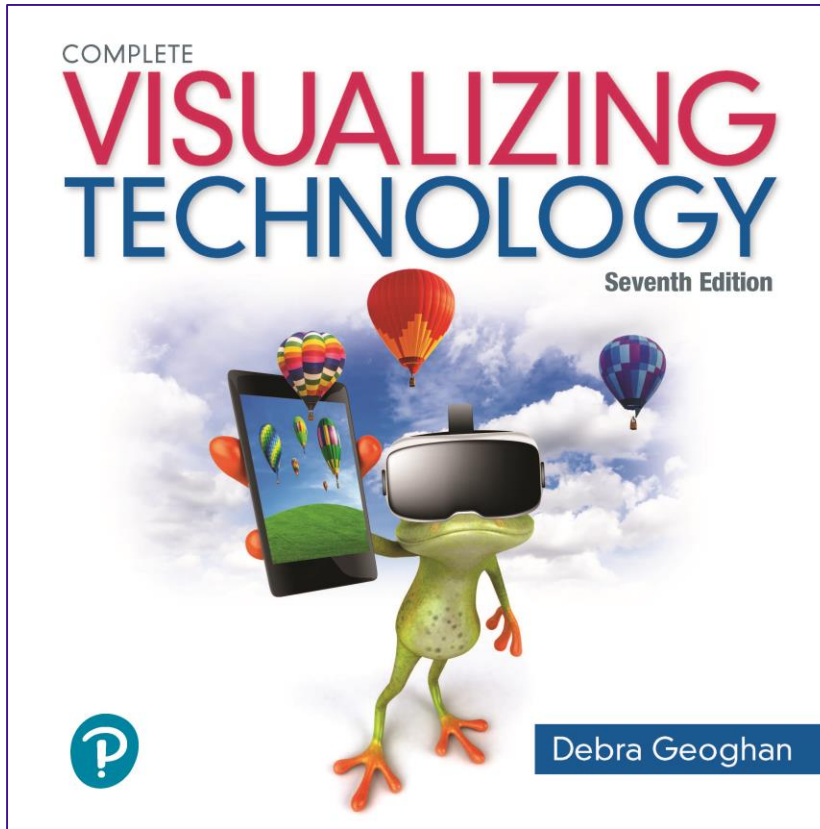# Introductory Visualizing Technology
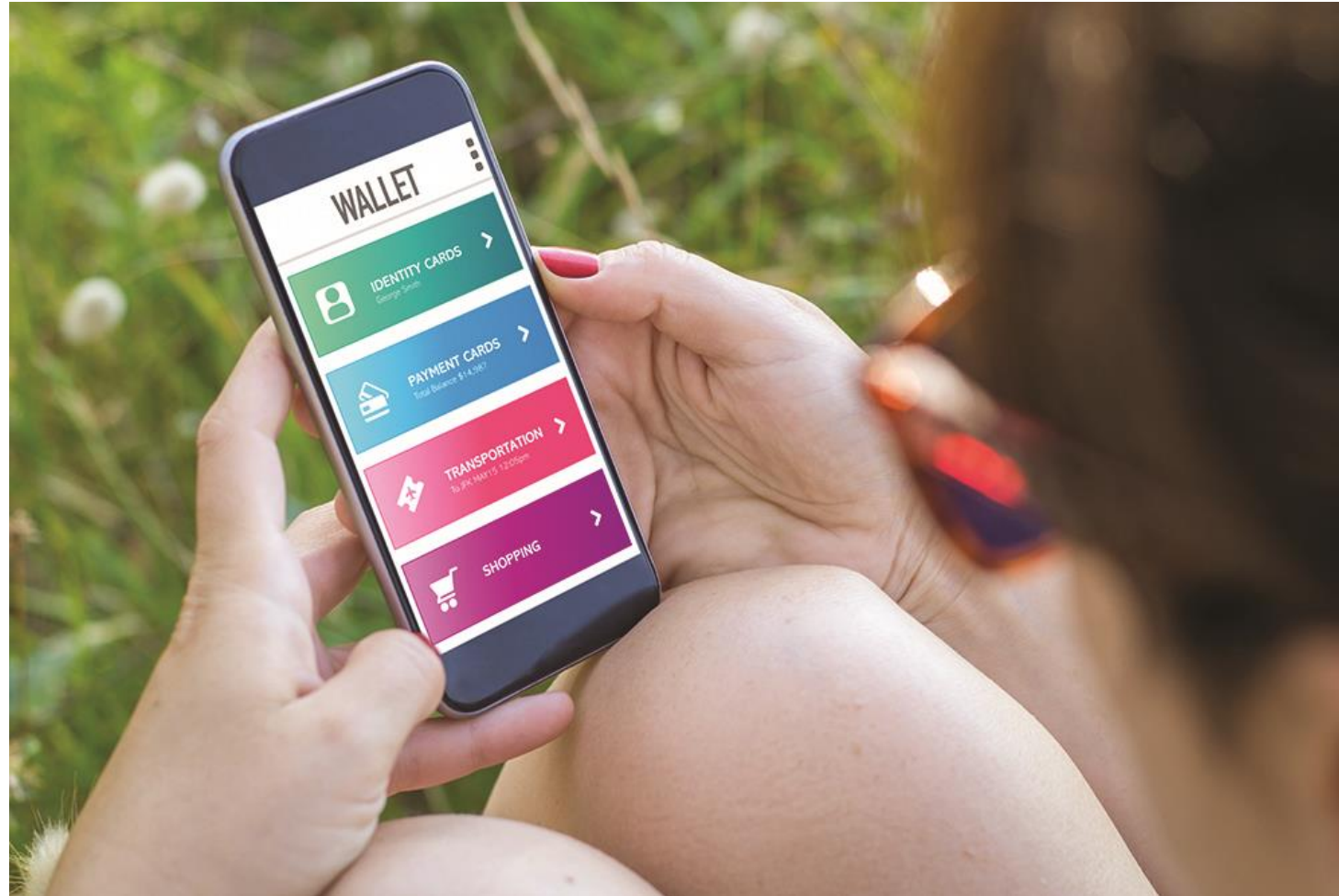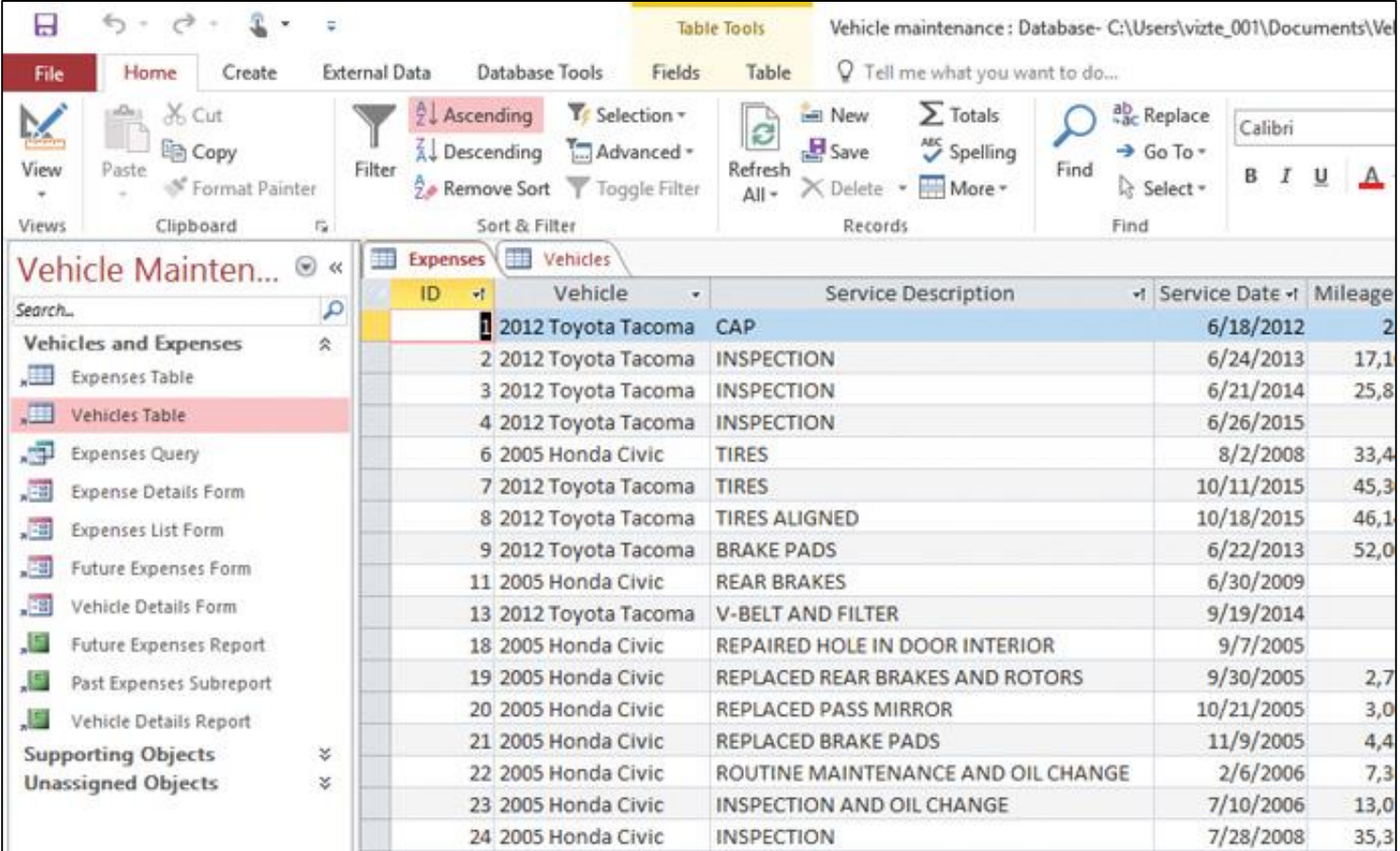
Seventh Edition

Chapter 11

Databases

Identify the Parts of a Database

Database Basics—Tables, Fields, and Records

- Database
  - Collection of information
  - Organized in a useful way
  - Database records are organized into tables

Database Basics—Tables, Fields, and Records

- Table
  - Data arranged in rows and columns

- Record
  - Row of data that describes a particular entry

- Field
  - Single piece of information in a record
  - Primary key a special field that uniquely identifies a record

A List of Student Grades Presented in a Spreadsheet – Single Theme

Hierarchy of Data Elements

What Is a Database?

Columns, also called fields

Student Number	Student Name	HW1	HW2	MidTerm
1325	BAKER, ANDREA	88	100	78
1644	LAU, SWEE	75	90	90
2881	NELSON, STUART	100	90	98
3007	FISCHER, MAYAN	95	100	74
3559	TAM, JEFFREY		100	88
4867	VERBERRA, ADAM	70	90	92
5265	VALDEZ, MARIE	80	90	85
8009	ROGERS, SHELLY	95	100	98

Rows, also called records

Characters, also called bytes
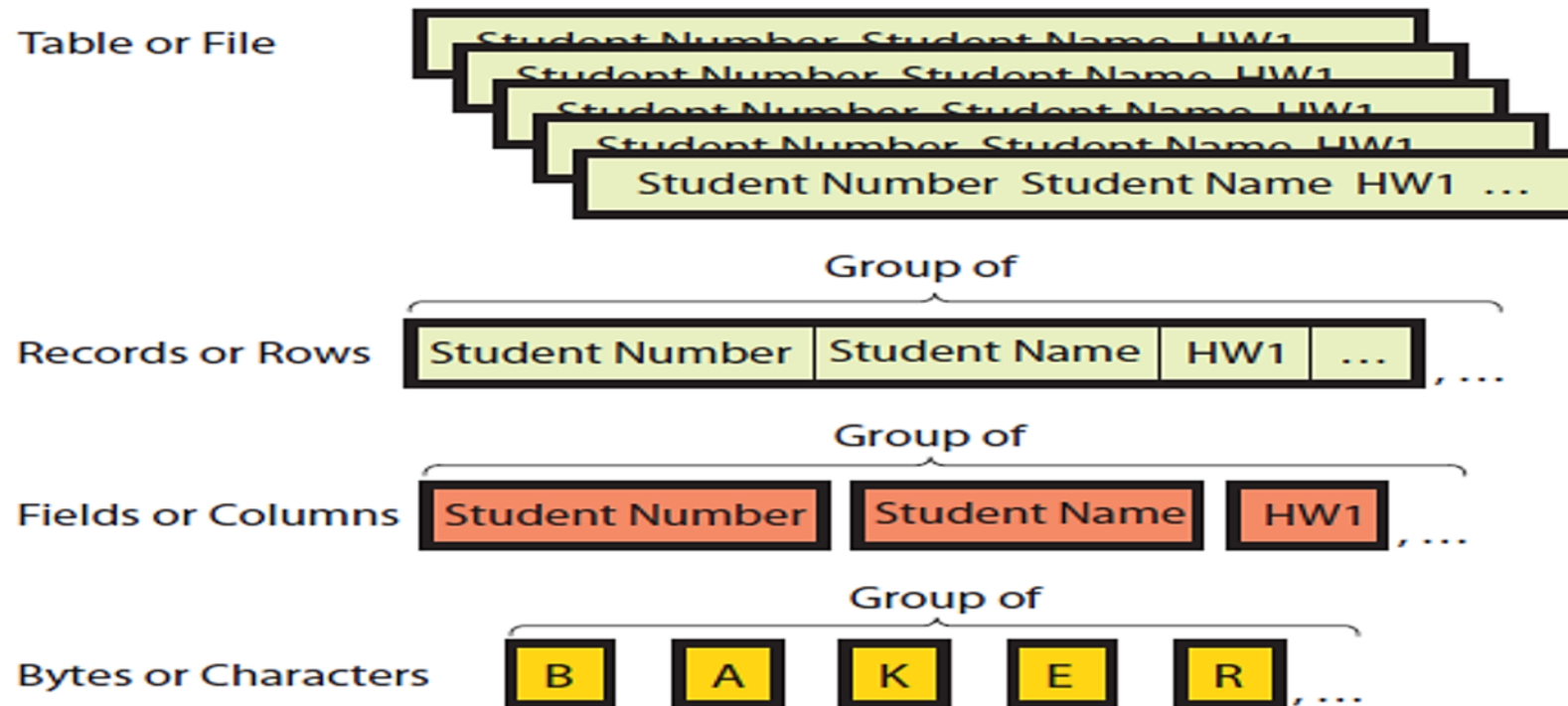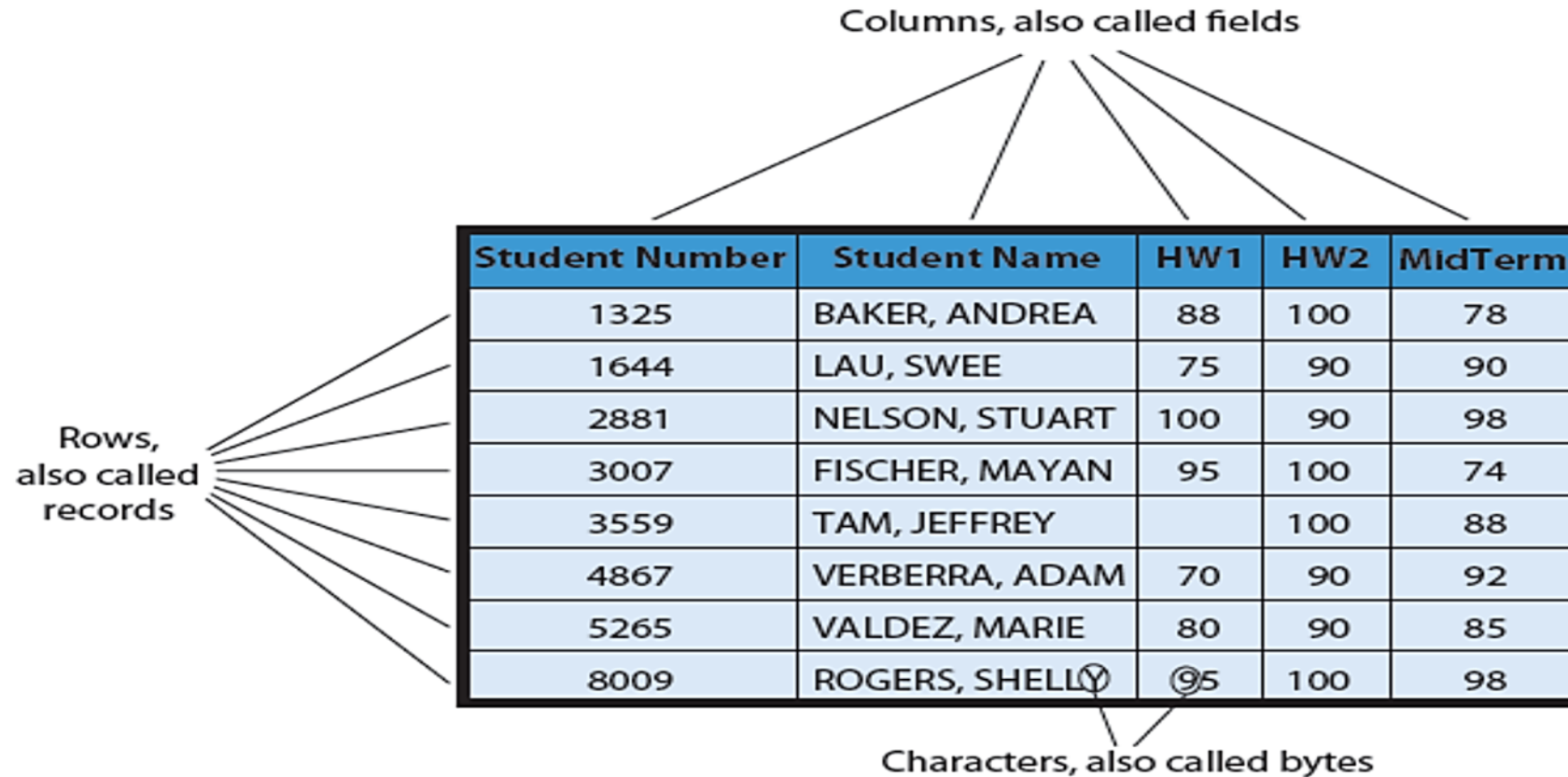
Components of a Database

Tables or Files
+
Relationships
Among
Rows in Tables
+
Metadata

= Database
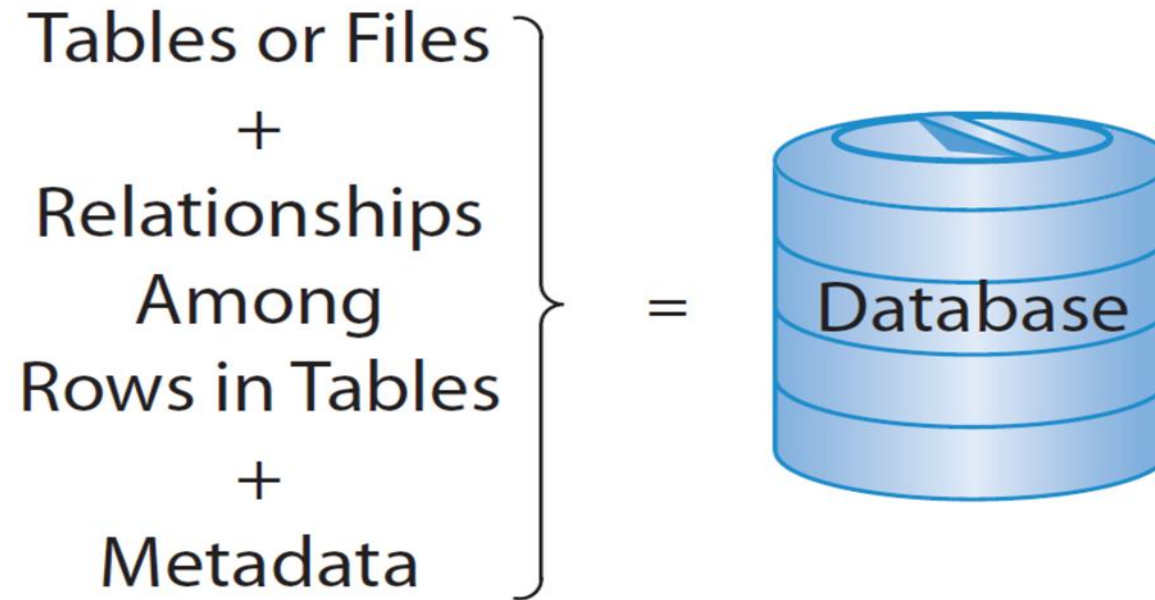
Example of Relationships Among Rows

Email Table

EmailNum	Date	Message	Student Number
1	2/1/2013	For homework 1, do you want us to provide notes on our references?	(1325)
2	3/15/2013	My group consists of Swee Lau and Stuart Nelson.	(1325)
3	3/15/2013	Could you please assign me to a group?	1644

Student Table

Student Number	Student Name	HW1	HW2	MidTerm
(1325)	BAKER, ANDREA	88	100	78
1644	LAU, SWEE	75	90	90
2881	NELSON, STUART	100	90	98
3007	FISCHER, MAYAN	95	100	74
3559	TAM, JEFFREY		100	88
(4867)	VERBERRA, ADAM	70	90	92
5265	VALDEZ, MARIE	80	90	85
8009	ROGERS, SHELLY	95	100	98

Office_Visit Table

VisitID	Date	Notes	Student Number
2	2/13/2013	Andrea had questions about using IS for raising barriers to entry.	1325
3	2/17/2013	Jeffrey is considering an IS major. Wanted to talk about career opportunities.	3559
4	2/17/2013	Adam will miss class Friday due to job conflict.	(4867)

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Sample Metadata (in Access)

Database Basics—Forms, Queries, and Reports

- Form
  - Allows user to enter data and display information
- Query
  - Retrieves specific data from one or more tables
- Report
  - Displays the data from a table or a query

Compare the Four Types of Databases

A Database for Every Purpose—Flat Databases

- Simplest type

- Consists of a single list of items

- Can be a list or a table in a document or spreadsheet
  - Shopping list
  - To-do list

A Database for Every Purpose—Relational Databases

- Most common type
- Multiple tables or relations
- Related by common information
- Reduces data redundancy

A Database for Every Purpose—Relational Databases

- Types of relationships
  - One-to-many—single record in one table links to multiple records in another table
  - One-to-one—single record in one table links to a single record in another table
  - Many-to-many—multiple records in one table can link to multiple records in another table

A Database for Every Purpose—Multidimensional Databases

- Optimized for storing and utilizing data
- Can be created using input from existing relational databases
- Structure information as multidimensional data cubes
- Data warehouse
  - Central repository for all data that an enterprise uses

DATA SOURCES   DATA WAREHOUSE   USER ANALYSIS

A Database for Every Purpose—Multidimensional Databases

- Data mining
  - Discovering relationships between data items
- Online analytical processing (OLAP)
  - Enables users to selectively extract and view data from different points of view

Explain Database Management Systems

What Is a Database Management System (DBMS)?

- Program used to create, process, and administer a database

- Licensed from vendors such as IBM, Microsoft, Oracle, and others

- **DB2** from IBM, **Access** and **SQL Server** from Microsoft, **Oracle Database** from Oracle Corporation

- **MySQL -** open source, license-free for most applications

The Tools of the Trade—Creating a Database What Is a Database Management System (DBMS)?

- A database management system is used to create and manage data in a database

  – Microsoft Access

  – MySQL

  – Microsoft SQL Server

  – Oracle

  – FileMaker Pro

The Tools of the Trade—Creating a Database

- Data dictionary
  - Defines data fields and types of data
  - Data type—the kind of data to enter into a field

The Tools of the Trade—Creating a Database

- Data normalization
  - Reduces data redundancy
  - Reduces the size of the database
  - Easier to keep records up-to-date
  - Increases query speed

The Tools of the Trade—Data Validation

- Reduces data entry errors

- Prevents user from entering wrong type of information

The Tools of the Trade—Structured Query Language (SQL)

- A query language is used to ask questions in a database

- Structured Query Language (SQL) is used in most DBMSs today

- SQL statements use relational keywords
    - SELECT
    - WHERE
    - FROM
    - AND


```
Expenses Query

SELECT Expenses.Vehicle, Expenses.[Service Description], Expenses.Cost
FROM Expenses
WHERE (((Expenses.Vehicle)=1));
```

The Tools of the Trade—Output

Discuss Important Types of Information Systems

Data In … Information Out—Office Support Systems (OSS)

- Also called office automation systems

- Software and hardware that improve productivity of employees

- Automate common tasks

- Microsoft Office

Data In … Information Out—Transaction Processing Systems (TPS)

- Link multiple operations that make up a transaction
- Ensures all operations in transactions are completed without error
- Must pass the ACID test
  - Atomicity
  - Consistency
  - Isolation
  - Durability
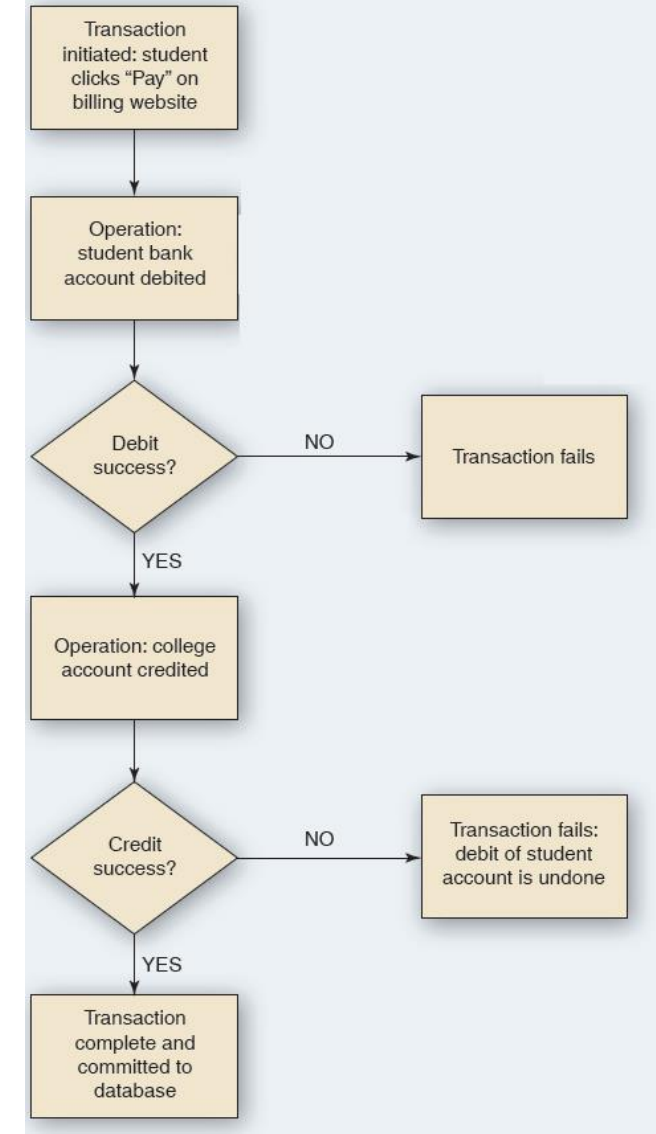
Data In … Information Out—Blockchain

- Decentralized electronic database of digital currency transactions

- Spread across a peer-to-peer network

- Future blockchain applications
  - Finance
  - Healthcare
  - Other industries

Data In … Information Out—Management Information Systems (MIS)

- Include:

  – Software and hardware

  – Data resources

  – Decision support systems

  – People

  – Project management applications

- Generate reports and create "what if" simulations

Data In … Information Out—Decision Support Systems (DSS)

- Help make decisions when there is uncertainty about outcomes

- Example: local business wanting to expand

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Data In … Information Out—Business Intelligence (BI) and Big Data

- People, hardware, and software that support data-intensive applications

- Data mining and warehousing

- OLAP

- DSSs

- Big data
  – The collection of large amounts of data from multiple sources

STATISTICS
DEMOGRAPHICS
CONSUMER HABITS TRENDS
STRATEGIC PLANNING
DEVELOPMENT

BIG DATA

Data In … Information Out—Expert Systems and Artificial Intelligence

- Artificial intelligence
  - Concerned with making computers behave like humans
- Expert system
  - Programmed to make decisions in real-life situations
  - Knowledge base: expert knowledge
  - Inference engine: set of rules

List Examples of Databases Used in Law Enforcement and Research

Real-World Databases—Law Enforcement

- Integrated Automated Fingerprint Identification System (IAFIS)
  - Largest criminal and civil biometric database
  - Maintained by FBI
  - Used by local and federal law enforcement
  - Fingerprints, mug shots, criminal histories, physical characteristics

Real-World Databases—Law Enforcement

- Combined DNA Index System (CODIS)
  - Contains DNA profiles
  - Five indices
    - Forensic
    - Arrestee
    - Detainee
    - Offender
    - Missing Persons
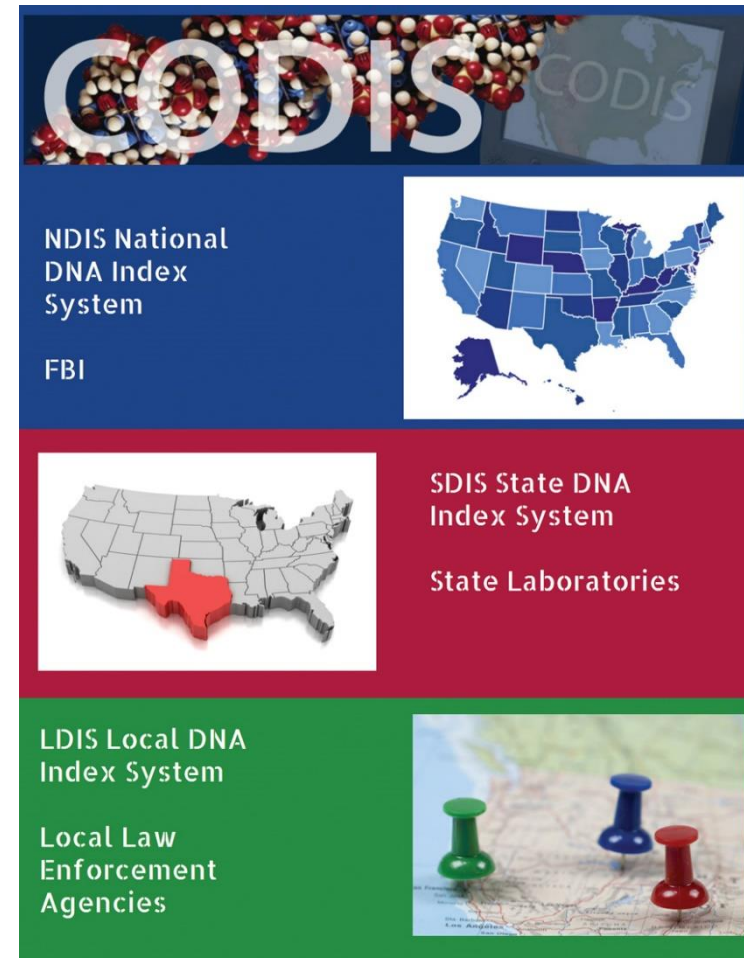
Real-World Databases—Science

- Human Genome Project (HGP)
  - U.S. Department of Energy
  - National Institutes of Health
  - Ran from 1990 to 2003
  - Data is used for:
    - New technologies
    - Agriculture
    - Energy production
    - Environmental science
    - Medical research

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Real-World Databases—Science

- Geographic Information Systems (GIS)
  - Combine layers of geographical reference information about the Earth's surface

Real-World Databases—Science

- Geographic Information Systems (GIS)
  - National Map has eight primary layers
    - Aerial photographs
    - Elevation
    - Geographic names
    - Hydrography
    - Boundaries
    - Transportation
    - Structures
    - Land cover

A Database for Every Purpose—Object-Oriented Databases

- Data stored as objects
- Used by modern programming languages
  - C++
  - Java
- Used for more complicated types of data
  - Images
  - Video
  - Audio

Questions

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