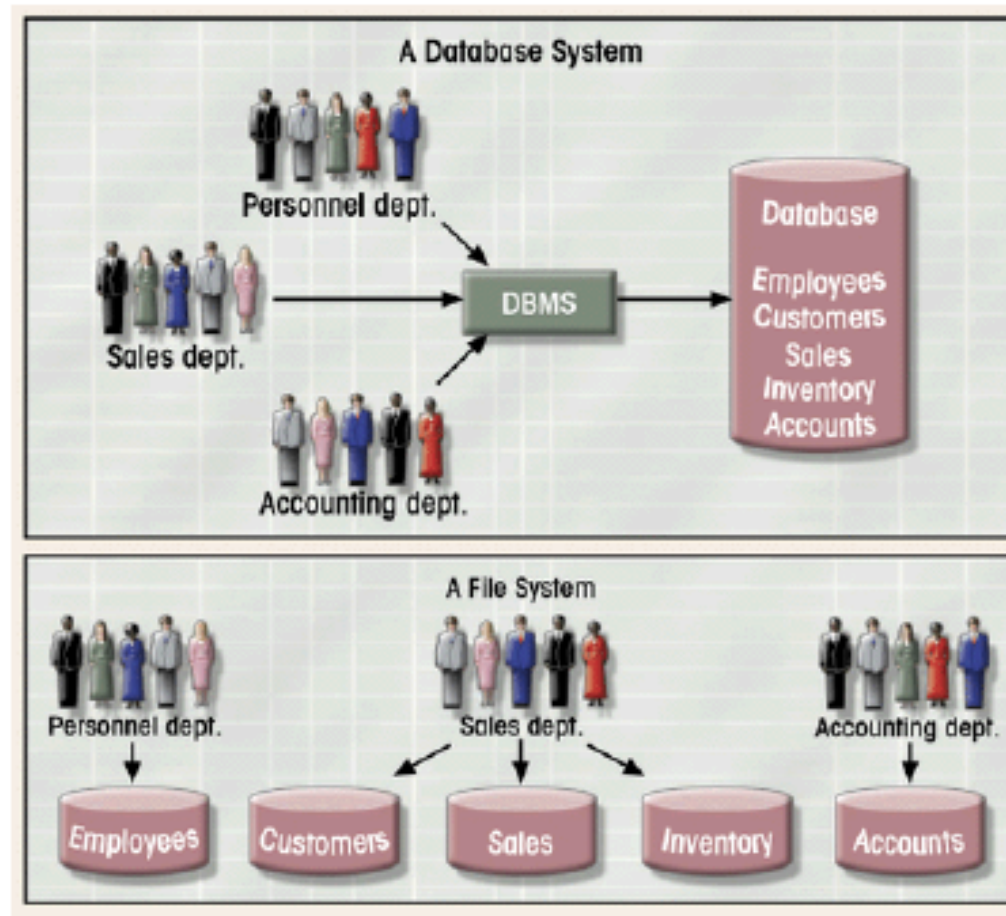
Advantages of Database Approach

- Program-Data Independence
 - Metadata stored in DBMS, so applications don't need to worry about data formats
 - Data queries/updates managed by DBMS so programs don't need to process data access routines
 - Results in: increased application development and maintenance productivity
- Minimal Data Redundancy
 - Leads to increased data integrity/consistency
- Improved Data Sharing
 - Different users get different views of the data
- Enforcement of Standards
 - All data access is done in same way
- Improved Data Quality
 - Constraints, data validation rules

Advantages of Database Approach (Cont.)

- Better Data Accessibility/Responsiveness
 - Use of standard data query language (SQL)
- Security, Backup/Recovery, Concurrency
 - Disaster recovery is easy

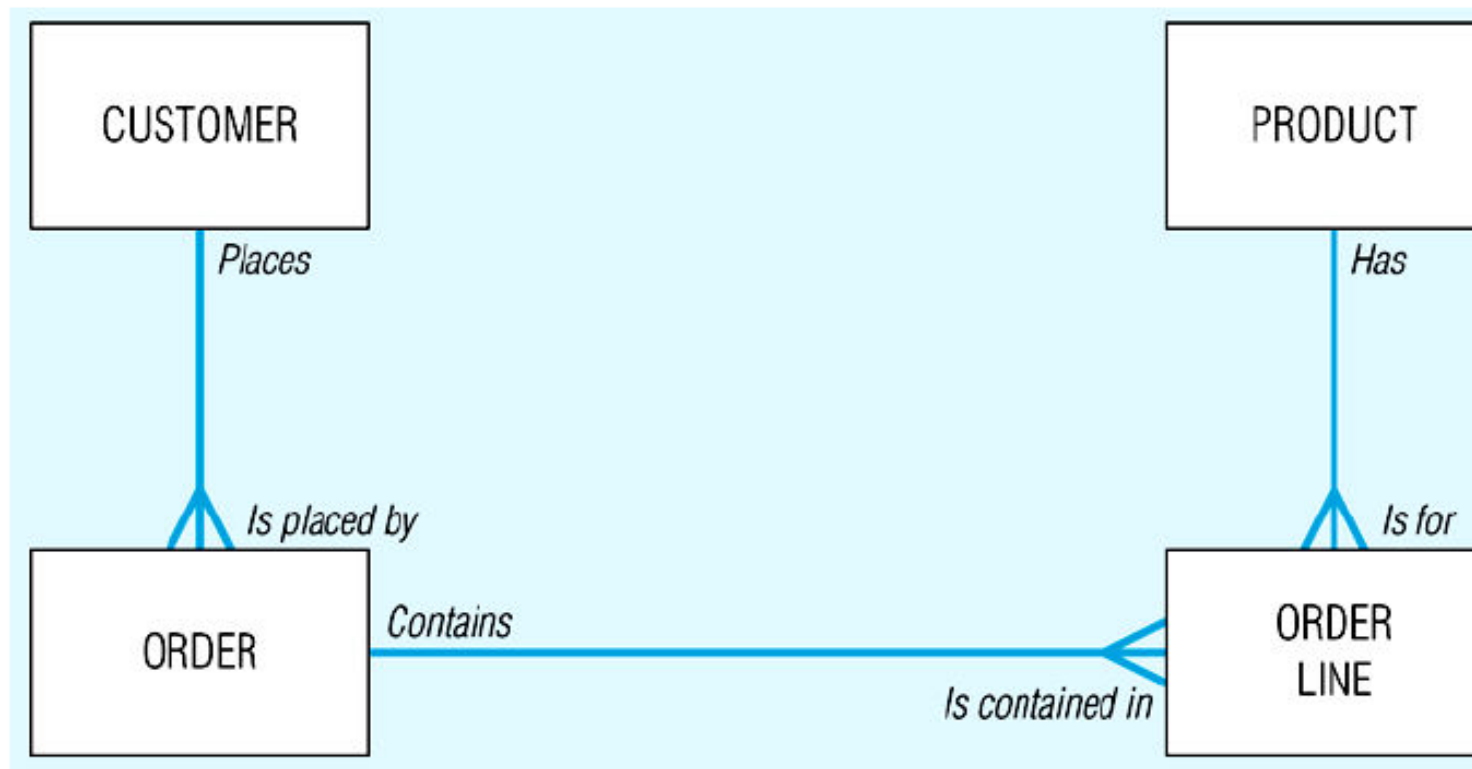
Database Vs. File Systems



The Database Approach

- The enterprise data model is a graphical model that shows the high-level entities for the organization and the relationships among those entities.
- Enterprise data model is represented with the help of a E-R diagram that shows the entities, attributes, relations, connectivities and cardinalities.

Segment from Enterprise Data Model



**Entity
Relationship
Diagram**

Figure 1-3b: Segment from Enterprise Data Model

Physical Tables in MS Access

Microsoft Access

ORDER_t : Table

Order_id	Order_Date	Customer_ID
1	9/8/2000	4
2	10/1/2000	3
3	7/19/2000	1
4	11/12/2000	6
5	7/28/2000	4
6	8/17/2000	6
7	8/17/2000	3
(AutoNumber)		0

Record: 1 of 7

Order line t : Table

Order_ID	Product_ID	Quantity
1	2	2
1	10	2
2	3	1
2	8	2
2	14	2
3	6	2
4	3	1
4	7	3
5	6	2
5	10	1
0	0	0

Record: 1 of 10

Relationships established in special columns that provide links between tables

Microsoft Access

PRODUCT_t : Table

Product ID	Product Description	Product Finish	Unit Price	On Hand
1	d Table	Cherry	\$175.00	8
2	Coffe Table	Birch	\$200.00	4
3	Computer Desk	Oak	\$375.00	5
4	Entertainment Center	Maple	\$650.00	3
5	Writer's Desk	Oak	\$325.00	0
6	8-Drawer Dresser	Birch	\$750.00	5
7	48" Bookcase	Walnut	\$150.00	5
8	48" Bookcase	Oak	\$175.00	2
9	96" Bookcase	Walnut	\$225.00	4
10	96" Bookcase	Oak	\$200.00	4
11	4-Drawer Dresser	Oak	\$500.00	3
12	8-Drawer Dresser	Oak	\$800.00	2
13	Nightstand	Cherry	\$150.00	5
14	Writer's Desk	Birch	\$300.00	2

Record: 1 of 14

CUSTOMER_t : Table

Customer ID	Customer Name	Address	City	State	Postal Code
1	Contemporary Casuals	1355 S Hines Blvd	Gainesville	FL	32601-
2	Value Furniture	15145 S.W. 17th St.	Plano	TX	75094-
3	Home Furnishings	1900 Allard Ave	Albany	NY	12209-
4	Eastern Furniture	1925 Beltline Rd.	Carteret	NJ	07008-
5	Impressions	5585 Westcott Ct.	Sacramento	CA	94206-
6	Furniture Gallery	325 Flatiron Dr.	Boulder	CO	80514-

Record: 1 of 6

- Each table row (tuple) represents a single entity occurrence within the entity set.
- Each table column represents an attribute, and each column has a distinct name.
- Each column/row intersection represents a single data value.
- All values in a column must confirm to the same data format.
- The order of the row and columns is immaterial to the DBMS.
- Each table must have an attribute or a combination of attributes that uniquely identifies each row.

Physical Tables in MySQL

Order

```
mysql> select * from Order_T;
```

OrderID	OrderDate	CustomerID
1001	2010-10-21	4
1002	2010-10-21	3
1003	2010-10-22	1
1004	2010-10-22	6
1005	2010-10-24	4
1006	2010-10-24	6
1007	2010-10-27	3
1008	2010-10-30	5
1009	2010-11-05	1
1010	2010-11-05	7

10 rows in set (0.00 sec)

```
mysql> select * from OrderLine_T;
```

OrderID	ProductID	OrderedQuantity
1001	1	2
1001	2	2
1001	4	1
1002	3	5
1003	3	3
1004	6	2
1004	8	2
1005	4	4
1006	4	1
1006	5	2
1006	7	2
1007	1	3
1007	2	2
1008	3	3
1008	8	3
1009	4	2
1009	7	3
1010	8	10

18 rows in set (0.00 sec)

**Order
Line**

```
mysql> select * from Customer_T;
```

CustomerID	CustomerName
1	Contemporary Casuals
2	Value Furniture
3	Home Furnshings
4	Eastern Furniture
5	Impressions
6	Furniture Gallery
7	Period Furniture
8	California Classics
9	M and H Casual Furniture
10	Seminole Interiors
11	American Euro Lifestyles
12	Battle Creek Furniture
13	Heritage Furnishings
14	Kaneohe Homes
15	Mountain Scenes

15 rows in set (0.00 sec)

Customer

```
mysql> select * from Product_T;
```

ProductID	ProductStandardPrice
1	175.00
2	200.00
3	375.00
4	650.00
5	325.00
6	750.00
7	800.00
8	250.00

8 rows in set (0.00 sec)

Product

Metadata in MySQL

```
mysql> describe customer_t;
```

Field	Type	Null	Key	Default	Extra
CustomerID	int(11)	NO	PRI	NULL	auto_increment
CustomerName	varchar(30)	YES		NULL	

2 rows in set (0.10 sec)

Customer**Order**

```
mysql> describe order_t;
```

Field	Type	Null	Key	Default	Extra
OrderID	int(11)	NO	PRI	NULL	auto_increment
OrderDate	date	NO		NULL	
CustomerID	int(11)	NO	MUL	NULL	

3 rows in set (0.07 sec)

```
mysql> describe orderline_t;
```

Field	Type	Null	Key	Default	Extra
OrderID	int(11)	NO	PRI	NULL	
ProductID	int(11)	NO	PRI	NULL	
OrderedQuantity	int(11)	NO		NULL	

3 rows in set (0.04 sec)

**Order
Line**

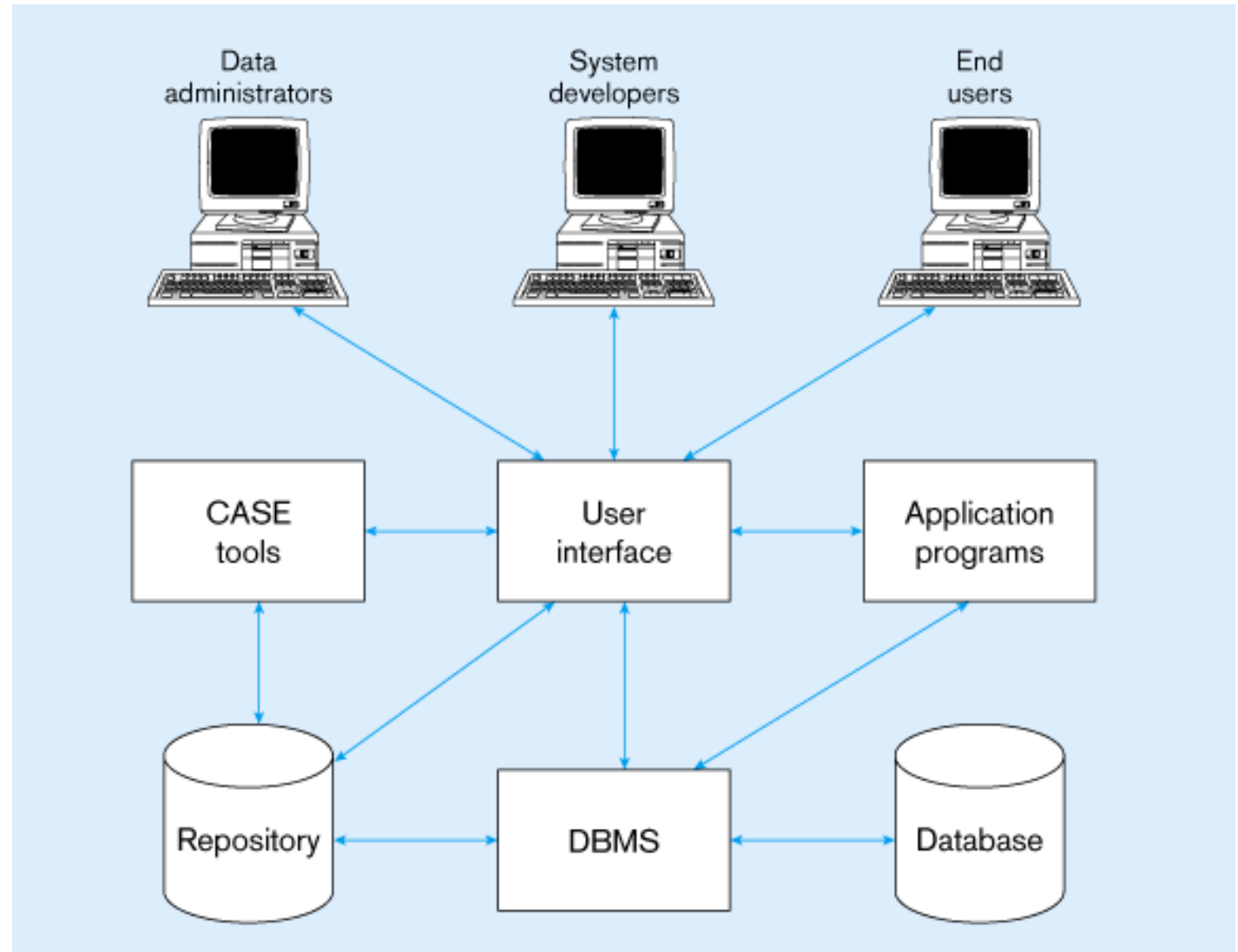
Costs & Risks of the Database Approach

- Up-front Costs
 - Installation Management Cost and Complexity
 - Conversion Cost
- Ongoing Costs
 - Requires New, Specialized Personnel
 - Need for Explicit Backup & Recovery
- Organizational Conflicts
 - Old habits die hard

Components of the Database Environment

- **CASE Tools** – computer-aided software engineering
- **Repository** – centralized storehouse of metadata
- **Database Management System (DBMS)** – software for managing the database
- **Database** – storehouse of the data
- **Application Programs** – software using the data
- **User Interface** – text and graphical displays to users
- **Data Administrators** – personnel responsible for maintaining the database
- **System Developers** – personnel responsible for designing databases and software
- **End Users** – people who use the applications and databases

Figure 1-5:
Components of the
Database
Environment



The Range of Database Applications

- Personal Databases (Standalone desktop database)
- Two-Tier Client/Server Databases (Local area network with <100 users)
- Multi-Tier Client/Server Database (Local area network with <1000 users)
- Enterprise Database – wide-area network (more than thousands of users)

Typical Data from a Personal Computer Database

Customer

Customer Name: Multi Media, Inc.	
Address: 1000 River Road	
City: San Antonio	
State: TX	
Zip: 76235	
Phone: (219) 864-2000	
Next Contact Date: 10/17/2000	Time: 10:30 AM

Contact History for Customer

Date	Time	Contact	Comments
08/04/2000	10:00 AM	Roberts	Review proposal
08/19/2000	08:00 AM	Roberts	Revise schedule
09/10/2000	09:00 AM	Pearson	Sign contract
09/21/2000	02:00 PM	Roberts	Follow up

Figure 1-6: Two-Tier Database with Local Area Network

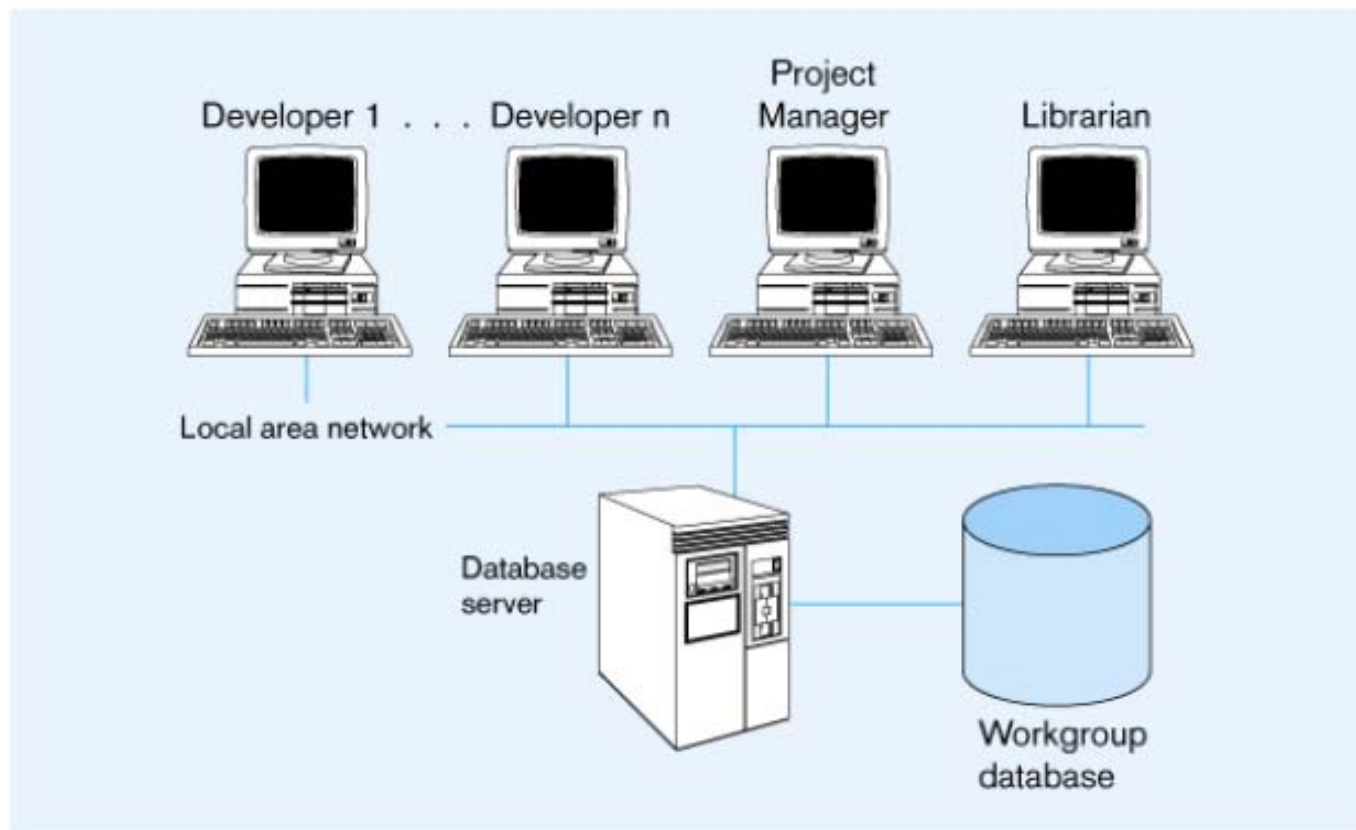
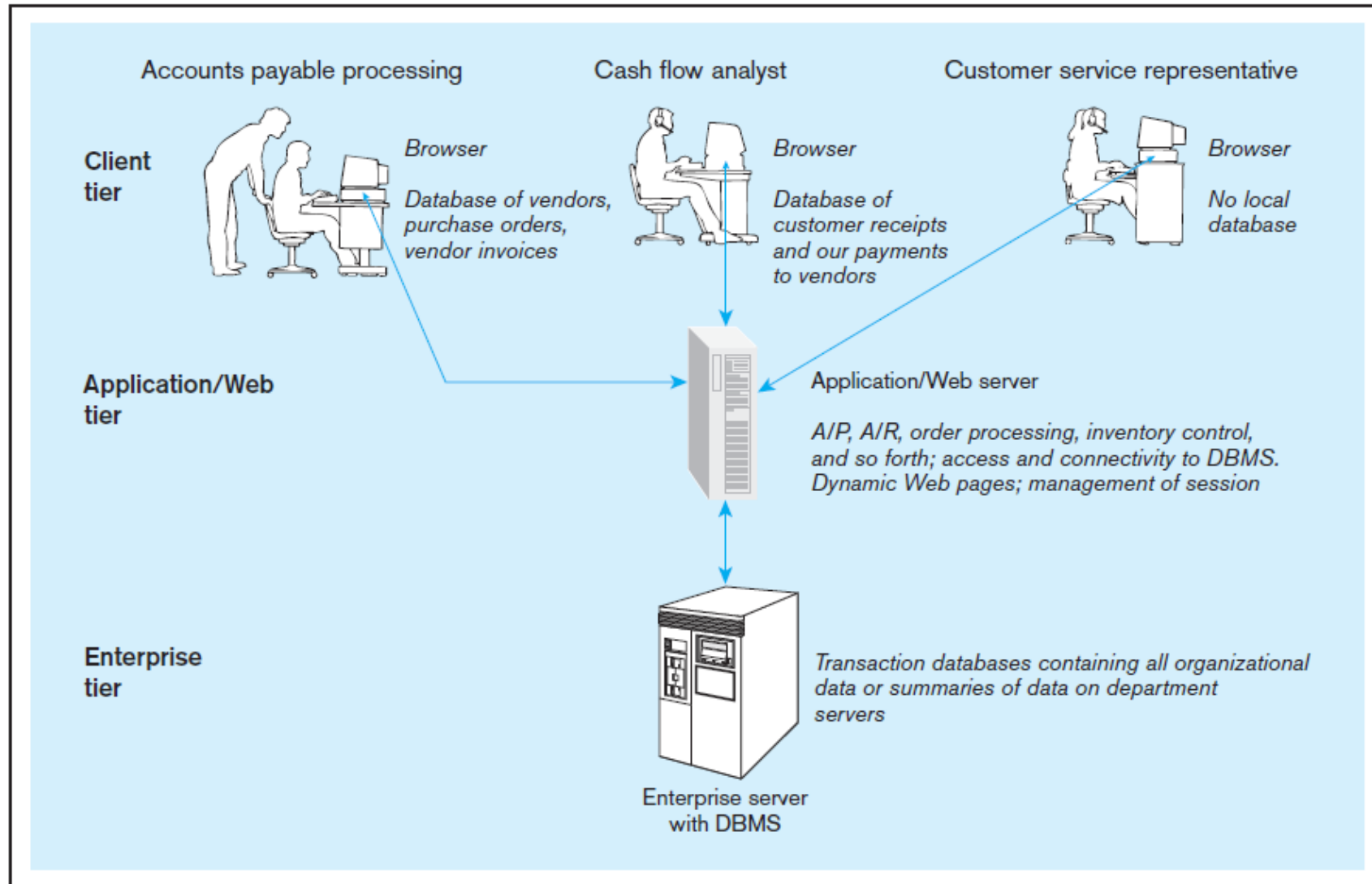
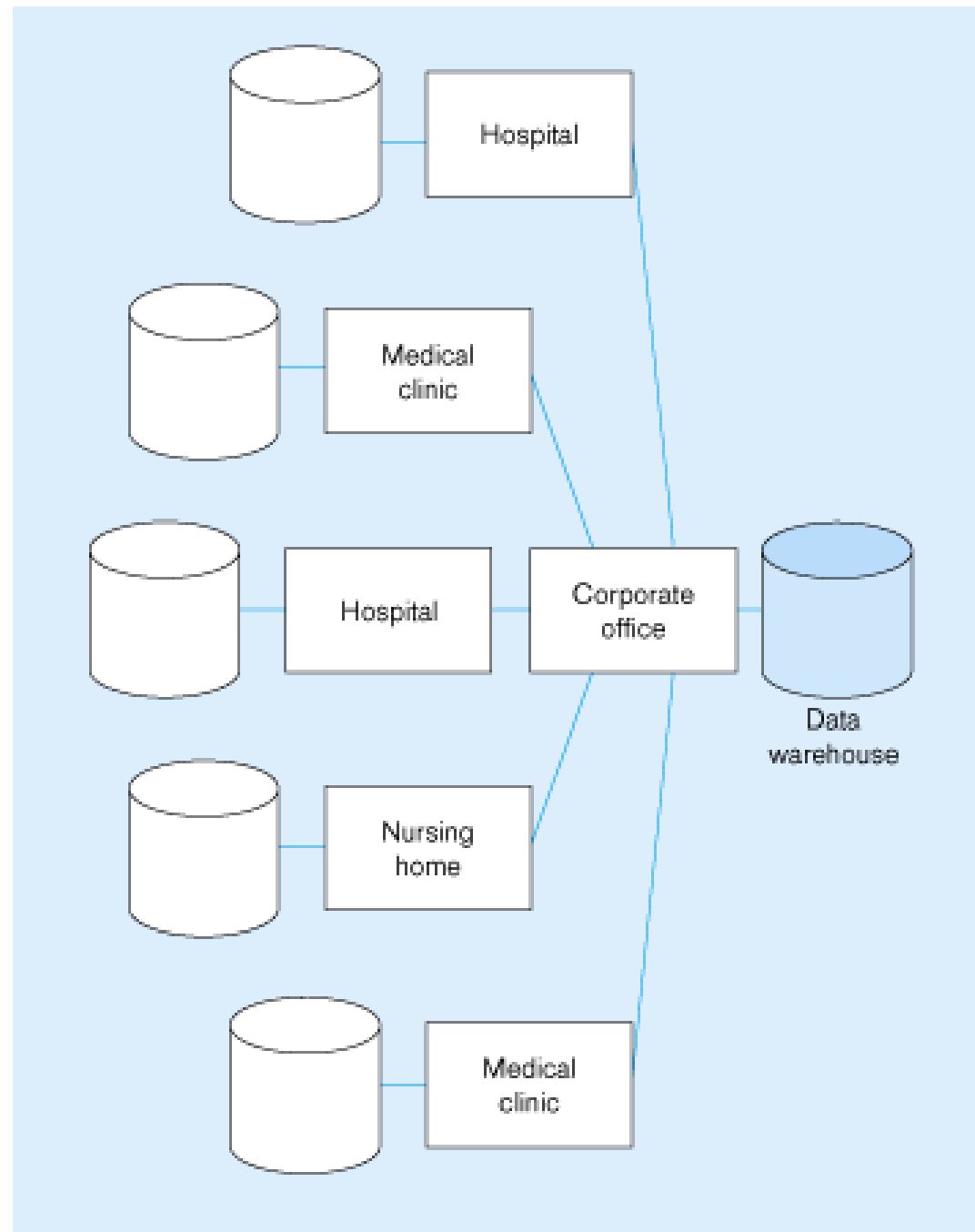


Figure 1-7: Three-Tier Database with Local Area Network



An Enterprise Data Warehouse

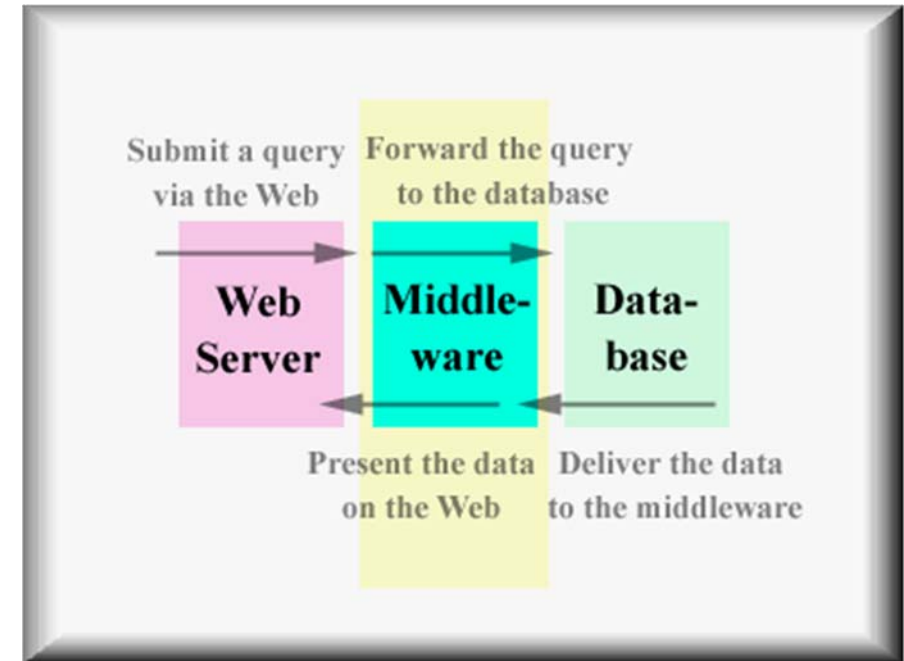
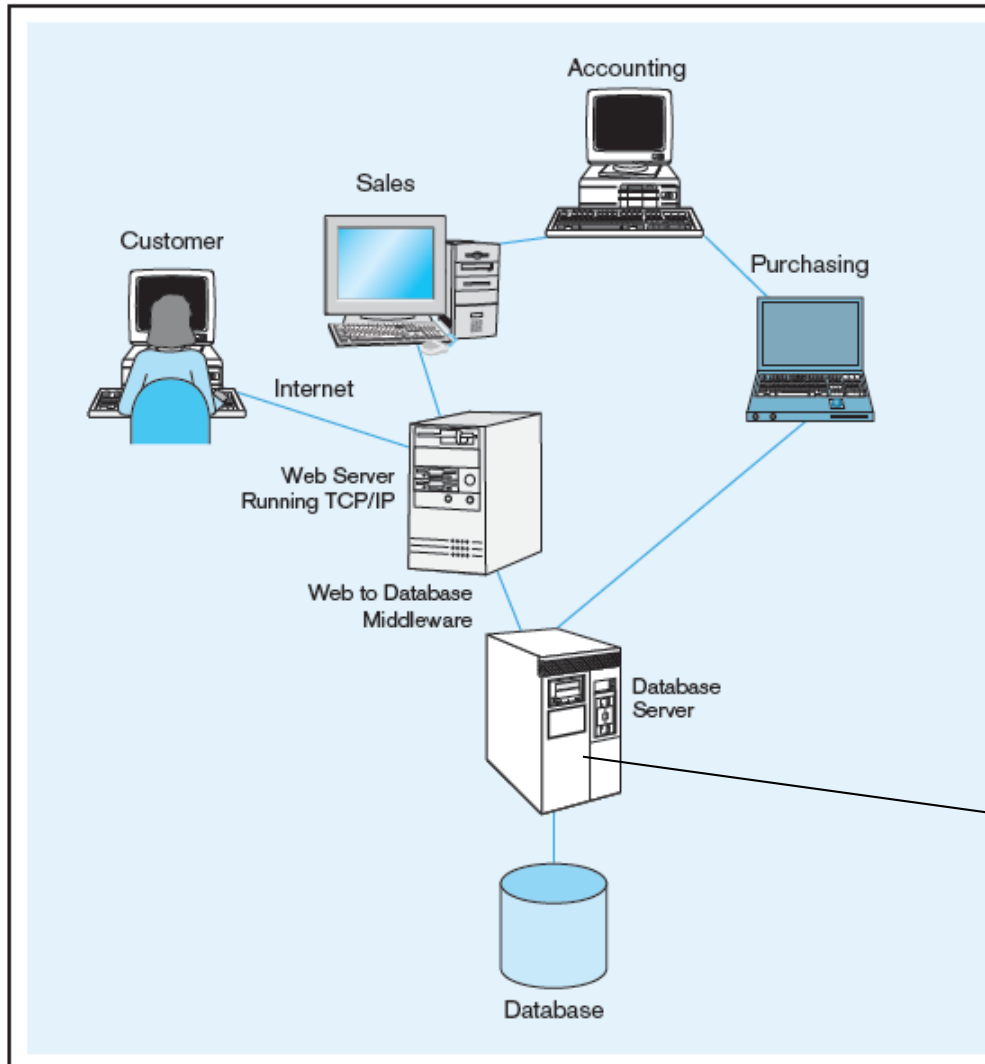


Summary of Database Applications

TABLE 1-5 Summary of Database Applications

Type of Database / Application	Typical Number of Users	Typical Size of Database
Personal	1	Megabytes
Two-tier	5–100	Megabytes–gigabytes
Three-tier	100–1000	Gigabytes
Enterprise resource planning	>100	Gigabytes–terabytes
Data warehousing	>100	Terabytes–petabytes

Figure 1-13: Client/Server System for Pine Valley Furniture Company



A dedicated computer which provides database services to other computer programs or computers. Examples: Microsoft SQL Server, Oracle, DB2, and Informix.

Evolution of Database Systems

- Flat files - 1960s - 1980s
- Hierarchical – 1970s - 1990s
- Network – 1970s - 1990s
- Relational – 1980s - present
- Object-oriented – 1990s - present
- Object-relational – 1990s - present
- Data warehousing – 1980s - present
- Web-enabled – 1990s – present
- Cloud – 2000s – present

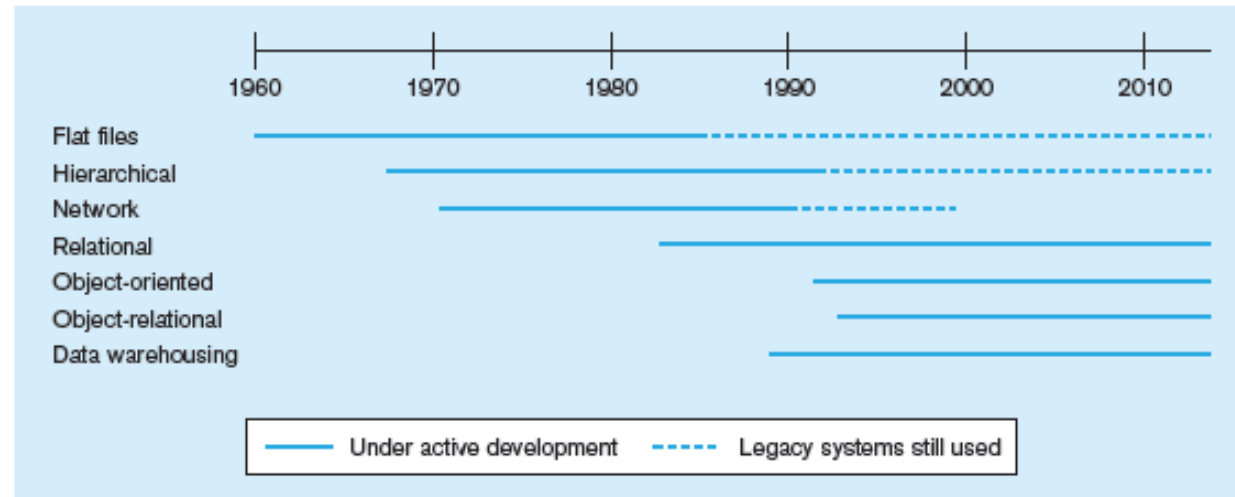


Figure 1-8a: Evolution of Database Technologies

Evolution of Database Systems (Cont.)

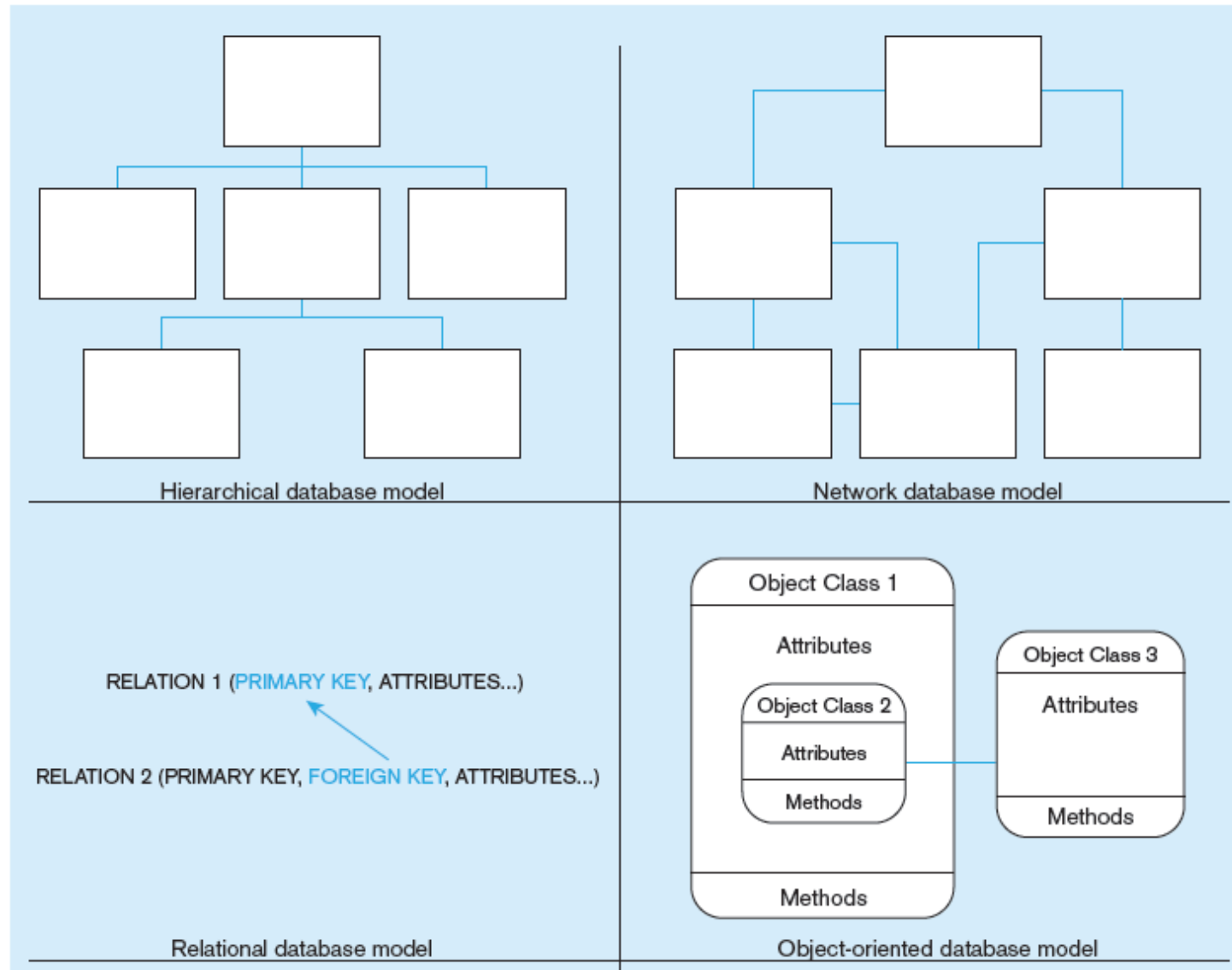
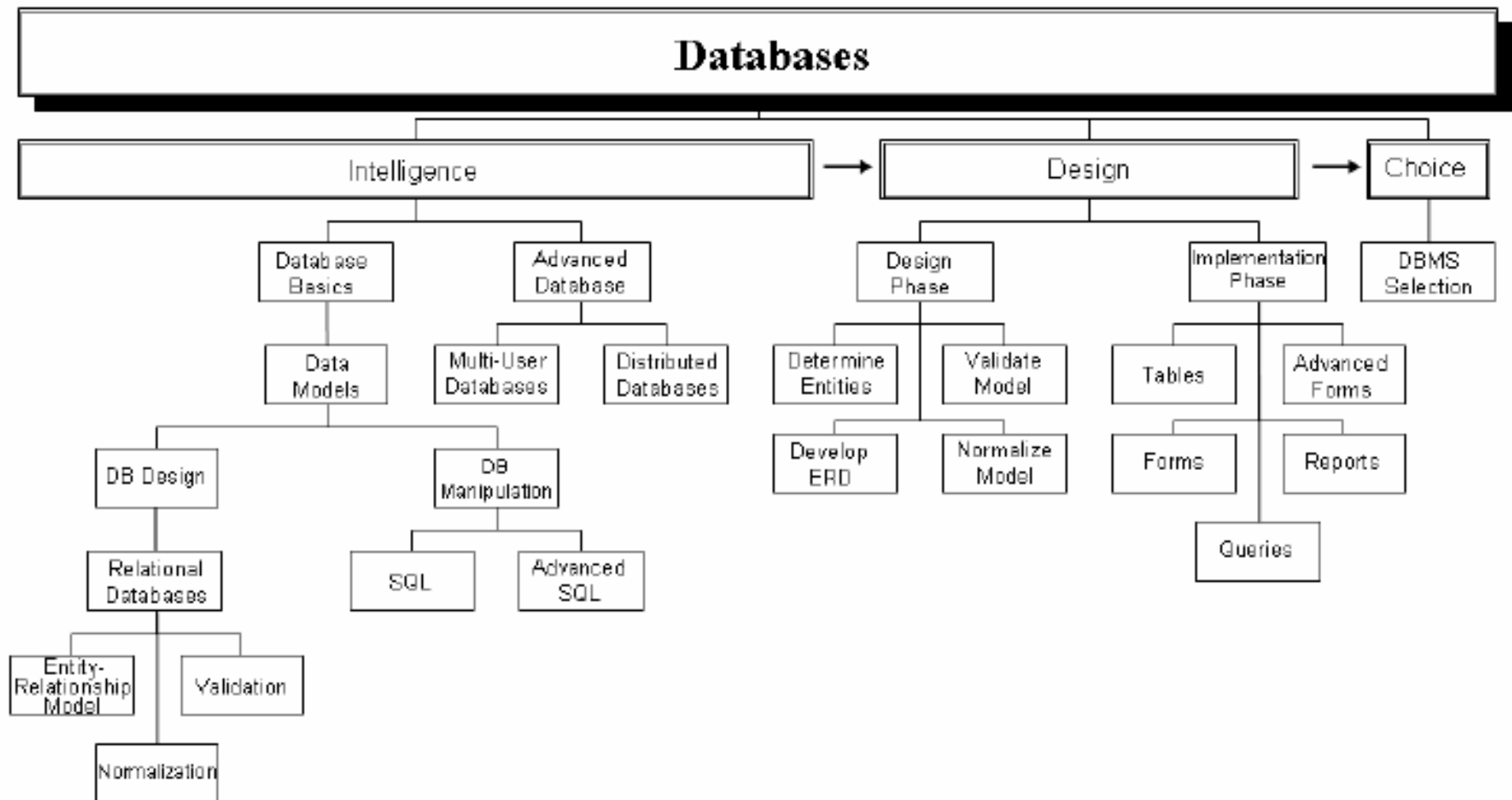


Figure 1-8b: Database Systems

Concept Map



Summary

- Introduced various terms
- Discussed traditional file processing system and its disadvantages
- Covered database approach, its advantages, and various costs
- Introduced Enterprise Data Model and its various constructs
- Discussed components of database environment
- Range of database applications
- Evolution of database systems