

15<sup>th</sup> Edition

# Understanding Computers

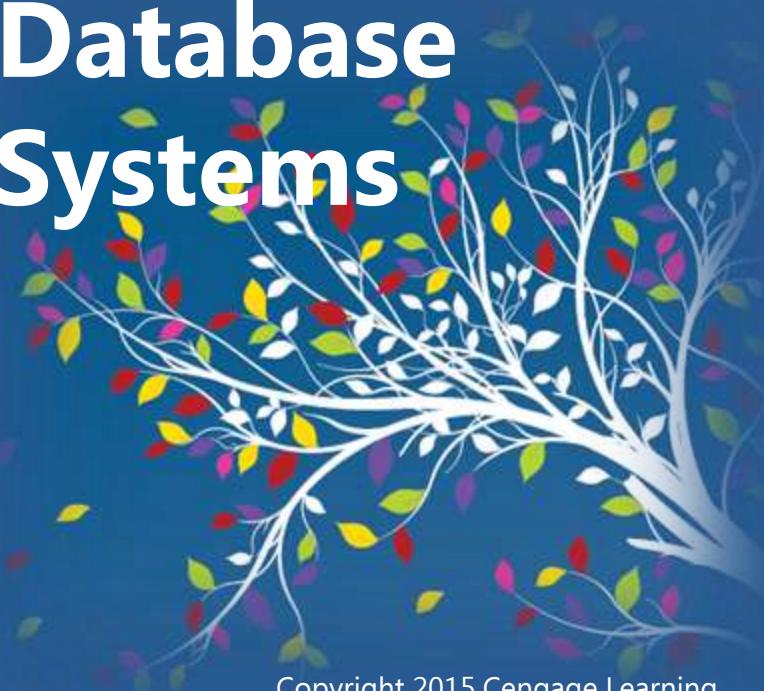
Today and Tomorrow  
Comprehensive

## Chapter 14:

# Databases and Database Management Systems

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# Learning Objectives

- Explain what a database is, including common database terminology, and list some of the advantages and disadvantages of using databases.
- Discuss some basic concepts and characteristics of data, such as data hierarchy, entity relationships, and data definition.
- Describe the importance of data integrity, security, and privacy and how they affect database design.
- Identify some basic database classifications and discuss their differences.



# Learning Objectives

4. List the most common database models and discuss how they are used today.
5. Understand how a relational database is designed, created, used, and maintained.
6. Describe some ways databases are used on the Web.



# Overview

- This chapter covers:
  - What a database is, the individuals who use them, and how databases evolved
  - Important database concepts and vocabulary
  - Database classifications and models
  - The relational database
  - How databases are used on the Web



# What Is a Database?

- Database
  - A collection of related data stored in a manner that enables information to be retrieved as needed
- Database Management System (DBMS)
  - Used to create, maintain, and access databases
  - Database engine
    - The part of the program that actually stores and retrieves data
  - Microsoft Access, OpenOffice Base, Corel Paradox, Oracle Database, etc.



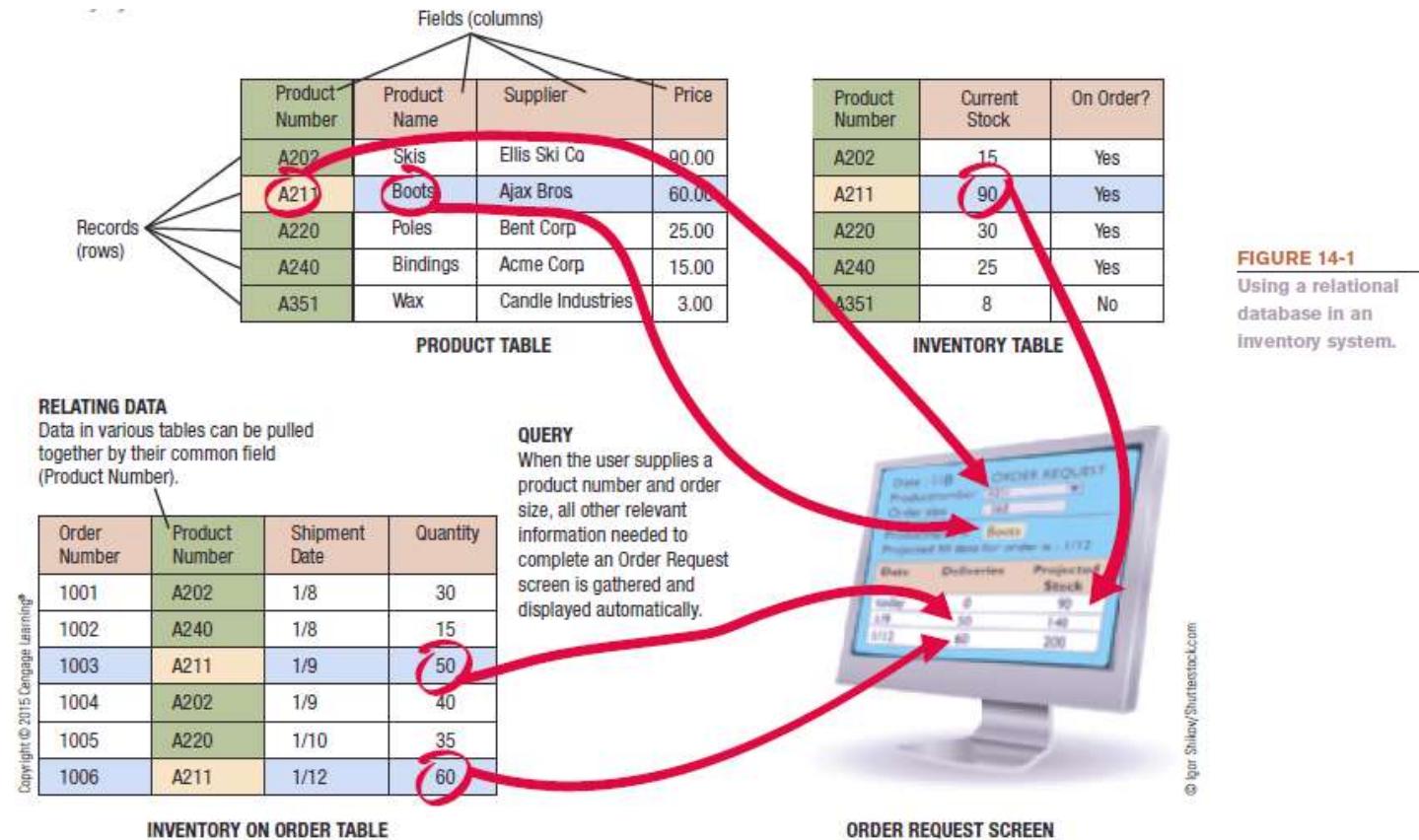
# What Is a Database?

- A database typically consists of:
  - Tables
    - Collection of related records
  - Fields (columns)
    - Single category of data to be stored in a database  
(name, telephone number, etc.)
  - Records (rows)
    - Collection of related fields in a database (all the fields  
for one customer, for example)



# What Is a Database?

- A Simple Relational Database Example



**FIGURE 14-1**  
Using a relational database in an inventory system.



# What is a Database?

- Primary Key
  - Field that uniquely identifies the records in a table
  - Field in a table that is used to relate that table to other tables

The yellow fields will always contain unique data and so are good to use as primary keys.

The blue fields will not always contain unique data and so are not good to use as primary keys.

Product Number	Product Name	Supplier	Price
Student ID Number	Student Name	Address	Phone
Customer Number	Address	Phone	Balance

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**FIGURE 14-2**

**Primary key fields.**  
A primary key field must contain unique data so it can be used to identify each record in the table.



# What Is a Database?

- Individuals Involved with a Database Management System
  - Database Designers
    - Design the database
  - Database Developers
    - Create the database
  - Database Programmers
    - Write the programs needed to access the database or tie the database to other programs



# What Is a Database?

- Database Administrators
  - Responsible for managing the databases within an organization
- Users
  - Individuals who enter data, update data, and retrieve information from the database



# What Is a Database?

- The Evolution of Databases

Model	Flat Files	Hierarchical	Network	Relational	Object-Oriented	Multidimensional
Year Begun	1940s	1960s	1960s	1970s	1980s	1990s
Data Organization	Flat files	Trees	Trees	Tables and relations	Objects	Data cubes, tables and relations, or a combination
Data Access	Low-level access	Low-level access with a standard navigational language	Low-level access with a standard navigational language	High-level, nonprocedural languages	High-level, nonprocedural, object-oriented languages	OLAP tools or programming languages
Skill Level Required to Access Data	Programmer	Programmer	Programmer	User	User	User
Entity Relationships Supported	One-to-one	One-to-one, one-to-many	One-to-one, one-to-many, many-to-many	One-to-one, one-to-many, many-to-many	One-to-one, one-to-many, many-to-many	One-to-one, one-to-many, many-to-many
Data and Program Independence	No	No	No	Yes	Yes	Yes

**FIGURE 14-3**  
The evolution of databases. Databases have evolved over the years, becoming more flexible, more capable, and easier to use.

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# What Is a Database?

- Advantages and Disadvantages of the DBMS Approach
  - Advantages
    - Low level of redundancy
    - Faster response time
    - Lower storage requirements
    - Easier to secure
    - Increased data accuracy
  - Disadvantages
    - Increased vulnerability (backup is essential)



# Inside the Industry Box

## File Management Systems

- Tables are not related so more time-consuming and more redundancy

PRODUCT NUMBER	PRODUCT NAME	SUPPLIER	PRICE
A202	Skis	Ellis Ski Co.	90.00
A211	Boots	Ajax Bros.	60.00
A220	Poles	Bent Corp.	25.00
A240	Bindings	Acme Corp.	15.00
A351	Wax	Candle Industries	3.00

PRODUCT TABLE

PRODUCT NUMBER	PRODUCT NAME	SUPPLIER	PRICE	CURRENT STOCK	ON ORDER?
A202	Skis	Ellis Ski Co.	90.00	15	Yes
A211	Boots	Ajax Bros.	60.00	90	Yes
A220	Poles	Bent Corp.	25.00	30	Yes
A240	Bindings	Acme Corp.	15.00	25	Yes
A351	Wax	Candle Industries	3.00	8	No

INVENTORY TABLE

ORDER NUMBER	PRODUCT NUMBER	SHIPMENT DATE	PRODUCT NAME	SUPPLIER	PRICE	QUANTITY
1001	A202	1/8	Skis	Ellis Ski Co.	90.00	30
1002	A240	1/8	Bindings	Acme Corp.	15.00	15
1003	A211	1/9	Boots	Ajax Bros.	60.00	50
1004	A202	1/9	Skis	Ellis Ski Co.	90.00	40
1005	A220	1/10	Poles	Bent Corp.	25.00	35
1006	A211	1/12	Boots	Ajax Bros.	60.00	60

INVENTORY ON ORDER TABLE

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### REDUNDANT FIELDS

Instead of just having one field duplicated like in the databases created using a DBMS (green shaded columns), flat files created using file management systems require many more fields to be duplicated (green and blue shaded columns). Notice that the blue shaded columns shown here appear only in the Product table in Figure 14-1; when using a DBMS, these fields are not included in the Inventory and Inventory on Order tables.

Because file management systems cannot retrieve data from more than one table at a time, there is a much higher level of redundancy.



# Data Concepts and Characteristics

- Data Hierarchy
  - Fields/columns
    - Hold single pieces of data
  - Records/rows
    - Groups of related fields
  - Tables
    - Collection of related records
  - Database
    - Contains a group of related tables



# Data Concepts and Characteristics

- Entities and Entity Relationships
  - Entity
    - A person, object, or event of importance to the organization
    - Entities that the organization wants to store data about typically becomes a database table
  - Attributes
    - Characteristics of an entity
    - Typically become fields in the entity's database table
  - Relationship
    - An association between two or more entities



# Data Concepts and Characteristics

- One to One (1:1) Entity Relationships
  - One entity is related to only one other entity of a particular type
  - Not a common type of relationship
- One to Many (O:M) Entity Relationship
  - Most common type of relationship
  - One entity can be related to more than one other entity
    - A supplier can supply more than one product to a company
- Many to Many (M:M) Entity Relationships
  - One entity can be related to more than one other entity, and those entities can be related to multiple entities of the same type as the original entity



# Data Concepts and Characteristics

- Data Definition
  - The process of describing the properties of data to be included in a database table
  - During data definition, each field is assigned:
    - Name (must be unique within the table)
    - Data type (such as Text, Number, Currency, Date/Time)
    - Description (optional description of the field)
    - Properties (field size, format of the field, allowable range, if field is required, etc.)
  - Finished specifications for a table become the table structure



# Data Concepts and Characteristics

The screenshot shows two windows of Microsoft Access. The left window, titled 'Inventory', is in 'DESIGN' mode, displaying the 'ProductNumber' field properties. The right window, also titled 'Inventory', is in 'DATA' mode, showing a table with six records.

**TABLE STRUCTURE**  
The table structure specifies the fields and their characteristics.

Properties of current field (Product Number).

Fields and data types.

Indicates this field is the primary key.

Field size for Product Number.

Indicates the pattern Product Number data must follow (one letter followed by three numbers).

A validation rule can be entered here.

Product Number field is required and cannot be left blank.

ProductNumber	CurrentStock	OnOrder?	Comments
A201	10	5	
A202	30	10	
A203	20	10	
A204	15	5	
A205	8	0	
A206	0	0	

**FIGURE 14-4**

Data definition. Each field in a database has a defined data type and properties that can be assigned to that field.

Used with permission from Microsoft Corporation



# Data Concepts and Characteristics

- The Data Dictionary
  - Contains all data definitions in a database, including:
    - Table structures
    - Security information (passwords, etc.)
    - Relationships between the tables in the database
    - Basic information about each table, such as the current number of records
  - Does not contain any of the data in the tables
  - Does contain metadata, which is information about the database tables
  - Ensures that data being entered into the database does not violate any specified criteria



# Data Integrity, Security, and Privacy

- Data Integrity
  - Accuracy of Data
    - Quality of data entered determines the quality of generated information
  - Data Validation
    - Process of ensuring that data entered into the database is valid
    - Record validation rules
      - Checks all fields before changes to a record are saved
    - Can be enforced on a per transaction basis so the entire transaction will fail if one part is invalid



# Data Integrity, Security, and Privacy

- Database Locking
  - Prevents two individuals from changing the same data at the same time

**WRONG DATA TYPE**  
Only data matching a field's assigned data type may be entered into that field.

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The screenshot shows a Microsoft Access database window with a table named 'Inventory'. A row for product A500 has a value 'A500' entered into the 'CurrentStock' field, which is defined as a Number data type. A validation error message box is displayed, stating: 'One or more values are prohibited by the validation rule >=0 set for Inventory.CurrentStock. Enter a value that the expression for this field can accept.' Below the table, a message box says: 'The value you entered does not match the Number data type in this column. Enter new value.' A red horizontal bar across the bottom of the table area displays the text 'NASH LOCK'.

**FIGURE 14-5**  
Data validation.  
Good data validation rules can prevent invalid data from being entered into a database table.

**VALIDATION RULE VIOLATION**  
Only data conforming to a field's assigned validation rule may be entered into that field.



# Data Integrity, Security, and Privacy

- Data Security
  - Protects data against destruction and misuse
  - Protects against unauthorized access to and unauthorized use of a database
  - Database activity monitoring programs can be used to detect possible intrusions and risks
  - Prevents data loss
  - Should include strict backup and disaster-recovery procedures (disaster-recovery plan)
  - Should be used with both in-house and cloud databases



# Data Integrity, Security, and Privacy

The screenshot shows the DbProtect™ software interface. At the top, there's a navigation bar with tabs: REPORT, MANAGE, and SET UP. Under REPORT, the sub-tabs are Dashboard, Library, History, Assets, Monitoring, Jobs, Users & Orgs, and System Settings. The Assets tab is selected, showing sub-options: Security Position, Rights Review, Activity Monitoring, and Asset Inventory. The main content area displays two reports:

**Most Hackable Assets**  
as of Sep 25, 2013 3:44:42 PM EDT

Asset	Misconfigured	Unpatched
MSSQLSERVER@172.16.32.209	●	●
MSSQLSERVER@172.16.32.208	●	●
172.16.32.228:3306	●	●
AT5YBTRGT@172.16.32.213	●	●
demo@172.16.32.212	●	●
erik9R2@192.168.2.49	●	●
dir9R1@dir.nycapt35k.com	●	●
172.18.0.169[SQL2K8R2]	●	●

**Highly Privileged Users with Weak Passwords**  
as of Sep 25, 2013 3:48:57 PM EDT

Asset	Users	Admin Likeness Scores	
		Avg.	Peak
MSSQLSERVER@172.16.32.209	2	95.52%	95.95%
erik9R2@192.168.2.49	6	61.62%	68.14%

At the bottom right, a pop-up window says "DbProtect now scans Hadoop!" with a "hadoop" logo. It includes links to learn about Hadoop security checks and a checkbox for "Don't show again".

**FIGURE 14-6**

**Database security tools.** This program secures databases and displays alerts for vulnerabilities and attacks.



# Data Integrity, Security, and Privacy

- Data Privacy
  - Growing concern because of the vast amounts of personal data stored in databases today
  - Many states require businesses to notify customers when their personal data has been compromised
  - Data breaches can be costly
    - One estimate is \$200 per breached record

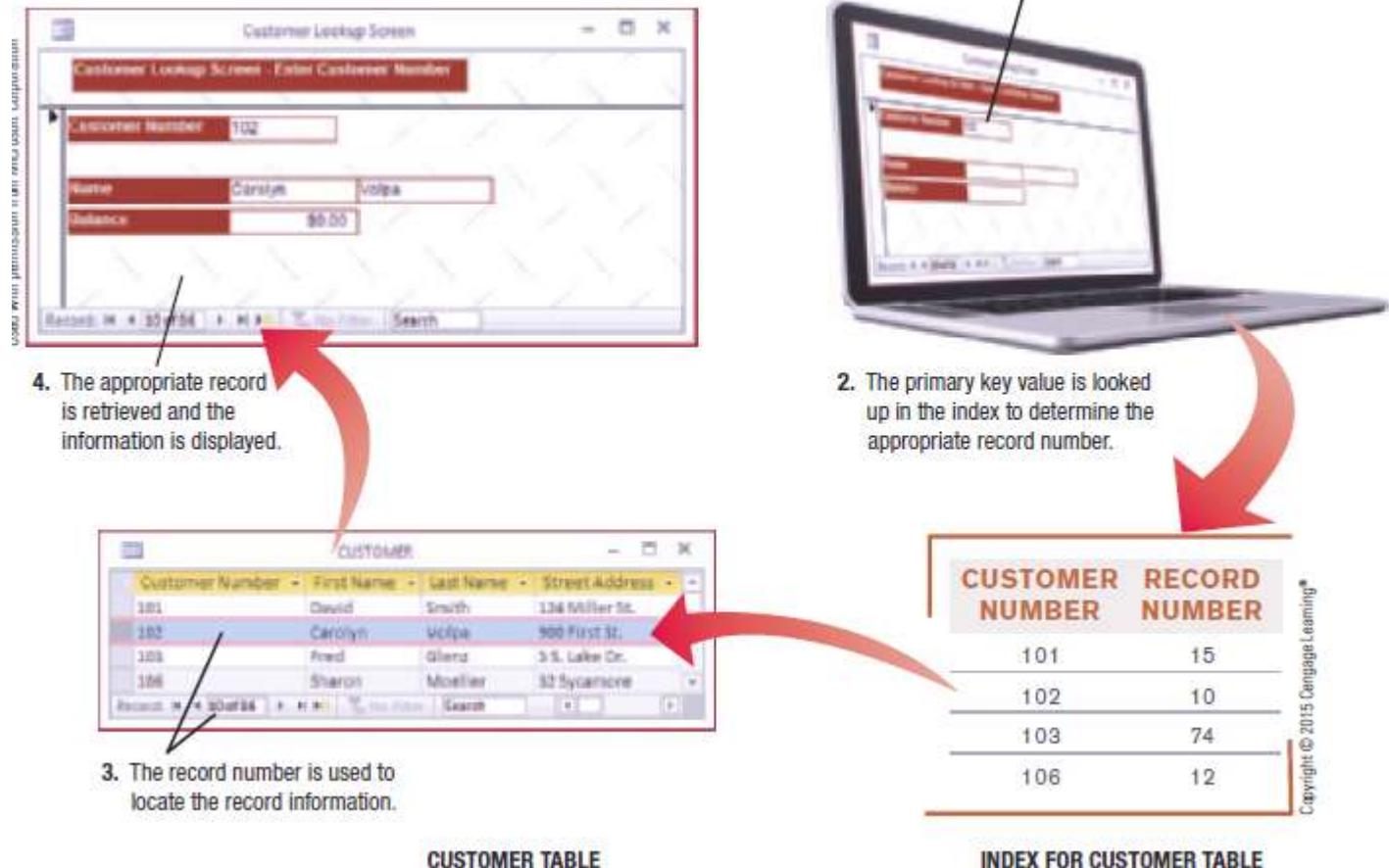


# Data Organization

- Data Organization
  - Arranging data for efficient retrieval
  - Indexed organization
    - Uses an index to keep track of where data is stored in a database
- Direct Organization
  - Uses hashing algorithms to specify the exact storage location
  - Algorithms should be designed to limit collisions
  - Some systems use a combination of both indexed and direct organization



# Data Organization



**FIGURE 14-7**  
Indexed organization is often used for real-time transaction processing.



# Data Organization

## HASHING PROCEDURE

Prime number

$$\begin{array}{r} 23 \\ \times 4 \\ \hline 92 \\ \text{Remainder: } 10 \end{array}$$

1. The primary key value (in this case the Customer Number) is divided by a prime number.
2. The remainder indicates the location to be used for that record (in this case, 10).

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**FIGURE 14-8**  
Direct organization  
is frequently used  
for faster real-time  
processing.

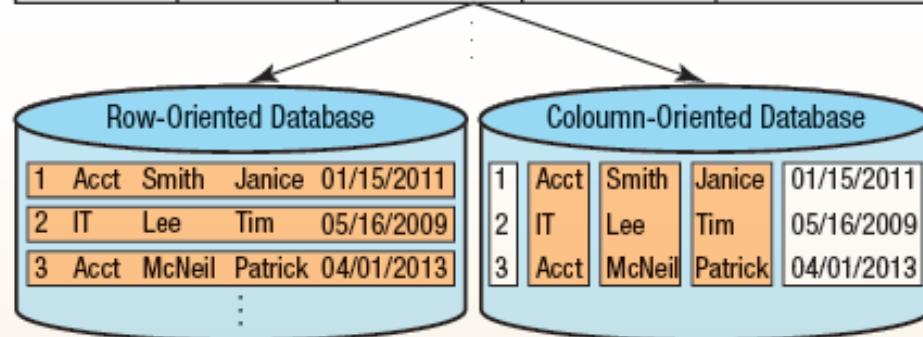


# How It Works Box

## Column Databases

- Stores data by columns instead of rows
- Improves performance by minimizing the time needed to read the disk
- Used with data warehouses and other big data applications

Emp_no	Dept	Emp_last	Emp_first	Hire_date
1	Acct	Smith	Janice	01/15/2011
2	IT	Lee	Tim	05/16/2009
3	Acct	McNeil	Patrick	04/01/2013
4	Sales	Wilson	Sammy	08/11/2012
5	IT	Morales	Jack	11/16/2013



Database needs to read all columns (because data is read by rows) to access the requested data.

Database needs to read only three columns to access the requested data.

**Example of retrieving the names of all IT employees using a row vs. a column database.**



# Quick Quiz

1. A column in a database in which customer names are stored would be referred to as a \_\_\_\_\_.
  - a. field
  - b. record
  - c. table
2. True or False: Data validation procedures are used to ensure that data entered into a database matches the specified type, format, and allowable value.
3. The \_\_\_\_\_ contains metadata about the database tables in a database.

*Answers:*

*1) a; 2) True; 3) data dictionary*



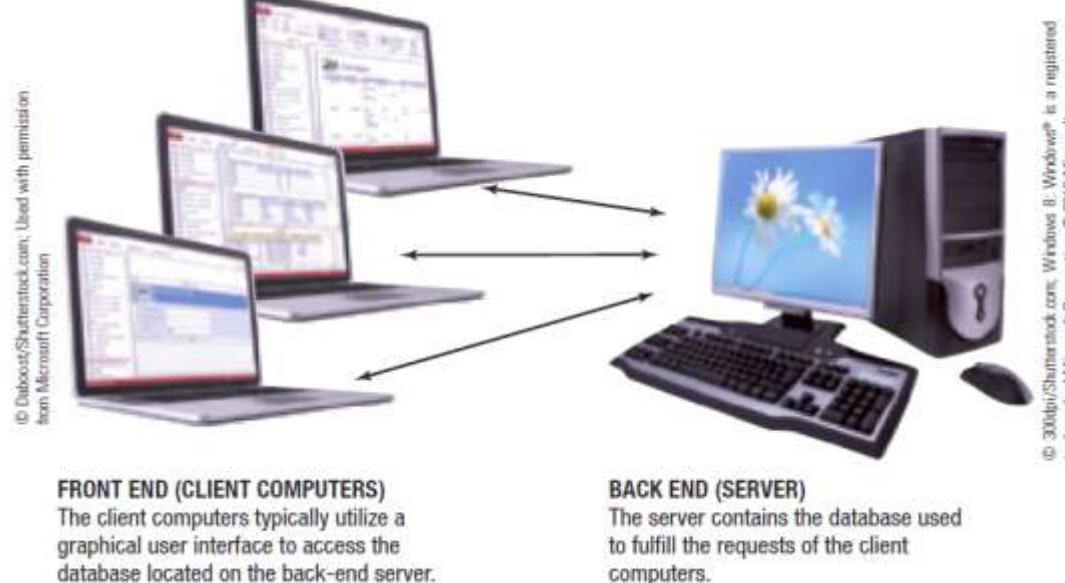
# Database Classifications

- Single-User vs. Multiuser Database Systems
  - Single-User Database System
    - Located on a single computer
    - Designed to be accessed by one user
    - Widely used for personal applications and very small businesses
  - Multiuser Database System
    - Designed to be accessed by multiple users (most business databases today)



# Database Classifications

- Client-Server and N-Tier Database Systems
  - Client-Server Database Systems
    - Has both clients (front end) and at least one database server (back end)

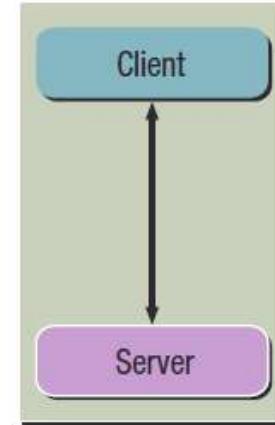


**FIGURE 14-9**  
Client-server  
database systems.

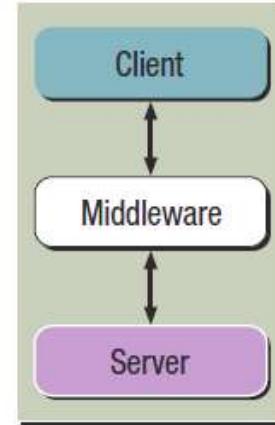


# Database Classifications

- N-Tier Database System
  - Has more than two tiers
  - Additional tiers typically contain software referred to as middleware
  - Allows program code to be separate from the database
  - Code can be divided into any number of logical components



**2-TIER MODEL**  
Has just a client and a server.



**N-TIER MODEL**  
Includes middleware, which contains additional programs used to connect the client and server.

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**FIGURE 14-10**  
A 2-tier vs. an n-tier database model.



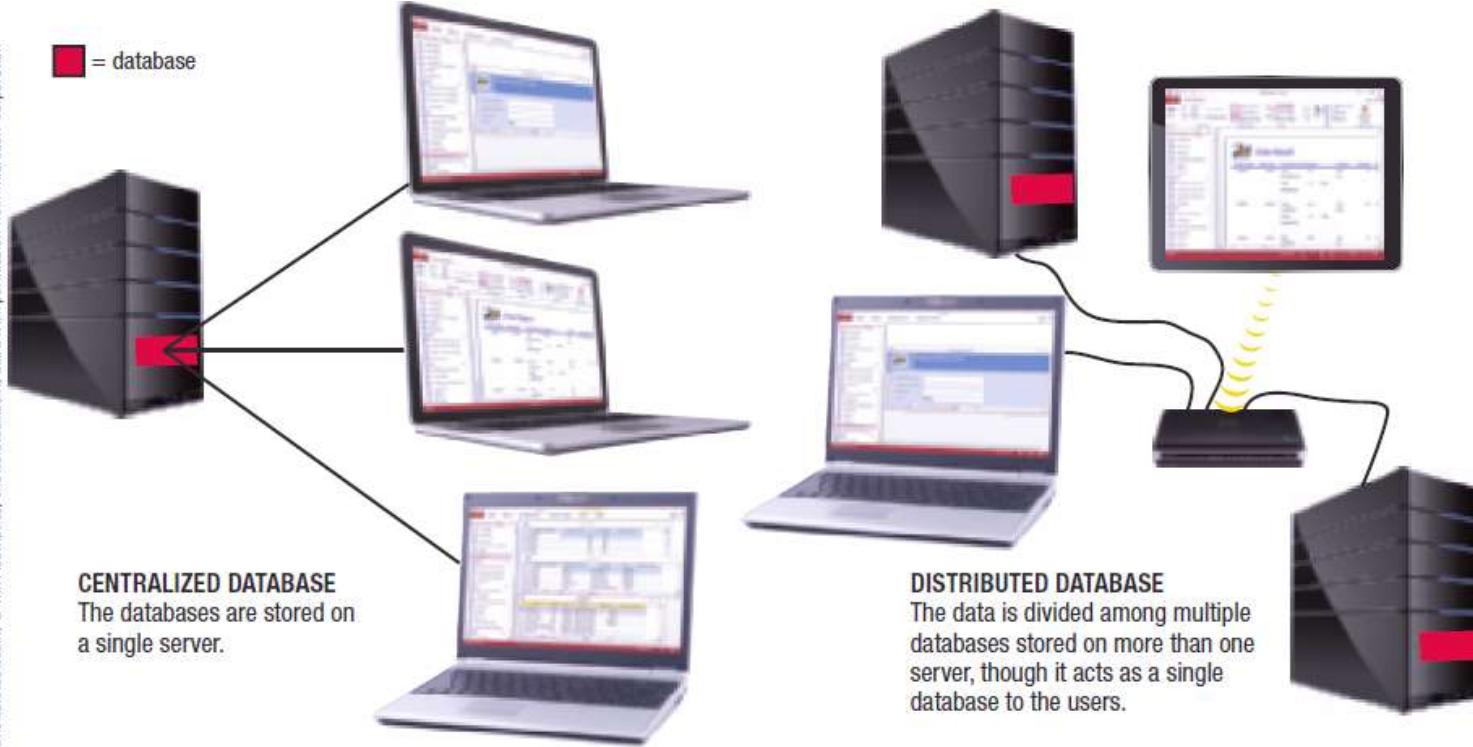
# Database Classifications

- Centralized vs. Distributed Database Systems
  - Centralized Database System
    - Database is located on a single computer, such as a server or mainframe
  - Distributed Database System
    - Data is physically divided among several computers connected by a network, but the database logically looks like it is a single database



# Database Classifications

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**FIGURE 14-11**  
Centralized vs.  
distributed  
databases.



# Database Classifications

- Disk-Based vs. In-Memory Database Systems
  - Disk-Based Systems
    - Data is stored on hard drives
  - In-Memory Databases (IMDBs)
    - Data is stored in main memory
    - Dramatically faster than disk-based databases
    - Good backup procedures are essential
    - Used both in high-end systems where performance is crucial and in small-footprint, embedded applications



# Quick Quiz

1. Which type of database system is beginning to be used in high-end systems where performance is crucial?
  - a. In-memory databases
  - b. Disk-based databases
  - c. Single-user databases
2. True or False: With the n-tier database model, there is at least one middle piece of software between the client and the server.
3. With a(n) \_\_\_\_\_ database system, the databases used by the system are all located on a single computer.

*Answers:*

*1) a; 2) True; 3) centralized*



# Database Models

- The Hierarchical and Network Database Models
  - Hierarchical Databases
    - Organizes data in a tree structure
    - Typically a one-to-many relationship between data entities
  - Network Databases
    - Allow both one-to-many and many-to-many relationships between data elements
  - Most databases today are neither hierarchical or network models



# The Relational Database Model (RDBMS)

- The Relational Database Model (RDBMS)
  - Data is organized in tables related by common fields
  - Most widely used database model today
  - Designing a Relational Database
    - Identify the purpose of the database
    - Determine the tables and fields
    - Assign the fields to a table and reorganize as needed to minimize redundancy (normalization – most databases stop at 3NF)
    - Finalize the structure (primary keys, field properties, etc.)



# The Relational Database Model (RDBMS)

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**PRODUCT TABLE**

Product Number	Product Name	Supplier	Price
----------------	--------------	----------	-------

**CUSTOMER TABLE**

Customer Number	First Name	Last Name	Street Address	City	State	ZIP	Phone	Balance
-----------------	------------	-----------	----------------	------	-------	-----	-------	---------

**ORDER TABLE**

Order Number	Customer Number	Order Date	Ship Date	Product Number	Quantity
--------------	-----------------	------------	-----------	----------------	----------

Each table contains  
a key field.

The key fields are repeated in other tables  
as needed to tie the tables together.

**FIGURE 14-14**

A preliminary design  
for three tables  
in the Inventory  
database.



# The Relational Database Model (RDBMS)

- Creating a Relational Database
  - Creating the Tables
    - Each table is created using the table structure developed during the database design process
      - In Access, can use Design view or Datasheet view
  - Entering and Editing Data
    - Existing data can be migrated to the new database
    - New data can be added via a form or Datasheet view
      - In either case, the same data is being manipulated



# Database Models

Use the View button to select the desired view.

You specify the name of the database file when the database file is created.

The screenshot shows two Microsoft Access windows side-by-side. The left window is titled 'Design View' and displays the 'Inventory' table structure. It includes a table grid with columns for Field Name, Data Type, and Description (Optional). Below the grid is a 'Field Properties' pane. The right window is titled 'Datasheet View' and shows the same 'Inventory' table data as a grid of rows and columns. Both windows have a ribbon at the top with tabs like FILE, HOME, CREATE, EXTERNAL DATA, DATABASE TOOLS, and TABLE TOOLS. The TABLE TOOLS tab is selected in both. A vertical red line highlights the 'View' tab in the ribbon of the Design View window, and another vertical red line highlights the 'Table' tab in the ribbon of the Datasheet View window. Callouts point from the text descriptions to these specific tabs.

DESIGN VIEW  
The table structure is created before data is entered.  
You create all fields and set the primary key.

DATASHEET VIEW  
The table structure is created as table data is entered.

You specify the name of the table when the table is saved.

Entering data creates appropriate fields that you can rename; an ID field primary key is created by default.

**FIGURE 14-15**

Tables can be created using Design view or Datasheet view.

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# Database Models

FIGURE 14-16

**Forms.** Forms can be used to view and edit table data.

1. Select the Product table, then click the Form button to create a form for the Product table.
2. A form containing all fields in the Product table is created and displayed in Form view.
3. Design view can be used to edit and format the form, including rearranging the fields, adding headings and logos, and so forth.
4. The finished form can be used to view and edit the data in the Product table.

Current record; can be edited or deleted.

Click to add a new record.

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# The Relational Database Model (RDBMS)

## – Relating Tables

- Once all tables have been created, they can be related to one another using their primary keys

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- Click to open Relationships.
- Drag a primary key field to a related table and then click the Create button to create the relationship between those two tables.
- Once the tables are related, data from one table (Order table, in this example) can be displayed within a related table (Customer table, in this example).

The screenshot shows the Microsoft Access ribbon with the 'RELATIONSHIPS' tab selected. The 'Relationships' dialog box is open, showing a relationship between 'CUSTOMER' and 'ORDER'. A red arrow points from the 'CustomerNumber' field in the 'CUSTOMER' table to the 'CustomerNumber' field in the 'ORDER' table. The 'Create' button is highlighted. Below the dialog, the 'Customer' and 'Order' datasheets are shown. The 'Customer' datasheet displays customer information, and the 'Order' datasheet displays order details, with the 'CustomerNumber' field populated with data from the related 'Customer' table.

**FIGURE 14-17**  
Relating tables.



# The Relational Database Model (RDBMS)

- Retrieving Information from a Relational Database
  - Query
    - A request to see information from a database that matches specific criteria
    - Every DBMS provides tools users can use to query the database for information
    - Can also write in structured query language (SQL)
    - Must be designed to extract information as efficiently as possible
    - Poorly written queries can impact the overall performance of the system



# The Relational Database Model (RDBMS)

Queries are saved; click a saved query to see the results.

Click to open the query design screen.

The screenshot shows the Microsoft Access ribbon with the 'HOME' tab selected. In the 'CREATE' section, the 'Query Design' icon is highlighted. The 'All Access Objects' pane on the left lists tables like CUSTOMER, INVENTORY, and PRODUCT, and queries like 'Products Less than \$20'. The main area displays the 'Products Less than \$20' query design screen. It shows a query named 'Products Less than \$20' with a single table 'PRODUCT' selected. The query results grid shows fields: Product Name, Product Number, and Price. A sorting option 'Sort Ascending' is applied to the Product Name field. The status bar at the bottom indicates '1 row(s) found'.

The three specified fields will be displayed.

The records in the query results will be sorted in alphabetical order by Product Name.

The query result will display only the records for which the price is less than \$20.

## 1. ORIGINAL TABLE

The original table contains data for all records.

PRODUCT NUMBER	PRODUCT NAME	SUPPLIER	PRICE
A202	Skis	Bills Ski Co.	\$60.00
A211	Boots	Ajax Bros.	\$65.00
A220	Poles	Bent Corp.	\$25.00
A230	Bindings	Acme Corp.	\$13.00
A301	Wax	Candle Industries	\$8.00

## 2. CREATING THE QUERY

Queries can be created using the query design screen or by typing SQL code.

The query design screen is used to specify the fields and records that should be displayed in the query results.

The underlying SQL code for a query can be viewed and edited using the View button on the HOME tab.

Products Less than \$20

```
SELECT PRODUCT.[Product Name], PRODUCT.[Product Number], PRODUCT.Price  
FROM PRODUCT  
WHERE (PRODUCT.Price) < 20  
ORDER BY PRODUCT.[Product Name];
```

Product Name	Product Number	Price
Bindings	A240	\$15.00
Wax	A351	\$3.00

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**FIGURE 14-18**

Querying a database. This example pulls information from the Product table in the Inventory database.

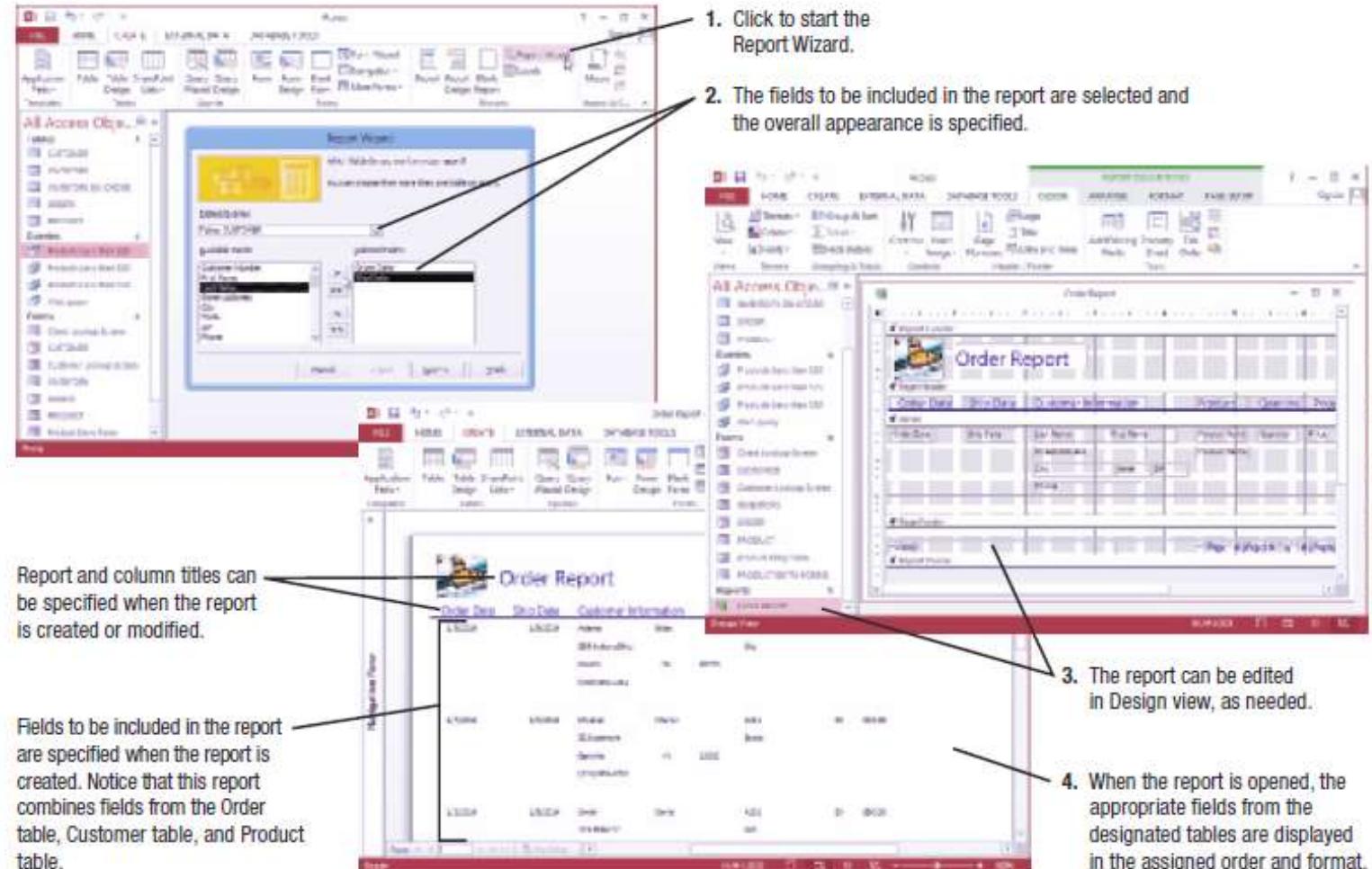


# The Relational Database Model (RDBMS)

- Reports
  - Formatted way of looking at a database table or the results of a query
  - Can pull data from more than one table
  - Many programs have wizards or other tools to make it easy to create a report
  - Can be modified and customized using the Design view
  - Reports in Microsoft Access are saved as objects in the database file



# The Relational Database Model (RDBMS)



**FIGURE 14-19**

**Reports.** Display table information with a more formal, businesslike appearance.

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# The Relational Database Model (RDBMS)

- Maintaining a Relational Database
  - Table structures can be modified when needed
  - Other possible modifications:
    - Adding new indexes to speed up queries
    - Deleting obsolete data
    - Upgrading database software, installing patches
    - Repairing/restoring data that has become corrupt
    - Continuing to evaluate and improve security



# The Object-Oriented Database Model

- The Object-Oriented Database Model
  - Object-Oriented Database Management System (OODBMS)
    - Database system in which multiple types of data are stored as objects along with their related code
    - Can contain virtually any type of data (video clip, text with music, etc.) along with the methods to be used with that data
    - Objects can be retrieved using queries (object query language or OQL)
    - Objects can be reused in other applications to create new applications quickly



# Trend Box

## Law Enforcement Databases

- Have been used for years but new database are now emerging that hold non-traditional data like photos and biometric data
  - Next Generation Identification (NGI)
    - Includes AFIT to store and match fingerprints
    - Includes support for photos and face-matching
    - Future improvements include support for voice, iris, DNA, palm prints, etc.



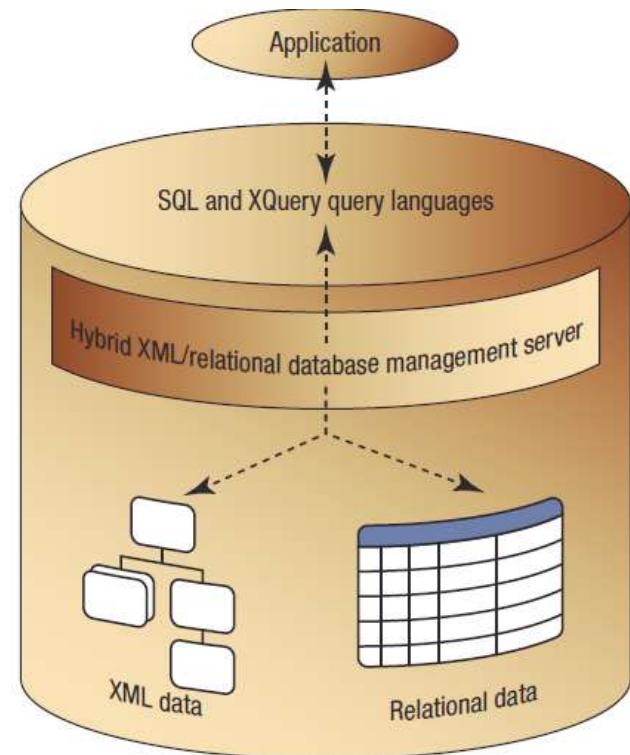
Courtesy FBI



# Hybrid Database Models

- Hybrid Database Models
  - A combination of two or more database types or models
    - Hybrid XML/Relational Database
      - Can store and retrieve both XML data and relational data

**FIGURE 14-21**  
Hybrid XML/  
relational databases.



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# Multidimensional Databases (MDDB)

- Multidimensional Databases (MDDB)
  - Designed to be used with data warehousing
  - Often used in conjunction with Online Analytical Processing (OLAP)
    - MOLAP (Multidimensional OLAP)
      - Data is stored in single structures called data cubes
    - ROLAP (Relational OLAP)
      - Data is stored in an existing relational database using tables to store the summary information
    - HOLAP (Hybrid OLAP)
      - Combination of MOLAP and ROLAP technologies



# Cloud Databases

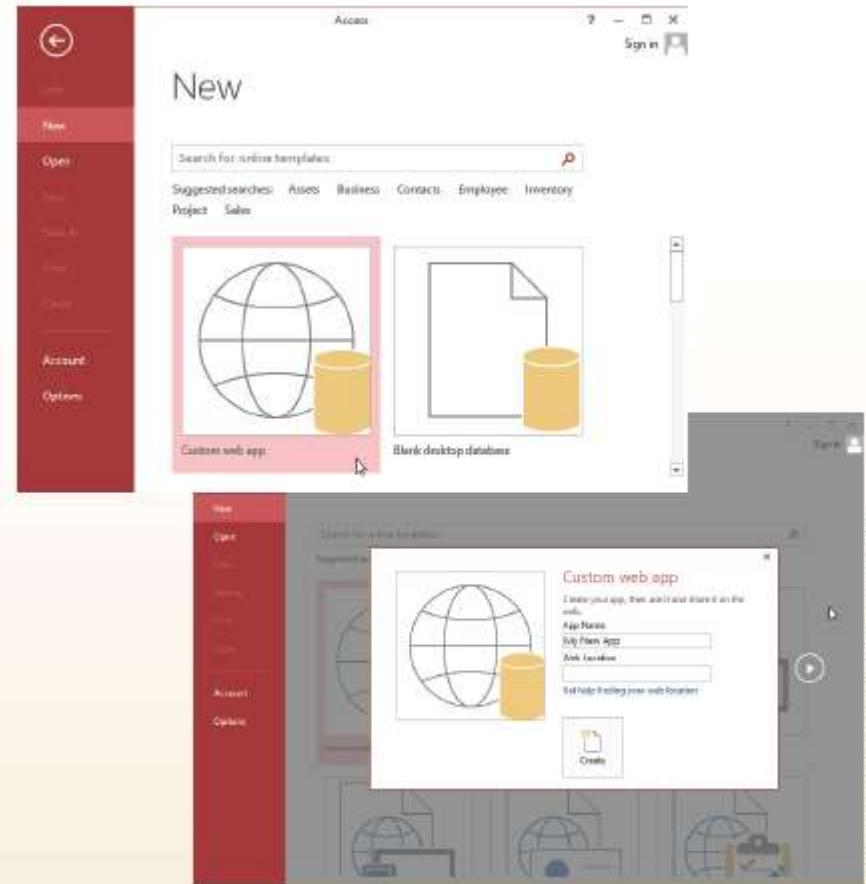
- Typically hosted on a cloud database provider's servers that is accessible to users via the Web
- Examples of Cloud Databases in Use
  - Information retrieval
    - Data to be accessed and displayed on a Web page is often stored in a database, i.e., Search sites
  - Support and facilitate e-commerce
    - Display product information, pricing, customer information, shopping cart content, etc.
  - Cloud databases allow Web pages to be dynamic Web pages



# Technology and You Box

## Cloud Databases

- Use growing rapidly
- Typically built using a cloud provider (Windows Azure, Amazon SimpleDB, or Google Cloud SQL)
- Requires less in-house hardware and maintenance
- Individuals can create via Microsoft Access web apps



With Microsoft Access, you can create custom cloud databases.

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# Cloud Databases

- How Cloud Databases Work
  - Visitor makes request by
    - Filling out a Web page form
    - Selecting an option from a menu displayed on a Web page form
  - Web server converts the request into a database query, passes it onto the database server, and then sends the results back to the visitor



# Cloud Databases

- Middleware
  - Software used to connect two otherwise separate applications, such as a Web server and a database management system
  - Commonly written as scripts
  - Common languages include
    - JavaScript
    - VBScript
    - CGI Scripts
    - Active Server Pages (ASPs)
    - PHP Scripts



# Cloud Databases

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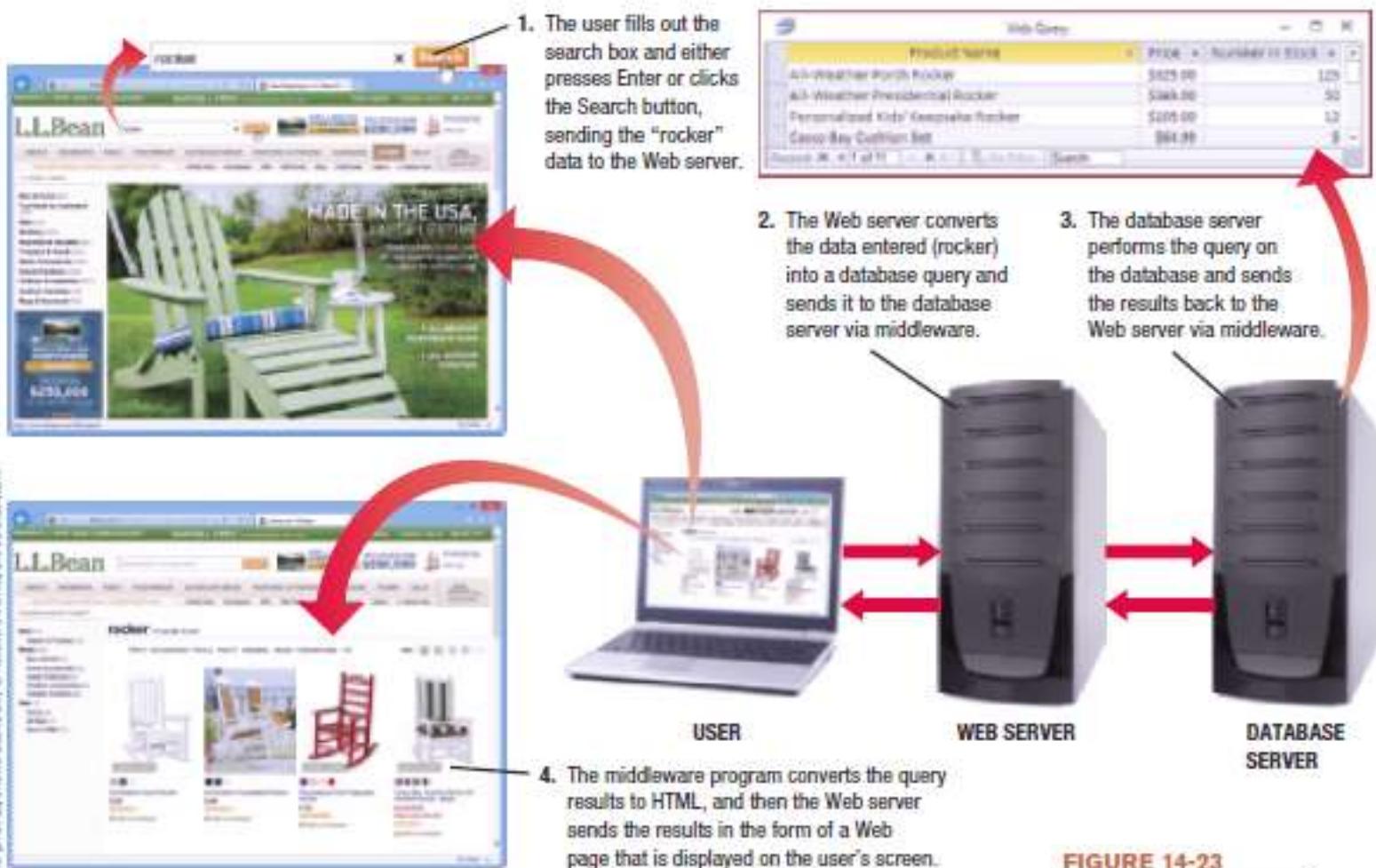


FIGURE 14-23

A cloud database in action.



# Quick Quiz

1. Which of the following is the most widely used type of database today?
  - a. Network
  - b. Relational
  - c. Object-oriented
2. True or False: Databases are often used in conjunction with dynamic Web pages.
3. A(n) \_\_\_\_\_ is used to extract specific information from a database by specifying particular conditions about the data to be retrieved.

*Answers:*

*1) b; 2) True; 3) query*



# Summary

- What Is a Database?
- Data Concepts and Characteristics
- Database Classifications
- Database Models
- Cloud Databases