

# Business Database Management

Yuan Qu  
Rutgers University

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THE STATE UNIVERSITY OF NEW JERSEY  
**RUTGERS**

## ■ Course Info

- Instructor: Yuan Qu  
(or Ryan Q, for convenience)
- Office Hours: 1 WP, Room 1057A  
Monday 5:30PM to 6:30PM
- Email: [yuan.qu@rutgers.edu](mailto:yuan.qu@rutgers.edu)

# Course Web Site

<http://blackboard.newark.rutgers.edu>

We will use Blackboard for this course (I can't access it yet).

This web site is the location for course documents, assignments, announcements and other information. You should check it frequently to remain updated. **You are responsible for keeping aware of the announcements on the course web site.**

# Grading Policy

In-class work (including attendance)	10%
Assignments (3 or 4)	30%
Exam I (Oct. 21 <sup>st</sup> )	30%
Exam II (Dec. 9 <sup>th</sup> )	30%

**Note that the final letter grade is based on a curve.**

# Attendance

Regular attendance is compulsory. You are not allowed to check your emails, access Web sites not related to the course or work on something that is beyond the scope of this course during the class time.

# Assignments

You may have discussions with your class members, but you must submit your own work. Please be sure to keep a copy of the assignment by yourself in case that there is any problem with your hand-in or you must use it later this semester.

Assignments must be submitted before the beginning of the class on the specified due day. No late submissions will be accepted. You are encouraged to type your work.

# Exams

There will be no make-up exams. You are required to present a written proof for situations, such as going to an emergency room due to unexpected and serious illness.

Chatting during the exam is not allowed. No collaboration between class members will be allowed during any exam. There will be no extra-credit project.

# Scholastic Dishonesty Policy

The University defines academic dishonesty as cheating, plagiarism, unauthorized collaboration, falsifying academic records, and any act designed to avoid participating honestly in the learning process. Scholastic dishonesty also includes, but not limited to, providing false or misleading information to receive a postponement or an extension on assignments, and submission of essentially the same written assignment for two different courses without the permission of faculty members.

The purpose of assignments is to provide individual feedback as well to get you thinking. Interaction for the purpose of understanding a problem is not considered cheating and will be encouraged. However, the actual solution to problems must be one's own.

# Database Systems

## Design, Implementation, and Management



# Chapter 1

# Database Systems

# Learning Objectives

- In this chapter, you will learn:
  - The difference between data and information
  - What a database is, the various types of databases, and why they are valuable assets for decision making
  - The importance of database design
  - How modern databases evolved from file systems

# Learning Objectives

- In this chapter, you will learn:
  - About flaws in file system data management
  - The main components of the database system
  - The main functions of a database management system (DBMS)

# Data vs. Information

## Data

- Raw facts
  - Raw data - Not yet been processed to reveal the meaning
- Building blocks of information
- **Data management**
  - Generation, storage, and retrieval of data

## Information

- Produced by processing data
- Reveals the meaning of data
- Enables **knowledge** creation
- Should be accurate, relevant, and timely to enable good decision making
- The key to survival in the information age!

# Transforming Raw Data into Information

## a) Initial Survey Screen

Devinney A. Jones College of Business Survey - Microsoft Internet Explorer

File Edit View Favorites Tools Help

### Business Computer Lab Satisfaction Survey

**College of Business COMPUTER LAB**

This survey is designed to obtain student feedback regarding the services provided by the Business Computer Lab and identify areas in which we need to improve. Please answer each question as accurately as possible.

**Using the Lab**

What is your academic classification?

Freshman  Sophomore  Junior  Senior  Graduate Student  Other

Do you own a computer?

Yes  No

How often do you use the Business Computer Lab?

Five or more times / week  
 Three or four times / week  
 Once or twice / week  
 Once / month or less

What do you primarily use the Business Computer Lab for?

You may check more than one.

<input type="checkbox"/> Internet (i.e. Web Browsing, Chat)	<input type="checkbox"/> Presentations (i.e. MS PowerPoint)
<input type="checkbox"/> Email Access	<input type="checkbox"/> Academic Programs (i.e., Minitab, Cobol, MS Visio, etc.)
<input type="checkbox"/> Word Processing (i.e. MS Word)	<input type="checkbox"/> Games
<input type="checkbox"/> Spreadsheets (i.e. MS Excel)	<input type="checkbox"/> Other: _____

What do you like **MOST** about the Business Computer Lab?

You may check more than one.

<input type="checkbox"/> Email	<input type="checkbox"/> Up to date software
<input type="checkbox"/> 24 Hour schedule	<input type="checkbox"/> Laser printers
<input type="checkbox"/> Availability of computers	<input type="checkbox"/> Scanners

Done Internet

# Transforming Raw Data into Information (continued)

b) Raw Data

	A	B	C	D	E	F	G	H	I	J
1	AcadClass	OwnComputer	HowOftenUseLab	PrimarilyLab						
2	Gra	N	5W	0	1	1	1	1	1	1
3	Sen	Y	5W	1	0	0	0	1	1	1
4	Sen	Y	1W	0	0	0	1	0	0	0
5	Sen	Y	1W	1	0	0	0	1	0	0
6	Sen	Y	3W	0	0	0	0	1	0	0
7	Gra	N	5W	0	0	0	0	1	1	1
8	Sen	Y	1W	1	0	0	0	1	0	0
9	Sen	Y	3W	1	0	1	0	1	1	0
10	Sen	Y	1W	0	0	0	1	0	1	0
11	Sen	Y	5W	0	1	0	0	0	0	0
12	Jun	Y	1W	1	0	0	0	1	0	1
13	Sen	N	5W	1	0	0	1	1	1	1
14	Jun	Y	1W	0	0	0	1	0	0	0
15	Sen	Y	5W	0	0	0	1	0	0	0
16	Jun	Y	1M	0	1	0	0	0	0	1
17	Sen	Y	1W	0	0	1	0	0	0	0
18	Sen	Y	1W	0	0	1	1	0	0	0
19	Gra	N	5W	1	0	0	1	0	1	1
20	Gra	Y	1M	0	1	0	0	0	0	0
21	Gra	Y	5W	0	0	1	1	1	1	1
22	Sen	N	3W	0	0	1	1	1	1	0
23	Jun	Y	1W	1	0	0	0	0	0	0
24	Sen	Y	3W	1	1	0	1	1	0	0
25	Jun	Y	1W	1	0	0	0	1	0	0
26	Jun	Y	1W	1	0	0	0	0	1	1
27	Sen	Y	1M	1	0	0	0	0	1	0
28	Sen	Y	5W	0	0	0	0	1	0	1
29	Gra	Y	1M	0	0	0	1	0	0	1
30	Gra	Y	5W	1	1	0	0	1	1	1
31	Jun	N	5W	1	0	0	1	1	1	1
32	Jun	Y	3W	1	0	0	1	0	0	0
33	Gra	Y	5W	0	1	0	1	0	1	1

# Transforming Raw Data into Information

c) Information in Summary Format

The screenshot shows a Microsoft Internet Explorer window displaying a survey summary page. The title bar reads "Jennings A. Jones College of Business Survey - Microsoft Internet Explorer". The main content area is titled "Summary: Business Computer Lab Satisfaction Survey". It shows a table of academic classification responses:

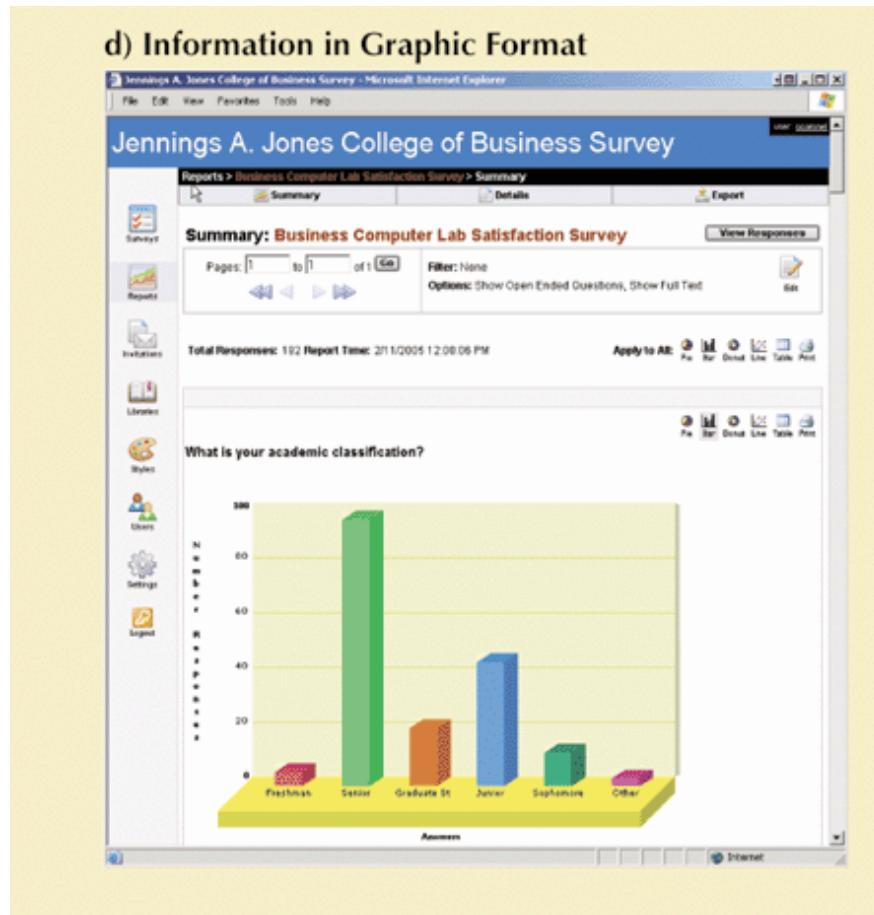
Response	Response Count	Percentage
Freshman	5	2.73%
Sophomore	52	6.56%
Junior	45	24.59%
Senior	87	53.81%
Graduate Student	21	11.48%
Other	2	1.64%
<b>Totals</b>	<b>193</b>	

Below this, there is another section titled "Do you own a computer?" with a similar table:

Response	Response Count	Percentage
Yes	185	99.19%
No	2	10.81%
<b>Totals</b>	<b>187</b>	

# Simple Statistics

# Transforming Raw Data into Information (continued)



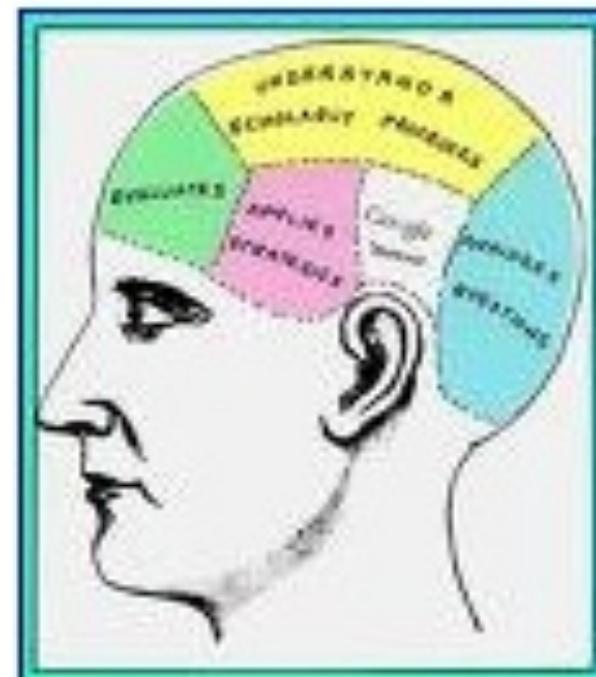
## Visualizations

# Information Is Subjective

- Information in one person's context is just a data point in another person's context.
- Information is always subjective.

## Data Characteristics of Good Information

- **Accurate**
- **Timely**
- **Relevant**
  - To context
  - To subject
- **Just sufficient**
- **Worth its cost**



# What is Information?

- Knowledge derived from data, and data are recorded facts or figures



Does this graph contain information?

# Transforming Raw Data into Information (continued)

- What elective courses are taken typically by sophomores in information systems?
- What computer services should be offered to benefit most of students?
- What would be an appropriate study plan for students in a particular situation?

Complex  
Queries  
and  
Knowledge  
Extraction

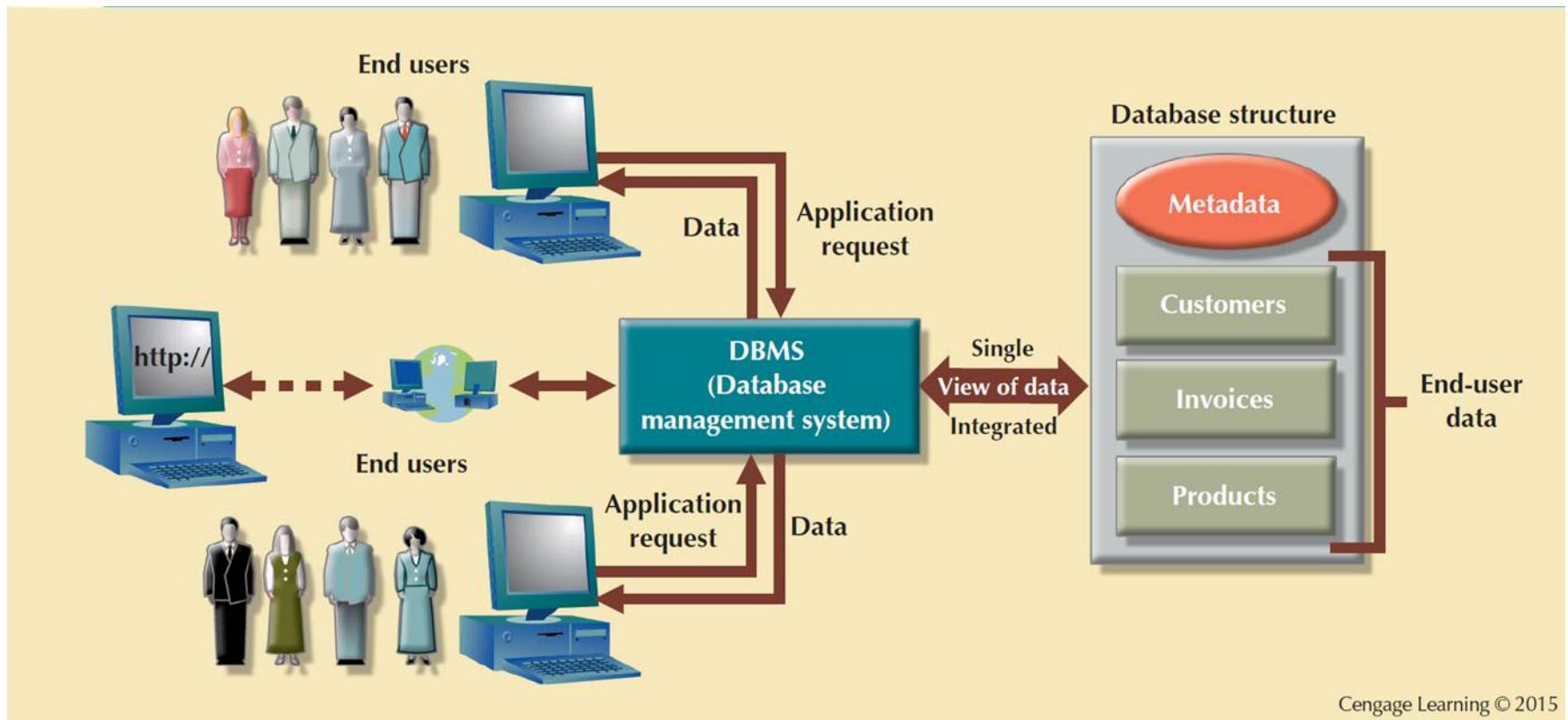
# Database

- Shared, integrated computer structure that stores a collection of:
  - End-user data - Raw facts of interest to end user
  - **Metadata:** Data about data, which the end-user data are integrated and managed
    - Describe data characteristics and relationships
- **Database management system (DBMS)**
  - Collection of programs
  - Manages the database structure
  - Controls access to data stored in the database

# Role of the DBMS

- Intermediary between the user and the database
- Enables data to be shared
- Presents the end user with an integrated view of the data
- Receives and translates application requests into operations required to fulfill the requests
- Hides database's internal complexity from the application programs and users

# Figure 1.2 - The DBMS Manages the Interaction between the End User and the Database



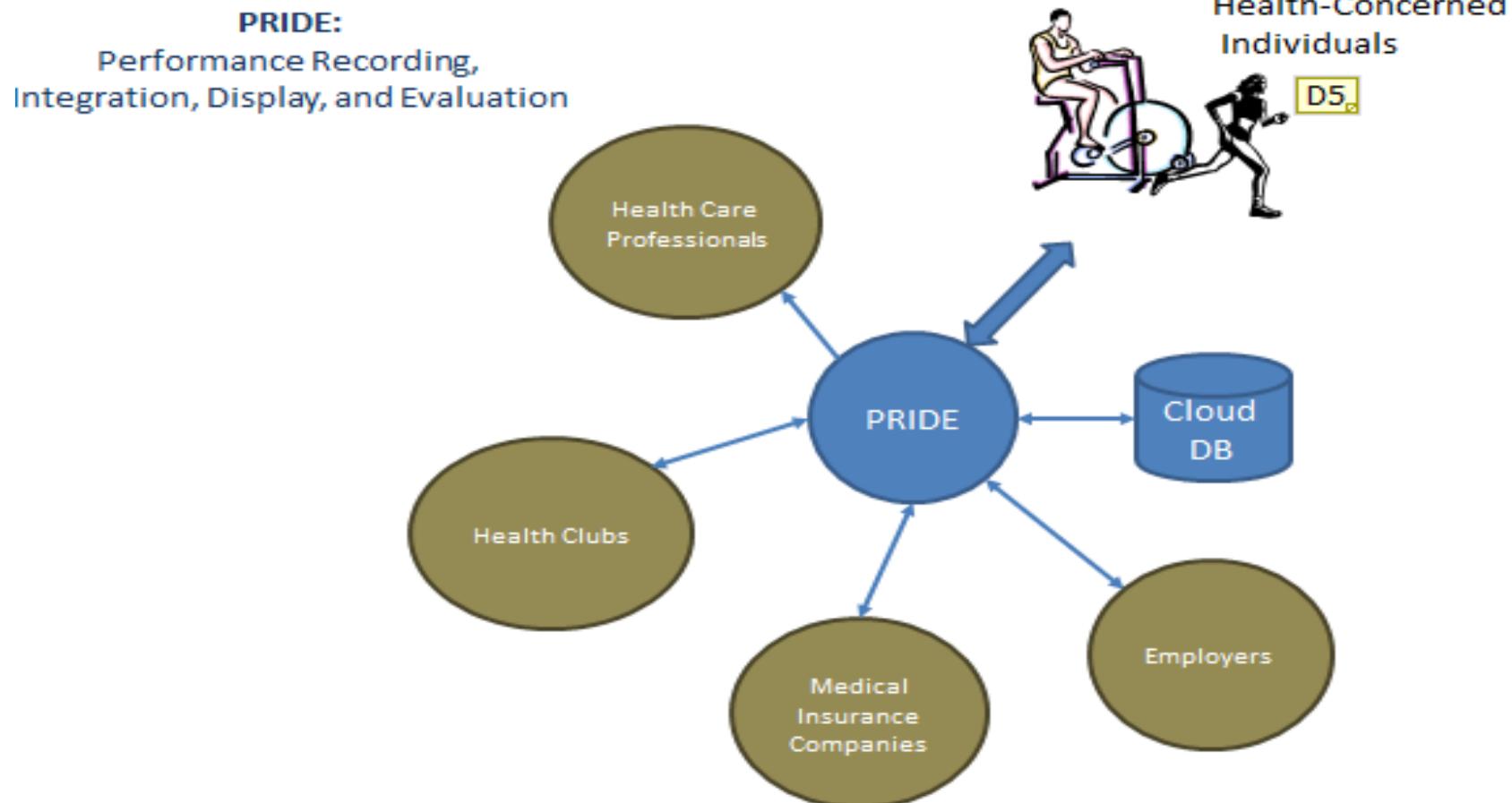
# Advantages of the DBMS

- Better data integration and less data inconsistency
  - **Data inconsistency:** Different versions of the same data appear in different places
- Increased end-user productivity
- Improved:
  - Data sharing
  - Data security
  - Data access
  - Decision making
    - **Data quality:** Promoting accuracy, validity, and timeliness of data

# Types of Databases

- **Single-user database:** Supports one user at a time
  - **Desktop database:** Runs on PC
- **Multiuser database:** Supports multiple users at the same time
  - **Workgroup databases:** Supports a small number of users or a specific department
  - **Enterprise database:** Supports many users across many departments

# Multiuser database



# Multiuser database

Scope	Example	Characteristics
Workgroup	Doctor's Office/ Medical Practice	Support one or more workgroup processes. 10–100 users; procedures often formalized; problem solutions within group; workgroups can duplicate data; somewhat difficult to change
Enterprise	Hospital	Support one or more enterprise processes. 100–1,000s users; procedures formalized; problem solutions affect enterprise; eliminate workgroup data duplication; difficult to change
Inter-enterprise	PRIDE System	Support one or more inter-enterprise processes. 1,000s users; systems procedures formalized; problem solutions affect multiple organizations; can resolve problems of duplicated enterprise data; very difficult to change

# Types of Databases

- **Centralized database:** Data is located at a single site
- **Distributed database:** Data is distributed across different sites
- **Cloud database:** Created and maintained using cloud data services that provide defined performance measures for the database

# Types of Databases

- **General-purpose databases:** Contains a wide variety of data used in multiple disciplines
- **Discipline-specific databases:** Contains data focused on specific subject areas

# Types of Databases

- **Operational (transactional) database:** Designed to support a company's day-to-day operations
- **Analytical database:** Stores historical data and business metrics used exclusively for tactical or strategic decision making
  - **Data warehouse:** Stores data in a format optimized for decision support

See <http://www.healthcatalyst.com/database-vs-data-warehouse-a-comparative-review/2/> for a concise discussion of the difference between a database and a data warehouse

# Types of Databases

- **Online analytical processing (OLAP)**
  - Enable retrieving, processing, and modeling data from the data warehouse
- **Business intelligence:** describes a comprehensive approach to capture and process business data with the purpose of generating information that support business decision making.

# Types of Databases

- **Unstructured data:** It exists in their original state
- **Structured data:** It results from formatting unstructured data to facilitate storage, use, and the generation of information.
  - Structure is applied based on type of processing to be performed
- **Semistructured data:** Processed to some extent
- **Extensible Markup Language (XML)**
  - A special language used to represent and manipulate data elements in textual format.
  - A XML database supports the storage and management of semistructured XML data.

# Database Design

- Focuses on the design of the database structure that will be used to store and manage end-user data
- Well-designed database
  - Facilitates data management
  - Generates accurate and valuable information
  - Avoids redundant data
- Poorly designed database causes difficult-to-trace errors → leads to bad decisions → can lead to failure of organization

# Bad Design Example

ID	ENum	Name	Title	HireDate	Skill1	Skill1Date	Skill2	Skill2Date	Skill3	Skill3Date
1	02345	Johnny Jones	DBA	2/14/1995	Basic Database Management	2/14/2000	Advanced Database Management	2/14/2003	Basic Web Design	8/9/2001
2	08273	Marco Bienz	Analyst	7/28/2006	Basic Web Design	3/8/2007	Advance Process Modeling	8/19/2010		
3	06234	Jasmine Patel	Programmer	8/10/2005	Basic Web Design	8/10/2005	Advanced C# programming	8/10/2005	Basic DB manipulation	1/29/2010
4	03373	Franklin Johnson, Jr.	Purchasing Agent	3/15/2002	Advanced Spreadsheets	6/20/2009				
5	13567	Almond, Robert	Analyst	9/30/2012	Basic Process Modeling	9/30/2012	Basic Database Design	5/23/2013		
6	10282	Richardson, Amanda	Clerk	4/11/2011						
7	09382	Jessica Johnson	Database Programmer	8/2/2010	Basic DB Design	8/2/2010	Basic Database Manipulation	8/2/2010	Advanced DB Manipulation	5/1/2011
8	14311	Duong, Lee	Programmer	9/1/2014	Basic Web Design	9/1/2014				
9					Master Database Programming					
10					Basic Spreadsheets					
11	09002	Ben Joiner	Clerk	5/20/2010	Advanced Spreadsheets	5/16/2011	Basic Web Design	5/16/2011		
12	13383	Raymond F. Matthews	Programmer	3/12/2012	Basic C# Programming	3/12/2012				
13	09283	Chavez, Juan	Clerk	7/4/2010						
14	04893	Patricia Richards	DBA	6/11/2004	Advanced Database Management	6/11/2004	Advanced Database Manipulation	9/20/2010		
15	13932	Lee, Megan	Programmer	9/29/2013						

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# Bad Design Example

- It would be difficult to produce an alphabetical listing of employees based on their last names.
- How many employees are certified in Basic Database Manipulation?
- Basic Database Manipulation=?Basic DB Manipulation
- Fourth skill? Fifth Skill?

**Table name: EMPLOYEE**

Employee_ID	Employee_FName	Employee_LName	Employee_HireDate	Employee_Title
02345	Johnny	Jones	2/14/1995	DBA
03373	Franklin	Johnson	3/15/2002	Purchasing Agent
04893	Patricia	Richards	6/11/2004	DBA
06234	Jasmine	Patel	8/10/2005	Programmer
08273	Marco	Bienz	7/28/2006	Analyst
09002	Ben	Joiner	5/20/2010	Clerk
09283	Juan	Chavez	7/4/2010	Clerk
09382	Jessica	Johnson	8/2/2010	Database Programmer
10282	Amanda	Richardson	4/11/2011	Clerk
13383	Raymond	Matthews	3/12/2012	Programmer
13567	Robert	Almond	9/30/2012	Analyst
13932	Megan	Lee	9/29/2013	Programmer
14311	Lee	Duong	9/1/2014	Programmer

**Table name: CERTIFIED**

Employee_ID	Skill_ID	Certified_Date
02345	100	2/14/2000
02345	110	8/9/2001
02345	180	2/14/2003
03373	120	6/20/2009
04893	180	6/11/2004
04893	220	9/20/2010
06234	110	8/10/2005
06234	200	8/10/2005
06234	210	1/29/2010
08273	110	3/8/2007
08273	190	8/19/2010
09002	110	5/16/2011
09002	120	5/16/2011
09382	140	8/2/2010
09382	210	8/2/2010
09382	220	5/1/2011
13383	170	3/12/2012
13567	130	9/30/2012
13567	140	5/23/2013
14311	110	9/1/2014

**Table name: SKILL**

Skill_ID	Skill_Name	Skill_Description
100	Basic Database Management	Create and manage database user accounts.
110	Basic Web Design	Create and maintain HTML and CSS documents.
120	Advanced Spreadsheets	Use of advanced functions, user-defined functions, and macroing.
130	Basic Process Modeling	Create core business process models using standard libraries.
140	Basic Database Design	Create simple data models.
150	Master Database Programming	Create integrated trigger and procedure packages for a distributed environment.
160	Basic Spreadsheets	Create single tab worksheets with basic formulas
170	Basic C# Programming	Create single-tier data aware modules.
180	Advanced Database Management	Manage Database Server Clusters.
190	Advance Process Modeling	Evaluate and Redesign cross-functional internal and external business processes.
200	Advanced C# Programming	Create multi-tier applications using multi-threading
210	Basic Database Manipulation	Create simple data retrieval and manipulation statements in SQL.
220	Advanced Database Manipulation	Use of advanced data manipulation methods for multi-table inserts, set operations, and correlated subqueries.

# Historical Roots: Files and File Systems

- Managing data with file systems is obsolete
  - Understanding file system characteristics makes database design easier to understand
  - Awareness of problems with file systems helps prevent similar problems in DBMS
  - Knowledge of file systems is helpful if you plan to convert an obsolete file system to a DBMS

# Evolution of File System Data Processing

## Manual File Systems

Accomplished through a system of file folders and filing cabinets



## Computerized File Systems

**Data processing (DP) specialist:** Created a computer-based system that would track data and produce required reports



## File System Redux: Modern End-User Productivity Tools

Includes spreadsheet programs such as Microsoft Excel

# Table 1.2 - Basic File Terminology

TERM	DEFINITION
Data	Raw facts, such as a telephone number, a birth date, a customer name, and a year-to-date (YTD) sales value. Data have little meaning unless they have been organized in some logical manner.
Field	A character or group of characters (alphabetic or numeric) that has a specific meaning. A field is used to define and store data.
Record	A logically connected set of one or more fields that describes a person, place, or thing. For example, the fields that constitute a record for a customer might consist of the customer's name, address, phone number, date of birth, credit limit, and unpaid balance.
File	A collection of related records. For example, a file might contain data about the students currently enrolled at Gigantic University.

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# The Customer File

## ■ Computerized file systems

C_NAME	C_PHONE	C_ADDRESS	C_ZIP	A_NAME	A_PHONE	TP	AMT	REN
Alfred A. Ramas	615-844-2573	218 Fork Rd., Babs, TN	36123	Leah F. Hahn	615-882-1244	T1	100.00	05-Apr-2014
Leona K. Dunne	713-894-1238	Box 12A, Fox, KY	25246	Alex B. Alby	713-228-1249	T1	250.00	16-Jun-2014
Kathy W. Smith	615-894-2285	125 Oak Ln, Babs, TN	36123	Leah F. Hahn	615-882-2144	S2	150.00	29-Jan-2015
Paul F. Olowksi	615-894-2180	217 Lee Ln., Babs, TN	36123	Leah F. Hahn	615-882-1244	S1	300.00	14-Oct-2014
Myron Orlando	615-222-1672	Box 111, New, TN	36155	Alex B. Alby	713-228-1249	T1	100.00	28-Dec-2014
Amy B. O'Brian	713-442-3381	387 Troll Dr., Fox, KY	25246	John T. Okon	615-123-5589	T2	850.00	22-Sep-2014
James G. Brown	615-297-1228	21 Tye Rd., Nash, TN	37118	Leah F. Hahn	615-882-1244	S1	120.00	25-Mar-2015
George Williams	615-290-2556	155 Maple, Nash, TN	37119	John T. Okon	615-123-5589	S1	250.00	17-Jul-2014
Anne G. Farriss	713-382-7185	2119 Elm, Crew, KY	25432	Alex B. Alby	713-228-1249	T2	100.00	03-Dec-2014
Olette K. Smith	615-297-3809	2782 Main, Nash, TN	37118	John T. Okon	615-123-5589	S2	500.00	14-Mar-2015

**C\_NAME** = Customer name

**C\_PHONE** = Customer phone

**C\_ADDRESS** = Customer address

**C\_ZIP** = Customer zip code

**A\_NAME** = Agent name

**A\_PHONE** = Agent phone

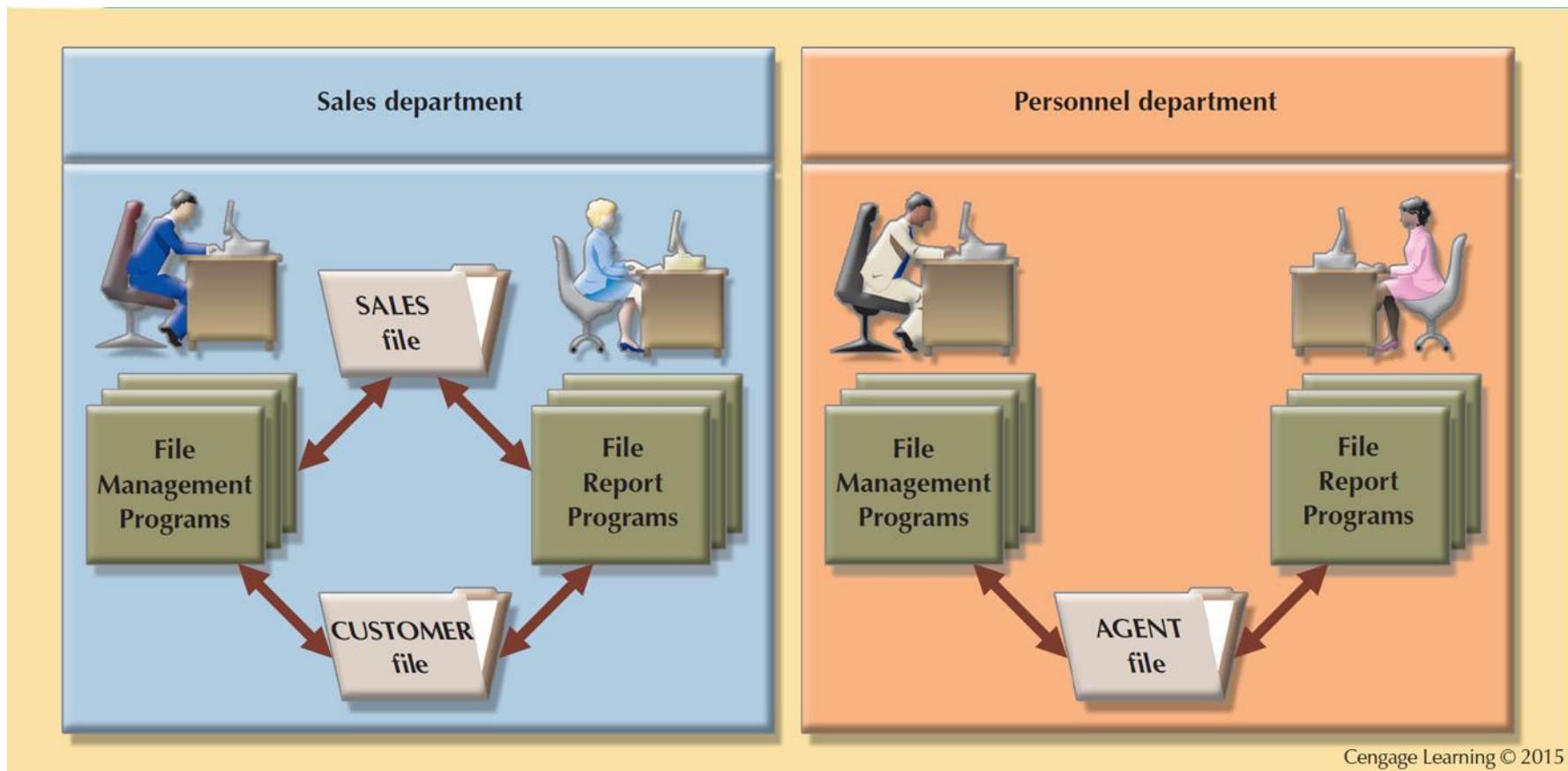
**TP** = Insurance type

**AMT** = Insurance policy amount, in thousands of \$

**REN** = Insurance renewal date

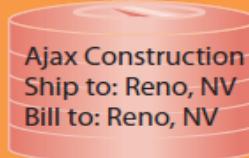
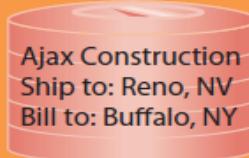
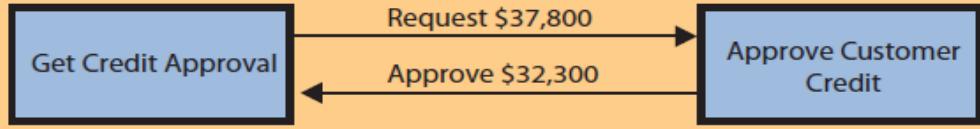
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# Figure 1.6 - A Simple File System



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# A Simple File System

Problem	Sales and Marketing	Accounting
Data duplication, data inconsistency		
Disjointed processes		
Limited information and lack of integrated information	 ?? Is IndyMac a preferred customer?	
Isolated decisions lead to organizational inefficiencies		 OneWest has been slow to pay.
Increased expense	Sum of problems above.	

# Problems with File System Data Processing

Lengthy development times

Difficulty of getting quick answers

Complex system administration

Lack of security and limited data sharing

Extensive programming

# Structural and Data Dependence

- **Structural dependence:** Access to a file is dependent on its own structure
  - All file system programs are modified to conform to a new file structure
  - Ex: Add a customer date-of-birth field to the CUSTOMER file.
    - Read a record from the original file
    - Transforms the original data to conform to the new structure's storage requirements
    - Writes the transformed data into the new file structure.
    - Repeats the preceding steps for each record in the original file.
  - None of the previous programs will work with the new CUSTOMER file structure.
- **Structural independence:** File structure is changed without affecting the application's ability to access the data

# Structural and Data Dependence

- Data dependence
  - Data access changes when data storage characteristics change
- Data independence
  - Data storage characteristics is changed without affecting the program's ability to access the data
  - Practical significance of data dependence is difference between logical (how the human being views the data) and physical format (how the computer must work with the data)

# Data Redundancy

- Unnecessarily storing same data at different places
- **Islands of information:** Scattered data locations
  - Increases the probability of having different versions of the same data

# Data Redundancy Implications

- Poor data security
- Data inconsistency
- Increased likelihood of data-entry errors when complex entries are made in different files
- **Data anomaly:** Develops when not all of the required changes in the redundant data are made successfully

# Types of Data Anomaly

Update Anomalies

Insertion Anomalies

Deletion Anomalies

# The Customer File

C_NAME	C_PHONE	C_ADDRESS	C_ZIP	A_NAME	A_PHONE	TP	AMT	REN
Alfred A. Ramas	615-844-2573	218 Fork Rd., Babs, TN	36123	Leah F. Hahn	615-882-1244	T1	100.00	05-Apr-2014
Leona K. Dunne	713-894-1238	Box 12A, Fox, KY	25246	Alex B. Alby	713-228-1249	T1	250.00	16-Jun-2014
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Paul F. Olowksi	615-894-2180	217 Lee Ln., Babs, TN	36123	Leah F. Hahn	615-882-1244	S1	300.00	14-Oct-2014
Myron Orlando	615-222-1672	Box 111, New, TN	36155	Alex B. Alby	713-228-1249	T1	100.00	28-Dec-2014
Amy B. O'Brian	713-442-3381	387 Troll Dr., Fox, KY	25246	John T. Okon	615-123-5589	T2	850.00	22-Sep-2014
James G. Brown	615-297-1228	21 Tye Rd., Nash, TN	37118	Leah F. Hahn	615-882-1244	S1	120.00	25-Mar-2015
George Williams	615-290-2556	155 Maple, Nash, TN	37119	John T. Okon	615-123-5589	S1	250.00	17-Jul-2014
Anne G. Farriss	713-382-7185	2119 Elm, Crew, KY	25432	Alex B. Alby	713-228-1249	T2	100.00	03-Dec-2014
Olette K. Smith	615-297-3809	2782 Main, Nash, TN	37118	John T. Okon	615-123-5589	S2	500.00	14-Mar-2015

**C\_NAME** = Customer name

**C\_PHONE** = Customer phone

**C\_ADDRESS** = Customer address

**C\_ZIP** = Customer zip code

**A\_NAME** = Agent name

**A\_PHONE** = Agent phone

**TP** = Insurance type

**AMT** = Insurance policy amount, in thousands of \$

**REN** = Insurance renewal date

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# The Customer File

- If agent Alex B. Alby has a new phone number, it must be entered in each of the CUSTOMER file records in which Mr. Alby is shown.
- If only the CUSTOMER file existed and you needed to add a new agent, you would also add a dummy customer data entry to reflect the new agent's addition.
- If you delete the customers Amy B .O'Brian, George William, and Olette K.Smith, you will also delete John T. Okon's agent data.

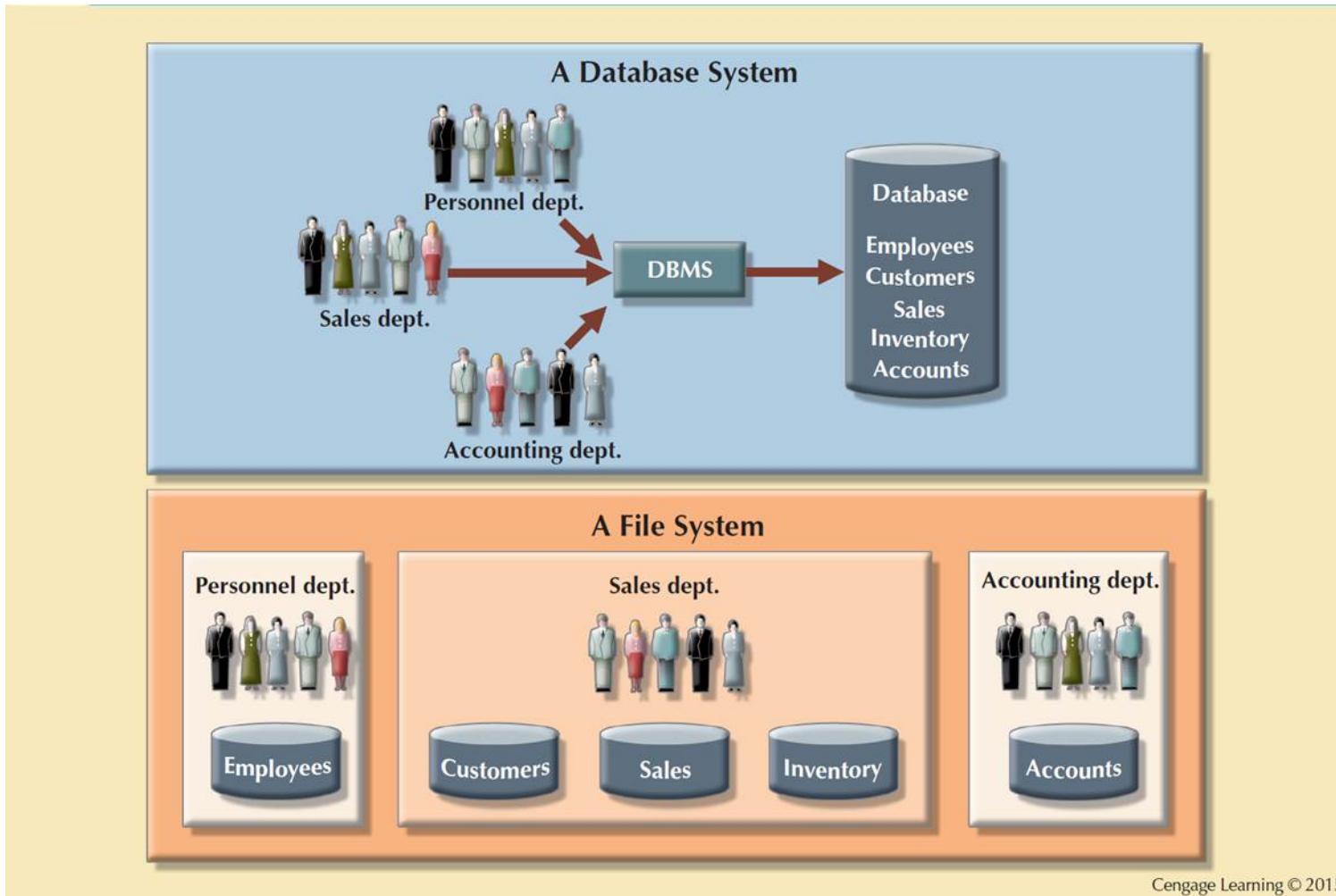
# Lack of Design and Data-Modeling Skills

- Evident despite the availability of multiple personal productivity tools being available
- Data-modeling skills is vital in the data design process
- Good data modeling facilitates communication between the designer, user, and the developer

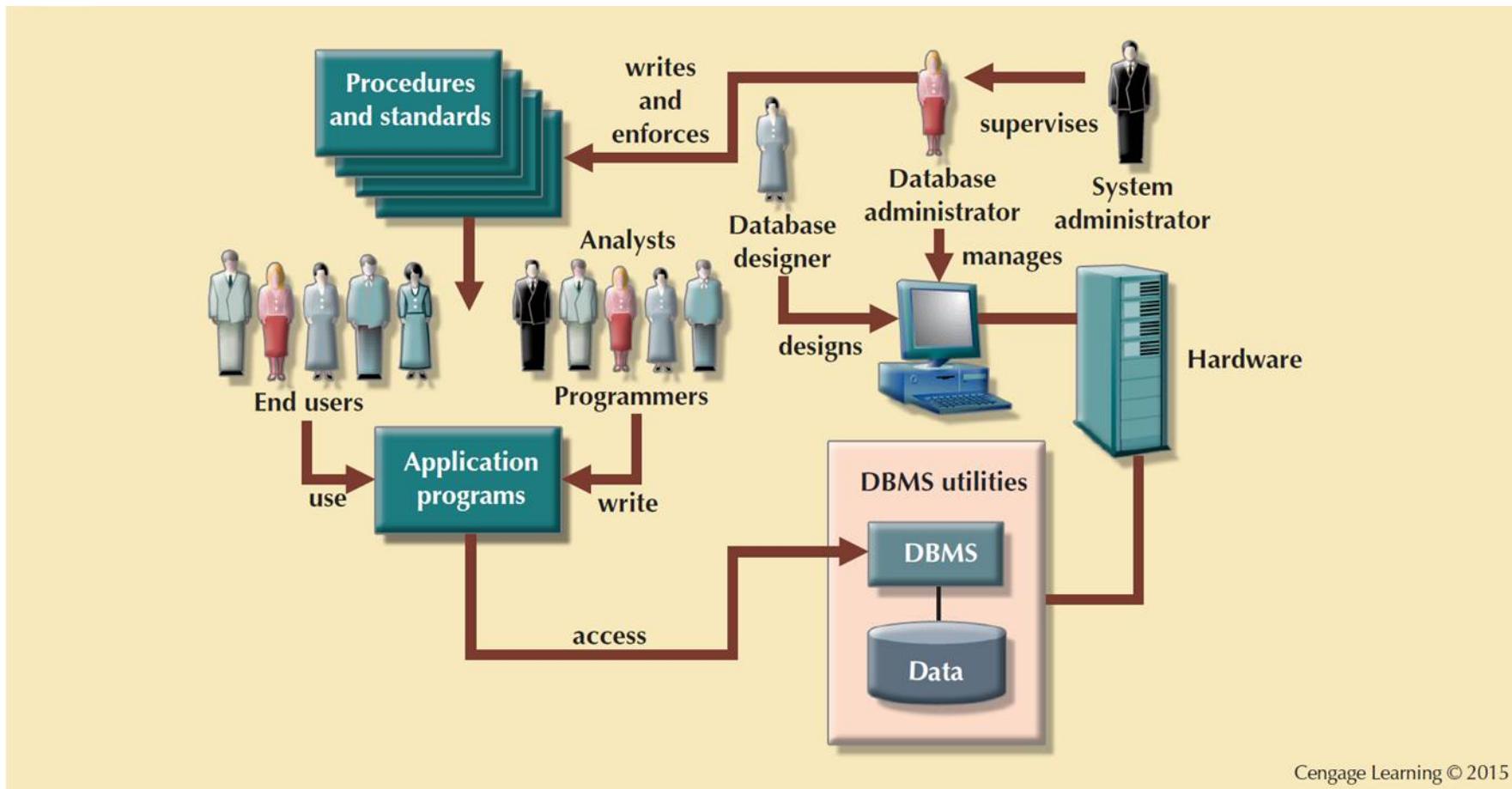
# Database Systems

- Logically related data stored in a single logical data repository
  - Physically distributed among multiple storage facilities
- DBMS eliminates most of file system's problems
- Current generation DBMS software:
  - Stores data structures, relationships between structures, and access paths
  - Defines, stores, and manages all access paths and components

# Figure 1.8 - Contrasting Database and File Systems

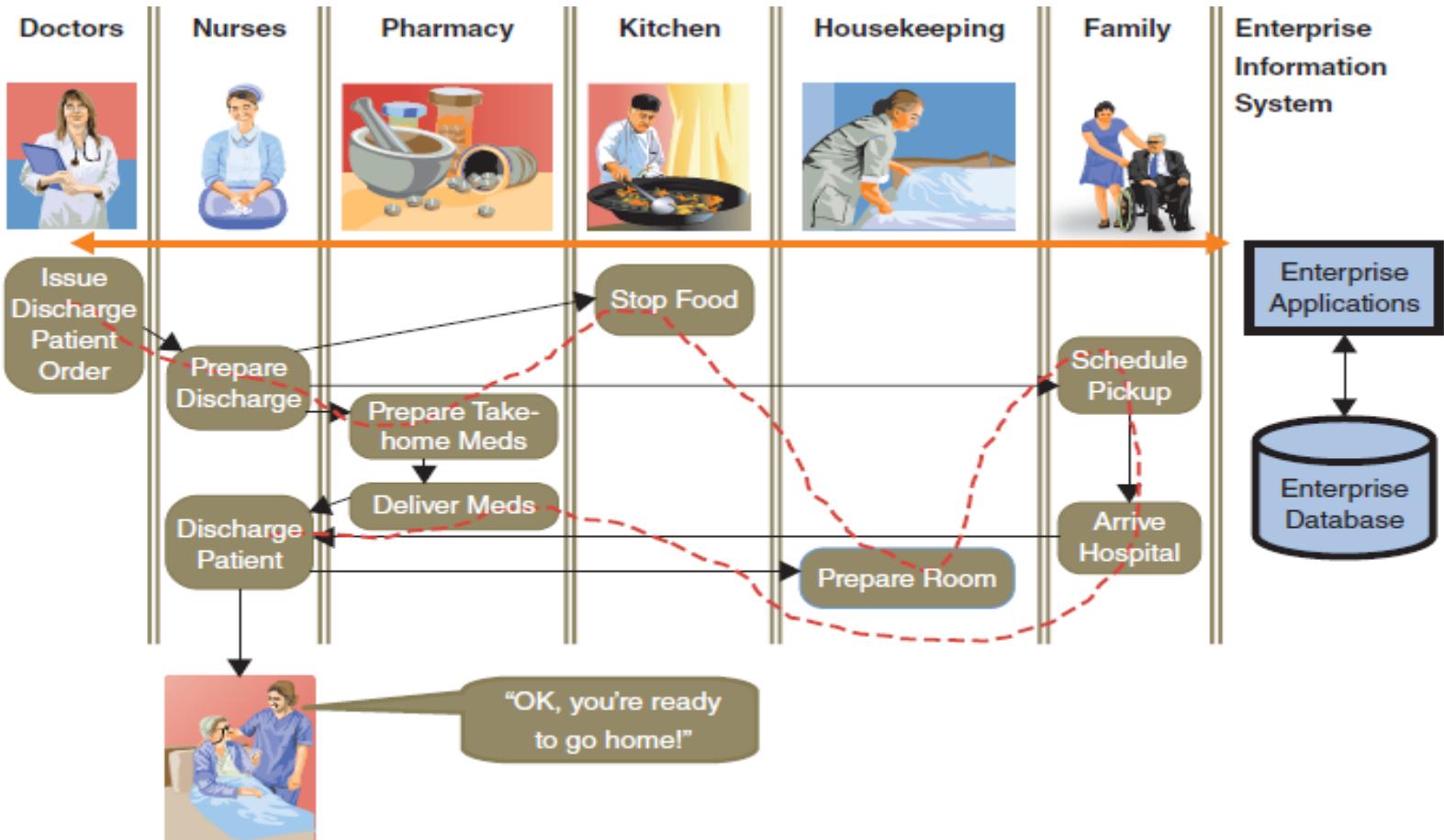


# Figure 1.9 - The Database System Environment



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# Database Systems



# DBMS Functions

## Data dictionary management

- **Data dictionary:** Stores definitions of the data elements and their relationships

## Data storage management

- **Performance tuning:** Ensures efficient performance of the database in terms of storage and access speed

## Data transformation and presentation

- Transforms entered data to conform to required data structures

## Security management

- Enforces user security and data privacy

# DBMS Functions

## Multiuser access control

- Sophisticated algorithms ensure that multiple users can access the database concurrently without compromising its integrity

## Backup and recovery management

- Enables recovery of the database after a failure

## Data integrity management

- Minimizes redundancy and maximizes consistency

# DBMS Functions

Database access languages and application programming interfaces

- **Query language:** Lets the user specify what must be done without having to specify how
- **Structured Query Language (SQL):** A query language and data access standard supported by the majority of DBMS vendors

Database communication interfaces

- Accept end-user requests via multiple, different network environments

# Disadvantages of Database Systems

Increased costs

Management complexity

Maintaining currency

Vendor dependence

Frequent upgrade/replacement cycles

# Table 1.3 - Database Career Opportunities

<b>JOB TITLE</b>	<b>DESCRIPTION</b>	<b>SAMPLE SKILLS REQUIRED</b>
Database Developer	Create and maintain database-based applications	Programming, database fundamentals, SQL
Database Designer	Design and maintain databases	Systems design, database design, SQL
Database Administrator	Manage and maintain DBMS and databases	Database fundamentals, SQL, vendor courses
Database Analyst	Develop databases for decision support reporting	SQL, query optimization, data warehouses
Database Architect	Design and implementation of database environments (conceptual, logical, and physical)	DBMS fundamentals, data modeling, SQL, hardware knowledge, etc.
Database Consultant	Help companies leverage database technologies to improve business processes and achieve specific goals	Database fundamentals, data modeling, database design, SQL, DBMS, hardware, vendor-specific technologies, etc.
Database Security Officer	Implement security policies for data administration	DBMS fundamentals, database administration, SQL, data security technologies, etc.
Cloud Computing Data Architect	Design and implement the infrastructure for next-generation cloud database systems	Internet technologies, cloud storage technologies, data security, performance tuning, large databases, etc.

# Summary

- Data are raw facts. Information is the result of processing data to reveal its meaning.
- To implement and manage a database, use a DBMS.
- Database design defines the database structure.
- A well-designed database facilitates data management and generates accurate and valuable information.
- A poorly designed database can lead to bad decision making, and bad decision making can lead to the failure of an organization.

# Summary (continued)

- Databases were preceded by file systems.
- Limitations of file system data management:
  - requires extensive programming
  - system administration complex and difficult
  - making changes to existing structures is difficult
  - security features are likely to be inadequate
  - independent files tend to contain redundant data
- DBMS's were developed to address file systems' inherent weaknesses