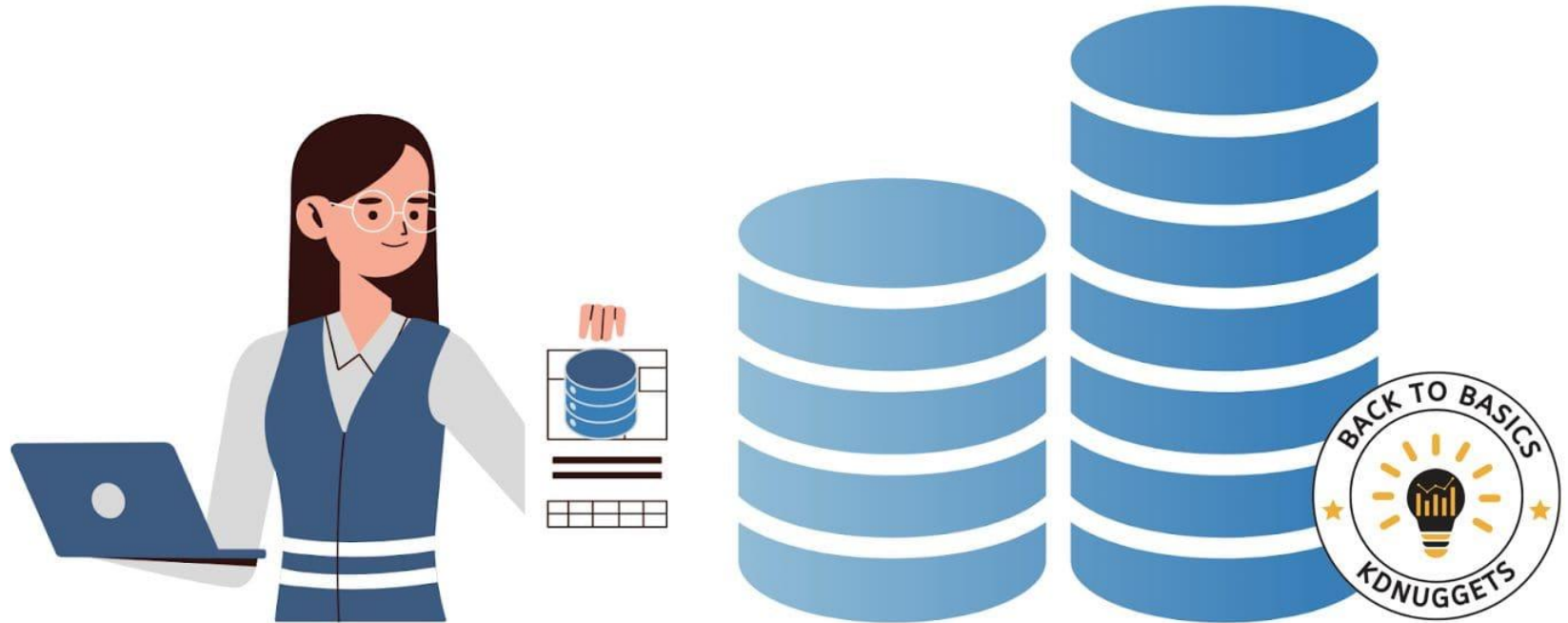


# Intro to Databases



# Introduction to Database

## Lecture 1

# Lecture outlines



**After completing this chapter, you will be able to:**

1. Define the difference between data and information
2. Describe what a database is, the various types of databases, and why they are valuable assets for decision making
3. Explain the importance of database design
4. See how modern databases evolved from file systems
5. Understand flaws in file system data management
6. Outline the main components of the database system
7. Describe the main functions of a database management system (DBMS)

The background is a dark blue gradient with various abstract digital elements. There are light blue circuit-like lines with small circles at the ends, some horizontal and some vertical. There are also clusters of small white dots. Large, semi-transparent geometric shapes, including a hexagon in the top left and a pentagon in the top right, are visible. The overall aesthetic is futuristic and tech-oriented.

01

>>>> **Data versus Information**

# Data vs. Information

---

## Data – Raw facts

- Must be formatted for storage and processing

## Information – **Process data to determine meaning**

- Requires context!
- Can become knowledge

## Data Management

- Generation, storage and retrieval of data to create information

## Decision Making

- Accurate, relevant and timely information retrieval

# FIGURE 1.2 TRANSFORMING RAW DATA INTO INFORMATION

## a) Data entry screen

**Middle Tennessee State University**

You are viewing the College Console

Select Member

Home | Reports | Activity Aggregators | Summaries | Maintenance | Offices & Accreditation | Strategies | Buttons & Tools | GO | Calendar | Directory | Logs | Settings | Home | Sign Out

**Jennings A. Jones College of Business**

Home | Manage Members | Add Faculty Info

Back | Save

DO NOT append School ID (MT) to Member ID

Member ID \* (no T or uppercase letters) (password will be initially sent to be same as Member ID)

First name or initial \*

Middle name/initial

Last name \*

☐ Chair/head ☐ Inactive ☐ Hyper chair for evaluation

Department \*

Area \*

Email \*

Hire Term \*

Member Default Status: Changing the status here changed only the default that is pulled into the uploaded teaching schedules. To change the historical status of members and to see your changes reflected in the various reports, AMT the teaching schedules themselves.

Involvement: ☐ Participating ☐ Supporting

Qualification: \*

☐ Participates in the governance of the school

☐ Considered to be a long term member

High Degree \*

Year Awarded \*

Rank: Assistant Professor

## b) Raw data

ID	Last Name	First Name	Dept Code	Office	Email	Rank	Hire Year	Degree
1	Winters	George	MGMT	N135	gwinters@mtsu.edu	Professor	2011	Ph.D.
2	Adams	John	PEA	N233	jadams@mtsu.edu	Professor	1914	Ph.D.
3	Joffrey	L	COGN		ljoffrey@mtsu.edu	Instructor	2002	M.S.A.
4	Madison	D	PEA	N236	dmadison@mtsu.edu	Associate Professor	1914	Ph.D.
5	Monroe	J	ACCT	N401	jmonroe@mtsu.edu	Associate Professor	1915	Ph.D.
6	Adams	G	ACCT	N400	gadams@mtsu.edu	Associate Professor	1919	Ph.D.
7	Jackson	C	COGN	N400	cjackson@mtsu.edu	Associate Professor	1919	Ph.D.
8	Von Stern	T	PEA	N236	tvonstern@mtsu.edu	Professor	1918	Ph.D.
9	Herrick	R	MGMT	N135	rherrick@mtsu.edu	Professor	1914	Ph.D.
10	Eyer	M	MGMT		myer@mtsu.edu	Assistant Professor	2008	Ed.D.
11	Pink	Cheryl	MGMT	N143	cpink@mtsu.edu	Associate Professor	2002	Ph.D.
12	Taylor	G	ACCT	N405	gtaylor@mtsu.edu	Associate Professor	1916	Ph.D.
13	Fleming	A	MGMT	JCB	afleming@mtsu.edu	Professor	1912	Ph.D.
14	Perrin	A	MGMT	N250	aperrin@mtsu.edu	Instructor	2005	M.S.A.
16	Buchanan	T	MGMT	N146	tbuchanan@mtsu.edu	Associate Professor	1916	C.B.A.
17	Lynch	W	MGMT	N150	wlynch@mtsu.edu	Associate Professor	1916	Ph.D.
18	Johnson	Arthur	SVS	N260	ajohnson@mtsu.edu	Professor	1917	Ph.D.
19	Grant	Kate	MGMT	N120	kgrant@mtsu.edu	Assistant Professor	1919	C.B.A.
20	Rutherford	Hayes	ACCT	N400	hrutherford@mtsu.edu	Professor	1912	Ph.D.
21	Groff	T	ACCT		tgroff@mtsu.edu	Assistant Professor	2014	Ph.D.
22	Arfai	Emily	ACCT	N403	earfai@mtsu.edu	Associate Professor	2003	J.D.
23	Owens	G	ACCT	N401	gowens@mtsu.edu	Associate Professor	1917	Ph.D.
24	Harris	X	PEA	N400	xharris@mtsu.edu	Associate Professor	2001	J.D.
25	Wentley	B	SVS	N263	bwentley@mtsu.edu	Adjunct	1914	M.S.
26	Rosenfeld	F	MGMT	N154	frosenfeld@mtsu.edu	Associate Professor	2002	Ph.D.
27	Wilson	Leann	COGN	N440	lwilson@mtsu.edu	Professor	1912	Ph.D.
28	Harding	William	MGMT	N114	wharding@mtsu.edu	Professor	1914	Ed.D.
29	Corbridge	Calvin	COGN	N139	ccorbridge@mtsu.edu	Professor	1915	Ph.D.
30	Hodder	Lisa	MGMT		lhodder@mtsu.edu	Adjunct	1916	M.S.A.
31	Tamm	Billy	ACCT	N405	btamm@mtsu.edu	Professor	1911	Ed.D.
32	Johnson	Robert	COGN	N240	rjohnson@mtsu.edu	Professor	2011	Ph.D.

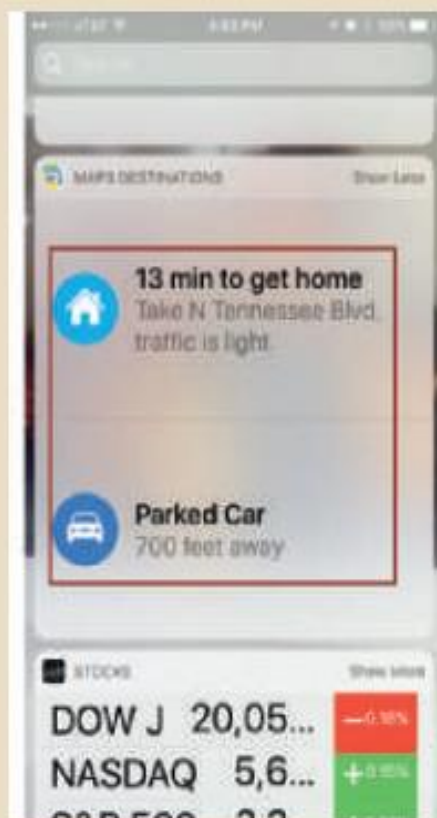
## c) Information in summary format

Rank	COUNT	%INF	TOT/COL	%COL. TOT.	%COL. FAC.
Adjunct	5	20.00%	23	21.74%	3.27%
Assistant Professor	2	8.00%	28	7.14%	1.31%
Associate Professor	9	36.00%	37	24.32%	5.88%
Instructor	2	8.00%	18	11.11%	1.31%
Professor	7	28.00%	47	14.89%	4.58%

## d) Information in graphical format



# FIGURE 1.3 SMARTPHONE TRACKING



Smartphone Tracking is provided by GPS Location Services. GPS Location Services are enabled by default in most smartphones. When you install and run an application the first time, it will ask you if you want to enable location services for such application.

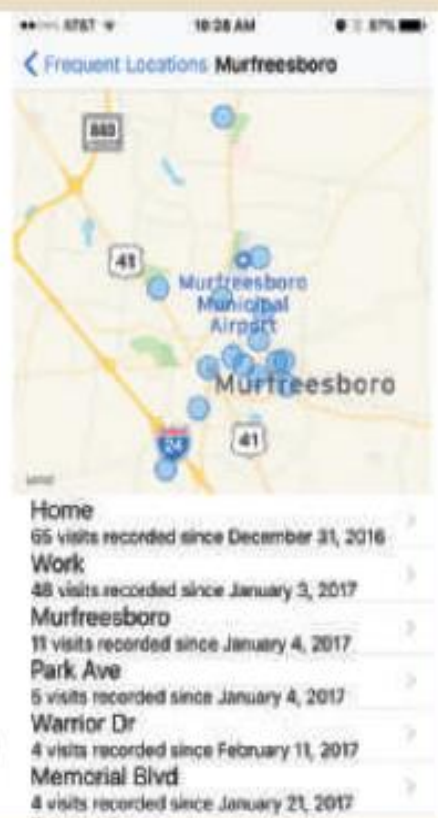
**How does the phone know where "home" is?**  
The phone knows where you spent most of your night hours and assumes that is your "home" location.

In the same way, it knows where you spent most of your work-day hours and assumes that is your "work" location.

**How does the phone know where you last "parked" your car?**  
If you use Bluetooth to pair your phone to your car audio system then, the phone knows where and when you are in your car. The phone remembers the last location you paired your phone to your car entertainment system.

If you enable "Frequent Locations" in your phone, it will track the places that you visit most frequently and keep an history of them.

Disclaimer: According to Apple, the GPS data is collected "in order to learn places that are significant to the end-user." Data are only stored locally in the phone and never shared.







02

>>>> **Introducing the Database**



# Database



A **database**: is a shared, integrated computer structure that stores a collection of the following:

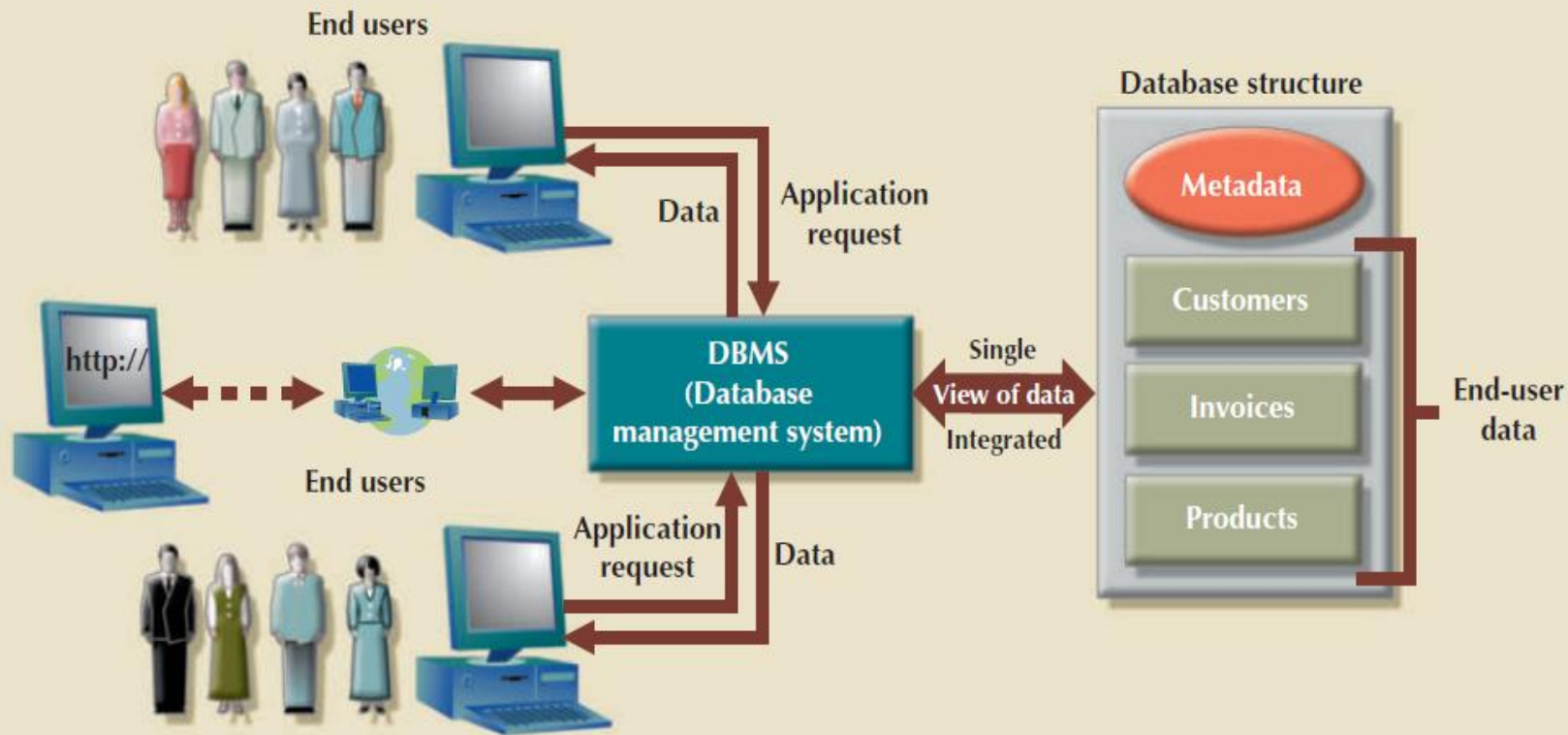
- End-user data—that is, raw facts of interest to the end user
- Metadata, or data about data, through which the end-user data is integrated and Managed
- The metadata describes the data characteristics and the set of relationships that links the data found within the database

# Database management system (DBMS)



A **DBMS**: is a collection of programs that manages the database structure and controls access to the data stored in the database.

FIGURE 1.4 THE DBMS MANAGES THE INTERACTION BETWEEN THE END USER AND THE DATABASE

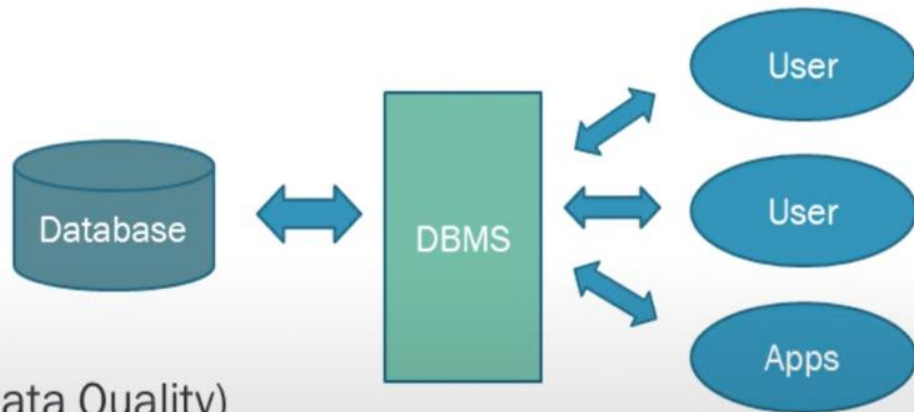


# Database Management System (DBMS)

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DBMS – An interface between the user and the data

- Data Sharing
- Data Security
- Data Integration
- Minimize Inconsistency
- Data Access (Query)
- Improved Decision Making (Data Quality)
- Increased Productivity



# Types of Databases

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## **Multi-user types:**

*Workgroup database - < 50 users*

*Enterprise database - > 50 users*

## **Cloud DB:**

*Microsoft Azure*

*Amazon AWS*

*Oracle Cloud Database*

## **Operational DB:**

- Online Transaction Processing (OLTP)
- Transactional
- Production

- Single User (Desktop) vs. Multi-User
- Centralized vs. Distributed (multi-location)
- Cloud database (MS Azure, Amazon AWS, etc)
- General Purpose vs. Discipline-Specific
- Operational vs. Analytical
- Structured vs. Unstructured (vs Semi-structured)
- XML (Extensible Markup Language)
- NO-SQL (Not Only SQL)



03

>>>> Why Database Design Is Important?

# Database design



- Personal productivity tools such as spreadsheets and desktop database programs suffer from lack proper data-modelling and database design skills
- **Database design:** refers to the activities that focus on the design of the database structure that will be used to store and manage end-user data.





# Poor Database design (Example)



- Consider the data shown in the following figure.
- What is the problems you notes in this design.

# Poor Database design (Example)

FIGURE 1.5 EMPLOYEE SKILLS CERTIFICATION IN A POOR DESIGN

Why are there blanks in rows 9 and 10?

How to produce an alphabetical listing of employees?

How to count how many employees are certified in Basic Database Manipulation?

Is Basic Database Manipulation the same as Basic DB Manipulation?

What if an employee acquires a fourth certification?

Do we add another column?

ID	EmpNum	Name	Title	HireDate	Skill1	Skill1Date	Skill2	Skill2Date	Skill3	Skill3Date
1	02345	Brian Oates	DBA	2/14/1997	Basic Database Management	2/14/2004	Advanced Database Management	2/14/2007	Basic Web Design	8/9/2005
2	08273	Marco Bienz	Analyst	7/28/2008	Basic Web Design	3/8/2011	Advance Process Modeling	8/19/2014		
3	06234	Jasmine Patel	Programmer	8/10/2007	Basic Web Design	8/10/2009	Advanced C# programming	8/10/2009	Basic DB manipulation	1/29/2014
4	03373	Franklin Johnson, Jr.	Purchasing Agent	3/15/2004	Advanced Spreadsheets	6/20/2013				
5	13667	Almond, Robert	Analyst	9/30/2014	Basic Process Modeling	9/30/2016	Basic Database Design	5/23/2017		
6	10282	Richardson, Amanda	Clerk	4/11/2013						
7	09382	Susan Mathis	Database Programmer	8/2/2012	Basic DB Design	8/2/2014	Basic Database Manipulation	8/2/2014	Advanced DB Manipulation	5/1/2015
8	14311	Duong, Lee	Programmer	9/1/2016	Basic Web Design	9/1/2018				
9					Master Database Programming					
10					Basic Spreadsheets					
11	09002	Wade Gaither	Clerk	5/20/2012	Advanced Spreadsheets	5/16/2015	Basic Web Design	5/16/2015		
12	13383	Raymond F. Matthews	Programmer	3/12/2014	Basic C# Programming	3/12/2016				
13	09283	Chavez, Juan	Clerk	7/4/2012						
14	04893	Patricia Richards	DBA	6/11/2006	Advanced Database Management	6/11/2006	Advanced Database Manipulation	9/20/2014		
15	13832	Lee, Meagan	Programmer	9/29/2015						

# Poor Database design (Example)



1. With the improved structure in Figure 1.6, you can use simple commands in a standard data manipulation language to do the following:
- 2.

- Produce an alphabetical listing of employees by last name:
  - `SELECT * FROM EMPLOYEE ORDER BY EMPLOYEE_LNAME;`
- Determine how many employees are certified in Basic Database

Manipulation:

- `SELECT Count (*)`
- `FROM SKILL JOIN CERTIFIED ON SKILL.SKILL_ID =`  
`CERTIFIED.SKILL_ID`
- `WHERE SKILL_NAME = 'Basic Database Manipulation';`

# FIGURE 1.6 EMPLOYEE SKILLS CERTIFICATION IN A GOOD DESIGN

Table name: EMPLOYEE

Employee_ID	Employee_FName	Employee_LName	Employee_HireDate	Employee_Title
02345	Brian	Oates	2/14/1999	DBA
03373	Franklin	Johnson	3/15/2006	Purchasing Agent
04893	Patricia	Richards	6/11/2008	DBA
06234	Jasmine	Patel	8/10/2009	Programmer
08273	Marco	Bienz	7/28/2010	Analyst
09002	Wade	Gaither	5/20/2014	Clerk
09283	Juan	Chavez	7/4/2014	Clerk
09382	Susan	Mathis	8/2/2014	Database Programmer
10282	Amanda	Richardson	4/11/2015	Clerk
13383	Raymond	Matthews	3/12/2016	Programmer
13567	Robert	Almond	9/30/2016	Analyst
13932	Megan	Lee	9/29/2017	Programmer
14311	Lee	Duong	9/1/2018	Programmer

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.

Database name: Ch01\_Text

Table name: CERTIFIED

Employee_ID	Skill_ID	Certified_Date
02345	100	2/14/2004
02345	110	8/9/2005
02345	180	2/14/2007
03373	120	6/20/2013
04893	180	6/11/2008
04893	220	9/20/2014
06234	110	8/10/2009
06234	200	8/10/2009
06234	210	1/29/2014
08273	110	3/8/2011
08273	190	8/19/2014
09002	110	5/16/2015
09002	120	5/16/2015
09382	140	8/2/2014
09382	210	8/2/2014
09382	220	5/1/2015
13383	170	3/12/2016
13567	130	9/30/2016
13567	140	5/23/2017
14311	110	9/1/2018



04

»»»» Evolution of File System  
Data Processing

# Evolution of File System Data Processing

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- Pencil and Paper
- File folders and cabinets
- If data was small, worked fine
- Moved to computers
- Required Data Processing (DP) Specialist
- Bad design caused issues



# Example of simple Computerized File

FIGURE 1.7 CONTENTS OF THE CUSTOMER FILE

Database name: Ch01\_Text

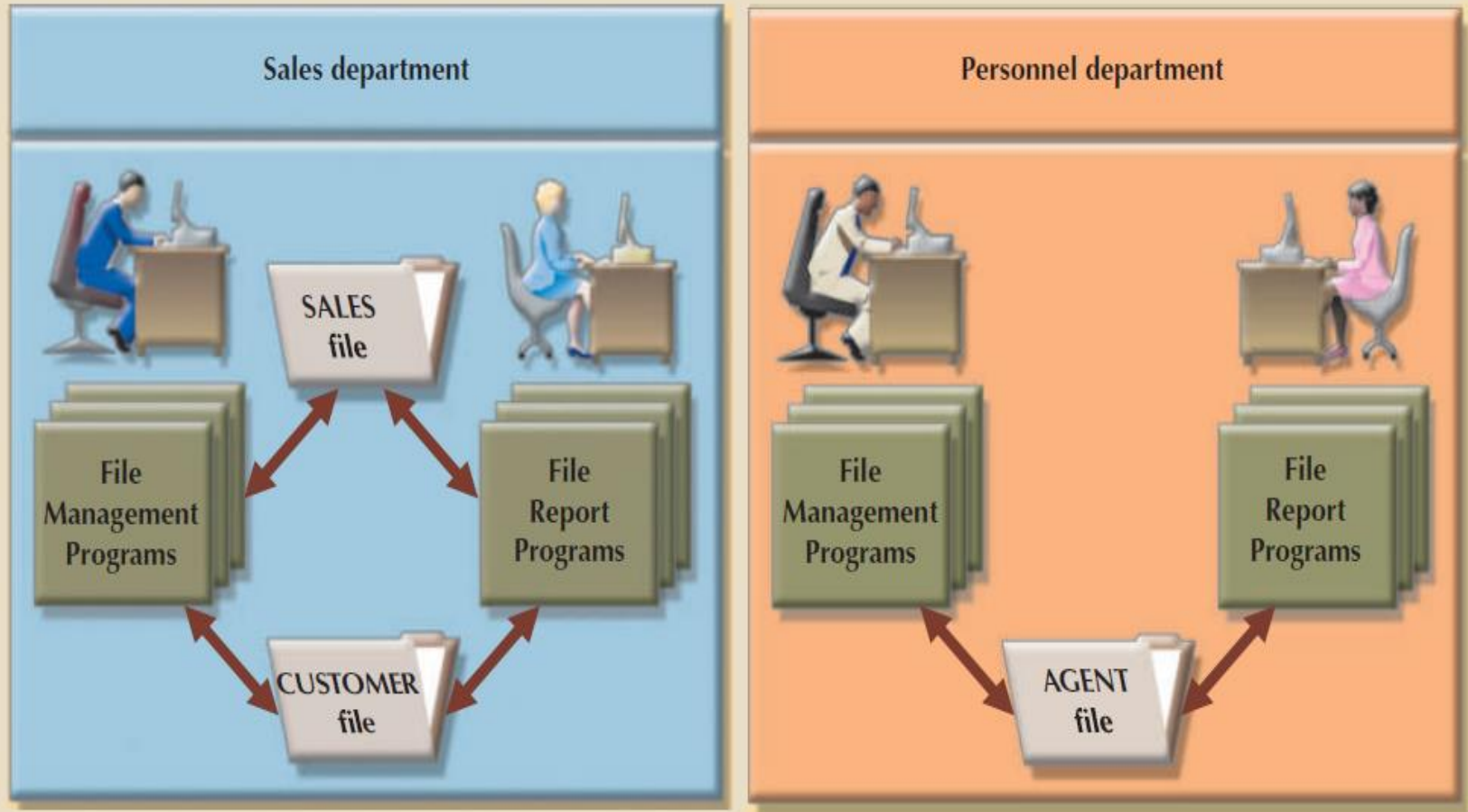
C_NAME	C_PHONE	C_ADDRESS	C_ZIP	A_NAME	A_PHONE	TP	AMT	REN
Alfred A. Ramas	615-844-2573	218 Fork Rd., Babs, TN	36123	Leah F. Hahn	615-882-1244	T1	100.00	05-Apr-2018
Leona K. Dunne	713-894-1238	Box 12A, Fox, KY	25246	Alex B. Alby	713-228-1249	T1	250.00	16-Jun-2018
Kathy W. Smith	615-894-2285	125 Oak Ln, Babs, TN	36123	Leah F. Hahn	615-882-2144	S2	150.00	29-Jan-2019
Paul F. Olowski	615-894-2180	217 Lee Ln., Babs, TN	36123	Leah F. Hahn	615-882-1244	S1	300.00	14-Oct-2018
Myron Orlando	615-222-1672	Box 111, New, TN	36155	Alex B. Alby	713-228-1249	T1	100.00	28-Dec-2018
Amy B. O'Brian	713-442-3381	387 Troll Dr., Fox, KY	25246	John T. Okon	615-123-5589	T2	850.00	22-Sep-2018
James G. Brown	615-297-1228	21 Tye Rd., Nash, TN	37118	Leah F. Hahn	615-882-1244	S1	120.00	25-Mar-2019
George Williams	615-290-2556	155 Maple, Nash, TN	37119	John T. Okon	615-123-5589	S1	250.00	17-Jul-2018
Anne G. Farriss	713-382-7185	2119 Elm, Crew, KY	25432	Alex B. Alby	713-228-1249	T2	100.00	03-Dec-2018
Olette K. Smith	615-297-3809	2782 Main, Nash, TN	37118	John T. Okon	615-123-5589	S2	500.00	14-Mar-2019

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

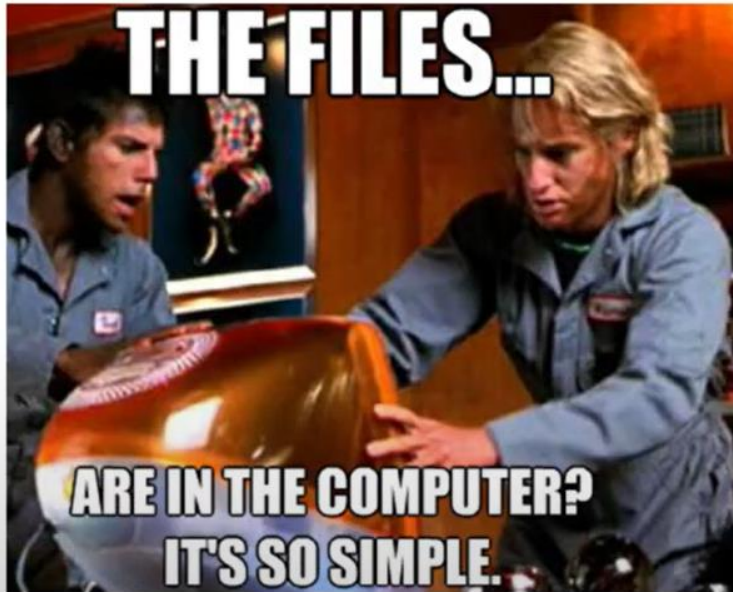


FIGURE 1.9 A SIMPLE FILE SYSTEM



# Issues with Computer File Data

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- Lengthy development time
- Difficulty getting answers
- Complex system administration
- Lack of security
- Limited data sharing
- Extensive programming

# More Data Issues

## STRUCTURE/ DATA DEPENDENCE/INDEPENDENCE

Can you change the **structure** without breaking the system?

Can you change the **data** without breaking the system?

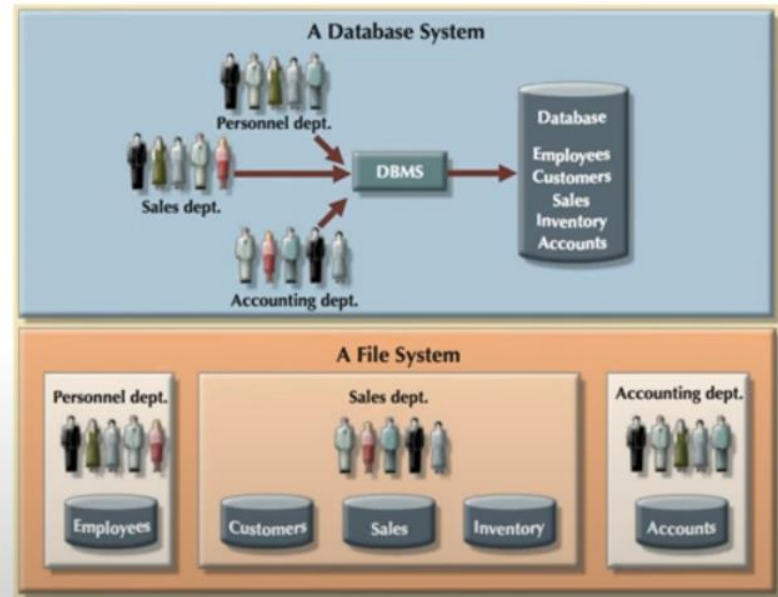
## DATA REDUNDANCY

- Poor data security
- Data inconsistency
- Data Entry errors
- Data integrity
- Data Anomalies

**Logical** data format (how you visualize) vs. **physical** data format (actual database)

# Database System Environment

- Hardware – Physical Devices
- Software
  - Operating System Software
  - DBMS
  - Application / Utility
- Procedures / Workflow
- Data / Information
- People
  - System Admin
  - Database Admin
  - Database Designer
  - System Analyst / Programmer
  - End Users



# DBMS Functions

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- ❖ Data Dictionary Management
- ❖ Data Storage Management
- ❖ Data Transformation and Presentation
- ❖ Security Management
- ❖ Multi-user Access Control
- ❖ Backup and Recovery Management
- ❖ Data Integrity Management
- ❖ Database Access Languages (SQL)
- ❖ Application Programming Interface
- ❖ Database Communication Interface

# Some issues with DBMS

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Increase Costs

Management Complexity

Maintaining Currency (keeping current, not money)

Vendor Dependence

Frequent Update/Replacement Cycles



# Want a Job with Databases?

JOB TITLE	DESCRIPTION	SAMPLE SKILLS REQUIRED
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.
Data Scientist	Analyze large amounts of varied data to generate insights, relationships, and predictable behaviors	Data analysis, statistics, advanced mathematics, SQL, programming, data mining, machine learning, data visualization



# Remember...

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Data is raw facts, Information is processed data

Data is stored in a database, that is managed by a DBMS

Database design is very, very important

Limitations include programming, system admin and money

TERM	DEFINITION
<b>Data</b>	Raw facts, such as a telephone number, a birth date, a customer name, and a year-to-date (YTD) sales value. Data has little meaning unless it has been organized in some logical manner.
<b>Field</b>	A character or group of characters (alphabetic or numeric) that has a specific meaning. A field is used to define and store data.
<b>Record</b>	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.
<b>File</b>	A collection of related records. For example, a file might contain data about the students currently enrolled at Gigantic University.