

Chapter 11

Databases

Computer Concepts 2014



11 Chapter Contents

- Section A: File and Database Concepts
- Section B: Data Management Tools
- Section C: Database Design
- Section D: SQL
- Section E: Database Security

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11 FastPoll True/False Questions

Answer A for True and B for False

- 110100 Predictive data entry produces data warehouses and OLAPs.
- 110200 The simplest model for storing data is a flat file.
- 110300 A fixed-length field contains field names and record types.
- 110400 An ERD shows relationships and cardinality.
- 110500 The most popular business database model is based on a relational database.

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11 FastPoll True/False Questions

Answer A for True and B for False

- 110600 Spreadsheet software is optimized for working with relational data.
- 110700 Database software such as Microsoft Access provides an option to produce HTML formatted reports.
- 110800 XML is a database model that combines flat files and relational database models.
- 110900 BLOB and SQL are data types.

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11 FastPoll True/False Questions

Answer A for True and B for False

- 111000 The goal of normalization is to reduce data redundancy.
- 111100 Sorting a database is the same as indexing it.
- 111200 Databases transmitted over the Web can be encrypted using HTML.
- 111300 A database audit can sometimes identify unauthorized intrusion attempts.

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11 Section A: File and Database Concepts

- Database Basics
- Database Models

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11 Question

- 112100 The plots for several recent movies revolve around the government's use of what technology to identify terrorists based on spending habits and other data stored in commercial and government databases?
 - A. Predictive analytics
 - B. Executive dashboards
 - C. ERDs
 - D. Data cubes

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11 Database Basics

- A database is a collection of information
 - Typically stored as computer files
 - The tasks associated with creating, maintaining, and accessing the information in databases are referred to as data management, file management, or database management



FIGURE 11-1
Database data that is no longer current is normally moved to an archive, which can be stored on a hard drive, secondary server, or tape. Many legacy data sites continue to store archival data on tape cartridges, which are accessed by a tape robot that pulls tapes out of the racks and loads them into a tape drive.

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11 Database Basics

- Databases can be used in a variety of ways
 - Collect and store data
 - Update data
 - Organize and output data
 - Distribute data
 - Find data
 - Analyze data



FIGURE 11-3
A query by example interface displays a form and formulates a query based on what the user enters.

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11 Database Basics

- Data mining refers to the process of analyzing existing database information to discover previously unknown and potentially useful information, including relationships and patterns
 - Data warehouse
 - Predictive analytics

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11 Database Basics

- OLAP (online analytical processing) allows decision makers to quickly get answers to complex queries
 - Executive dashboard software
 - Big data



FIGURE 11-4
Executive dashboard software helps decision makers visualize data from complex data sets.

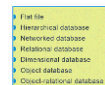
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11 Database Models

- An unstructured file has a unique structure and contains different kinds of data
- A structured file uses a uniform format to store data
- The underlying structure of a database is referred to as a database model

FIGURE 11-5
Database Models



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11 Database Models

- The simplest model for storing data is a flat file that consists of a single, two-dimensional table of data elements



FIGURE 11-6 Records can be displayed as rows in a table or as forms.

11 Database Models

- A field contains the smallest unit of meaningful information
- Each field has a unique field name
- Variable-length field vs. fixed-length field



FIGURE 11-7 When setting up a database, the length of text fields should be adequate to store the longest names or files. The Time field can be short because the longest tracks are 60 minutes or less, which can be expressed in the format MM:SS, where MM is minutes and SS is seconds.

11 Database Models

- A record is a collection of data fields
- The template for a record is referred to as a record type
- A record that contains data is referred to as a record occurrence

| Record Type | Record Occurrence |
|-------------|------------------------------|
| Name | Name: All My Loving |
| Time | Time: 02:09 |
| Artist | Artist: Beatles |
| Album | Album: The Beatles 1962-1966 |
| Genre | Genre: Rock |

FIGURE 11-8 A record type (left) is simply a list of fields, whereas a record occurrence (right) contains data for a particular entity. In this case, the entry is a track called "All My Loving" on the album "The Beatles 1962-1966."

11 Database Models

- A relationship is an association between data that is stored in different record types
 - Cardinality
 - One-to-many relationship
 - Many-to-many relationship
 - One-to-one relationship

11 Database Models

- Cardinality refers to the number of associations that can exist between two record types
- The relationship between record types can be depicted graphically with an entity-relationship diagram



FIGURE 11-9 An entity-relationship diagram depicts each record type as a rectangle. Relationships and cardinalities are shown by connecting lines.

11 Database Models

- A hierarchical database allows one-to-one and one-to-many relationships, linked in a hierarchical structure

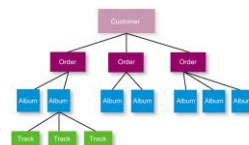


FIGURE 11-10 In this hierarchical database, Customer, Album, Track, and Order are record types. All of the relationships are one-to-many.

11 Database Models

- A network database uses a mesh-like structure to offer the additional capacity to define many-to-many relationships

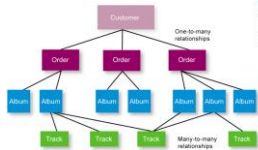


FIGURE 11-11 A network database allows many-to-many relationships as well as one-to-many relationships between record types.

11 Database Models

- A relational database stores data in a collection of related tables

Vintage Music Shop stores data in six tables.

| Album | Track |
|--------------|--------------|
| Artist | Track No. |
| Album Title | Track Title |
| Release Date | Track Length |
| Genre | Track Price |

| ORDER DETAILS | ORDER |
|----------------|----------------|
| OrderNumber | OrderNumber |
| CustomerNumber | CustomerNumber |
| City | TotalPrice |
| OrderDate | OrderDate |

| CUSTOMERS | | | | |
|----------------|-----------|----------|--------|------|
| CustomerNumber | FirstName | LastName | Street | City |

| Albums | Tracks |
|--------------|--------------|
| Artist | Track No. |
| Album Title | Track Title |
| Release Date | Track Length |
| Genre | Track Price |

11 Database Models

- A dimensional database organizes relationships over three or more dimensions

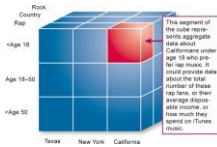


FIGURE 11-16 This data cube represents data available for queries about the musical preferences of customers based on their age and location.

11 Database Models

- An object database stores data as objects, which can be grouped into classes and defined by attributes and methods



FIGURE 11-17 An object database can easily store data about different types of orders. A class called Orders holds data and methods common to all types of orders. A derivative class called Phone Orders inherits all the characteristics of Orders, but it has attributes and methods unique to orders placed by telephone. Other Orders is a derivative class that has attributes and methods unique to orders placed over the Web.

11 Database Models

- The term object-relational database is used to describe a variety of technologies that combine object-oriented and relational concepts

FIGURE 11-18 A relational database serves as the basis for an object-relational database. (top), but an object-relational database can store the song data and the routine to play it.



11 Section B: Data Management Tools

- Data Management Software
- Database Management Systems
- Databases and the Web
- XML

11 Question

- 112200 Most people have purchased merchandise from Amazon.com and similar online stores. What technology do these sites use to describe merchandise and handle customer shopping carts?
 - A. Static Web publishing
 - B. Spreadsheet data management
 - C. Server-side programming
 - D. E-commerce client software

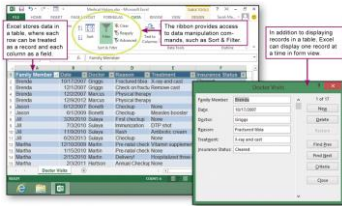
11 Data Management Software



FIGURE 11-17 Microsoft Word allows you to create a table of information, such as a mailing list, which you can edit, sort, search, and print. In addition, you can merge data from the table with a template letter to create form letters, mailing labels, and envelopes. Access your digital toolbox to learn how to use Microsoft Word to create mailing lists and mail merges.

11 Data Management Software

FIGURE 11-18 Spreadsheet software usually provides tools for working with flat files. Learn how to use the data features within Microsoft Excel.



In addition to displaying reports in tables, Excel can display one record at a time in table view.

Excel presentation is a single column based on the data that databases are most likely to use. Programs that manipulate a database are not tied to the structure of fields, records, relations, and reports.



11 Data Management Software

- It is possible to enter data as ASCII text file
- Custom data management software
- Data dependence vs. data independence

11 Database Management Systems

- Software designed to manage data stored in a database
 - XML DBMS
 - OODBMS
 - RDBMS

11 Database Management Systems



FIGURE 11-21 An entry-level DBMS usually includes all the tools you need to manipulate data in a database. Learn how to work with tables in a Microsoft Access database.

Microsoft Access provides tools for working with tables and for creating queries, forms, reports, and Web pages.

11 Database Management Systems

- Database client software allows any remote computer or network workstation to access data in a database



FIGURE 11-22 Multiple users can access a database using client software.

11 Database Management Systems

- Multiple users can interact with the same database

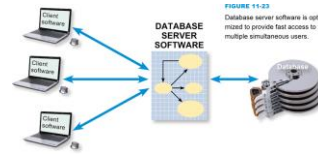


FIGURE 11-23 Database server software is optimized to provide fast access to multiple simultaneous users.

11 Databases and the Web

- The Web allows access to many databases
 - Static Web publishing
 - Dynamic Web publishing
 - Server-side program

11 Databases and the Web



FIGURE 11-24 Many entry-level DBMSs include an easy way to turn a report into an HTML document that you can post as a Web page. Learn how to generate an HTML report from a Microsoft Access database.

11 Databases and the Web

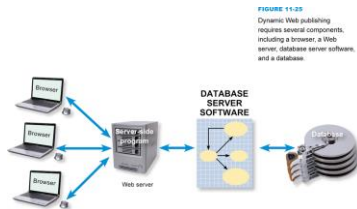


FIGURE 11-25 Dynamic Web publishing requires several components, including a browser, a Web server, database server software, and a database.

11 Databases and the Web

- HTML forms can collect data, as well as specifications for a query

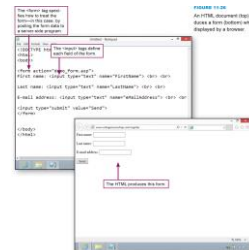


FIGURE 11-26 An HTML document that provides a form interface is displayed to a browser.

11 Databases and the Web

- The process of sending data to a database requires several data handoffs
 - Server-side script



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11 XML

- Markup language that allows field tags, data, and tables to be incorporated into a Web document

```

<?xml version="1.0"?>
<document type="SPEECH" ></document>
<speechTitle> Have a Break/SpeechTitle </>
<author>Martin Luther King, Jr.</author>
<speechText>
  I have dreamed on the steps at the Lincoln Memorial in Washington D.C. I have dreamed
  that one day I would sit down with the greatest leaders of the century to discuss
  the issues of our time.
  I was born years ago, a great American, in whose symbolic
  shadow we stand today. I grew up in the humble town of Prichard,
  Mississippi, where I was as a great believer, full of hopes to
  all those of my race who had been told in the words of
  someone I should to come on a journey to break to end the
  long night of their captivity.
  Not one hundred years later, the Negro still is not free. One
  hundred years later, the Negro still is not free. One
  hundred years later, the Negro still is not free.
  
```

FIGURE 11-28
A document with XML tags allows you to make a targeted search for author = Martin Luther King, Jr. and document type = SPEECH.

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11 XML

- Language used to specify a standard structure of fields and records
- Data in an XML document is searchable
- XML is portable, but not optimized for many common database operations
 - Consider storing data in a relational database, managing it with RDBMS software, and generating XML documents for exchanging data over the Web

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11 Section C: Database Design

- Defining Fields
- Normalization
- Organizing Records
- Designing the Interface
- Designing Report Templates
- Loading Data

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11 Question

- 112300 Most commercial databases store data in a series of tables, rather than in a single flat file. Why?
 - A. To reduce data redundancy
 - B. To maintain unique sort keys
 - C. To enable field validation rules
 - D. To avoid case sensitivity

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11 Defining Fields

- The term database structure refers to the arrangement of fields, tables, and relationships in a database
- Break data into fields just by using common sense and considering how people might want to access the data
- Use a primary key field to make each record unique
- Use appropriate data types for each field

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11 Defining Fields

FIGURE 11-33
Commonly Used Data Types

| Data Type | Description | Sample Field | Sample Data |
|-----------|---|------------------|--------------------------|
| Real | Numbers that include decimal places | DiscountPrice | 9.99 |
| Integer | Whole numbers | City | 5 |
| Date | Month, day, and year | OrderDate | 9/3/2014 |
| Text | Letters or numerals not used for calculations | Name | GIHart |
| Logical | Data that can have one of two values | InStock | Y |
| Memo | Variable length comment field | Condition | Some wear on album cover |
| BLOB | Binary data | SampleTrack | [An MP3 file] |
| Hyperlink | URLs | MusiciansWebSite | www.bobbyjen.com |

11 Defining Fields

- A computed field is a calculation that a DBMS performs during processing and temporarily stores in a memory location
- Uppercase and lowercase are not always treated the same
 - Case sensitive database
- Use field formats to show what the data is supposed to look like when it's entered
- Use field validation rules to filter data

11 Normalization

- Process that helps save storage space and increase processing efficiency
 - Minimizes data redundancy

FIGURE 11-38
Fields for each order are separated into two tables: one for customer information and one for order information. Information in these two tables can be linked using the CustomerNumber field. This field makes it easy to find all the orders for a specific customer.

| CUSTOMERS | ORDERS |
|----------------|----------------|
| CustomerNumber | OrderNumber |
| FirstName | CustomerNumber |
| LastName | TotalPrice |
| Street | OrderDate |
| City | City |
| State | State |
| ZipCode | Price |
| EmailAddress | |
| PhoneNumber | |

11 Organizing Records

- Records can be organized in different ways, depending on use
- Sorting
 - A table's sort order refers to the order in which records are stored on disk
 - Sort key
- Database index
 - Similar to the index in a book

11 Organizing Records

FIGURE 11-40
When arranged by date, Blue Hawaii is the second record in the index. The index file contains a lot of keys and the fill pointer to the record containing more information about the album released on that date. **Tip** To see how indexing works, link the figure to your original textbook.

| INDEX | Album | Artist | Release Date | # Tracks | Price | Discount Price |
|-------|----------|----------------|--------------|----------|-------|----------------|
| 1 | LPM-2285 | Elvis Presley | 10/01/1960 | 4 | 20.00 | 18.99 |
| 2 | 7500-02 | Rolling Stones | 02/08/1967 | 1 | 13.99 | 11.49 |
| 3 | LSP-248 | Elvis Presley | 10/01/1961 | 2 | 50.00 | 45.00 |
| 4 | N19014 | Beach Boys | 02/27/2001 | 8 | 18.99 | 17.99 |

11 Designing the Interface

- Arrange fields in a logical order
- Provide visual clues to the entry areas
- Entry areas should appear in a consistent position relative to their labels
- Provide a quick way to move through the fields in order

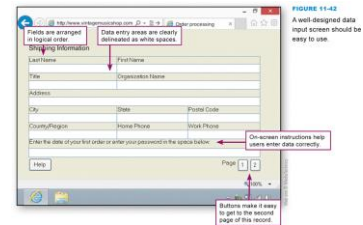
11 Designing the Interface

- Use scrolling or create multiple screens, if necessary
- Provide buttons or other easy-to-use controls for moving from one record to another
- Supply on-screen instructions

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11 Designing the Interface



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11 Designing Report Templates

- Report generators are used to specify the content and format for a database report
- A report template contains the outline or general specifications for a report

ANSWER: 11-43
A report template contains the specifications to produce the report.

Report Date: 8/21/2014

| Discount Price | Album | Artist | Qty in Stock |
|----------------|-------------------------|--------------------|--------------|
| \$15.00 | Magical Mystery Tour | Beatles | 3 |
| \$12.00 | Beatles 1967 | Beatles | 5 |
| | Chicago Tribute | Jerry Seinfeld | 2 |
| | Beatles Tribute | Jefferson Airplane | 1 |
| \$12.00 | One Day at a Time | Sam Beaud | 2 |
| \$12.00 | Beatles Ten Albums | Beatles | 2 |
| | Let It Be | Beatles | 2 |
| | Abbey Road | Beatles | 4 |
| | John Bull | Sam Beaud | 1 |
| \$12.00 | John Bull's Golden Rule | John Bull | 2 |
| | Chicago Blues | John | 2 |

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11 Designing Report Templates

- Supply only the information required
- Present information in a usable format
- Information should be timely
- Information should be presented in a clear, unambiguous format
- Present information in the most appropriate format for the audience

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11 Loading Data

- Data can be loaded into a database by:
 - Using generic data entry tools
 - Using a customized data entry module
- A conversion routine converts the data from its current format into a format that can be automatically incorporated into the new database

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11 Section D: SQL

- SQL Basics
- Adding Records
- Searching for Information
- Updating Fields
- Joining Tables

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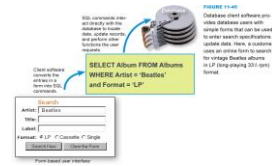
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11 Question

- 112400 How does SQL relate to a typical computer user?
 - A. Because search engines like Google are databases, you can use SQL to make advanced searches.
 - B. You can use SQL to get beyond the main menu option on e-commerce sites like the iTunes store.
 - C. You can use SQL to find music at free file sharing sites.
 - D. Knowing how a query language works can help you understand how databases work behind the scenes.

11 SQL Basics

- Intermediary between the database client software and the database itself



11 SQL Basics

FIGURE 11-46 SQL Commands

| Command | Description | Example |
|---------|------------------------------|---|
| CREATE | Create a database or table | CREATE TABLE Album |
| DELETE | Remove a record from a table | DELETE FROM Tracks WHERE TrackTitle = 'Blue Suede Shoes' |
| INSERT | Add a record | INSERT INTO Albums (AlbumDescription (Cat#_Condition) VALUES ('LPM-2256', 'Mint condition; no visible scratches; original album cover') |
| JOIN | Use the data from two tables | SELECT FROM Albums JOIN Tracks ON Albums.Cat# = Tracks.Cat# |
| SELECT | Search for records | SELECT FROM Albums WHERE Artist = 'Beatles' |
| UPDATE | Change data in a field | UPDATE Albums SET DiscoutPrice = 15.95 WHERE Cat# = 'LPM-2256' |

11 Adding Records

FIGURE 11-47 Data from the Customer form is added to the database.

Customer form

First Name:

Last Name:

Address Line 1:

Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Phone Number:

SQL statement

```
INSERT INTO Customers (LastName, FirstName, Street, City, State, ZipCode, PhoneNumber) VALUES ('Rodriguez', 'Jorge', '101 Las Vegas Court', 'Tomball', 'NM', '87571', '565555412')
```

Customers table

| LastName | FirstName | Street | City | State | ZipCode | PhoneNumber |
|-----------|-----------|---------------------|---------------|-------|---------|--------------|
| Rodriguez | Jorge | 101 Las Vegas Court | Tomball | NM | 87571 | 565-555-5412 |
| Everson | Jonathan | 10000 Lakes Dr. | Nagansong | MI | 48366 | 949-555-7131 |
| Wincheta | Daisy | 499 Table Mesa | Boulder | CO | 80301 | 303-555-6702 |
| Venkata | Patel | 872 Old York Way | Durango | CO | 81301 | 970-555-4438 |
| Wong | Jay | 502 Park Place | New York | NY | 10022 | 212-555-9803 |
| Palming | Nathaniel | 5 Winsome Drive | Cheyenne | WY | 82003 | 303-555-3223 |
| Chen | Liu Chi | 2226 Overline Trail | San Francisco | CA | 94118 | 415-555-9301 |
| Watson | William | 500 Vista Mesa Dr | Albuquerque | NM | 87204 | 505-555-1111 |
| Bolton | Luc | 41 Blue St | Littleton | CO | 80120 | 303-555-4297 |

11 Searching for Information

SELECT Album, AlbumCover FROM Albums WHERE Artist = 'Jefferson Airplane'

- The AND, OR, and NOT Boolean operators are used to perform complex queries
- The use of parentheses indicates the part of the query to perform first

11 Updating Fields

UPDATE Albums SET InStock = InStock - 1 WHERE Album = 'G.I. Blues'

- Global updates change the data in more than one record at a time
 - Works only for records with similar characteristics

11 Joining Tables

- Joining tables in SQL allows you to create relationships between tables

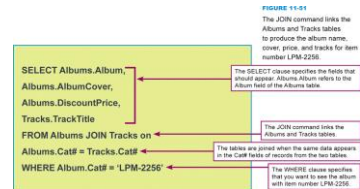
FIGURE 11-59
Records in the Albums table and Tracks table both include a Cat# field. When the data in these fields is the same, the records refer to the same entity—in this case, an Elton Presley album called G. J. Blues.

| Album# | Cat# | Album | Artist | Year | Tracks | Price | Disc# | DiscOrder |
|----------|---------------|--------------------|------------|--------------------|--------|-------|-------|-----------|
| LPM-2256 | G. J. Blues | Elton Presley | 10/21/1967 | 6 | 20.00 | 1 | 18 95 | |
| F499-2 | Elton Presley | Elton Presley | 10/21/1967 | 1 | 13.99 | 1 | 11 40 | |
| LSP-240 | Elton Presley | Elton Presley | 10/21/1967 | 1 | 13.99 | 1 | 11 40 | |
| W10214 | Elton Presley | Elton Presley | 10/21/1967 | 1 | 13.99 | 1 | 11 40 | |
| | LPM-2256 | Franklin's Special | 1/2 | Franklin's Special | | | | |
| | LPM-2256 | Wooden Heart | 103 | Wooden Heart | | | | |
| | F499-2 | Blue Suede Shoes | 104 | Blue Suede Shoes | | | | |
| | F499-2 | Rocky Turned | 107 | Rocky Turned | | | | |

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11 Joining Tables



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11 Section E: Database Security

- Database Vulnerabilities
- Database Security Measures
- Database Security Regulations
- What Individuals Can Do

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11 Question

- 112500 If you are a hacker trying to get your hands on a database with lots of social security numbers, what is the easiest way to do it?
 - A. Hack into the database of an ATM.
 - B. Steal a government computer, preferably a notebook that's been left unattended.
 - C. Tap into HIPAA.
 - D. Hack into a local business that has an unsecured wireless connection.

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11 Database Vulnerabilities

- Databases are vulnerable to physical theft, hacking, and unauthorized access
 - Databases can be stolen without going missing
- There is hardly a person in America who is not in at least one computer database
 - Privacy is viewed as an inherent right
 - Importance of data accuracy
 - Data should be kept secure

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11 Database Security Measures

- Today's computers are under assault from hackers and natural disasters
- Security measures include encryption, access controls, data security policies, and intrusion monitoring
- Encryption can make data in a database unintelligible to a hacker
- The process of decrypting database information in response to a query typically increases the amount of time necessary to process each query

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11 Database Security Measures

- An access control limits access to systems, such as computer databases
 - Control who accesses the database
 - Control how users interact with the database
 - User privileges
 - Data view



11 Database Security Measures

- To minimize vulnerabilities caused by employee inattention, organizations can formulate database use policies
 - A database audit is a procedure that monitors and records user activity within a database



11 Database Security Regulations

- International e-commerce makes database security a global concern; many countries have enacted laws to protect personal data stored on databases
 - European Union's Privacy Directive
 - Canada's Personal Information Protection and Electronics Document Act
 - U.S. Privacy Act of 1974
 - USA PATRIOT Act
 - Video Privacy Protection Act
 - Health Insurance Portability and Accountability Act 1996
 - Gramm-Leach-Bliley Act 1999

11 What Individuals Can Do

- The key to minimizing your risk is to be vigilant about the information you divulge
 - Know when data is being collected
 - Find out how data is being used
 - Find out what data is retained
 - Supply only the data that is required
 - Opt-out when possible
 - Protect your passwords
 - Don't trade your privacy
 - Use antivirus software
 - Do not reply to spam
 - Before registering, check the site's privacy policy

11 What Individuals Can Do

FIGURE 11-05
Portable password managers that you can use from a USB flash drive include:



11 What Do You Think?

- 113100 Should your government continue to develop and deploy data mining techniques designed to identify terrorists?
 - A. Yes B. No C. Not sure
- 113200 Are you concerned about your personal data being included in government data mining operations?
 - A. Yes B. No C. Not sure
- 113300 Do you think that governments should apologize to and compensate individuals who are inappropriately harmed by data mining operations?
 - A. Yes B. No C. Not sure

NEW PERSPECTIVES

Chapter 11 Complete

Computer Concepts 2014

