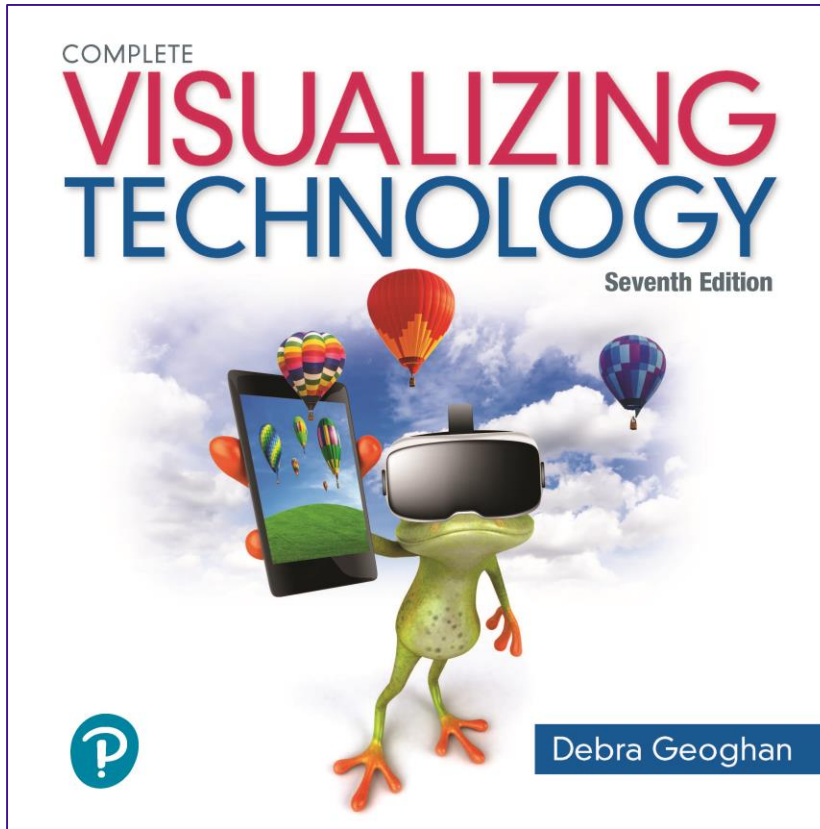


# Introductory Visualizing Technology

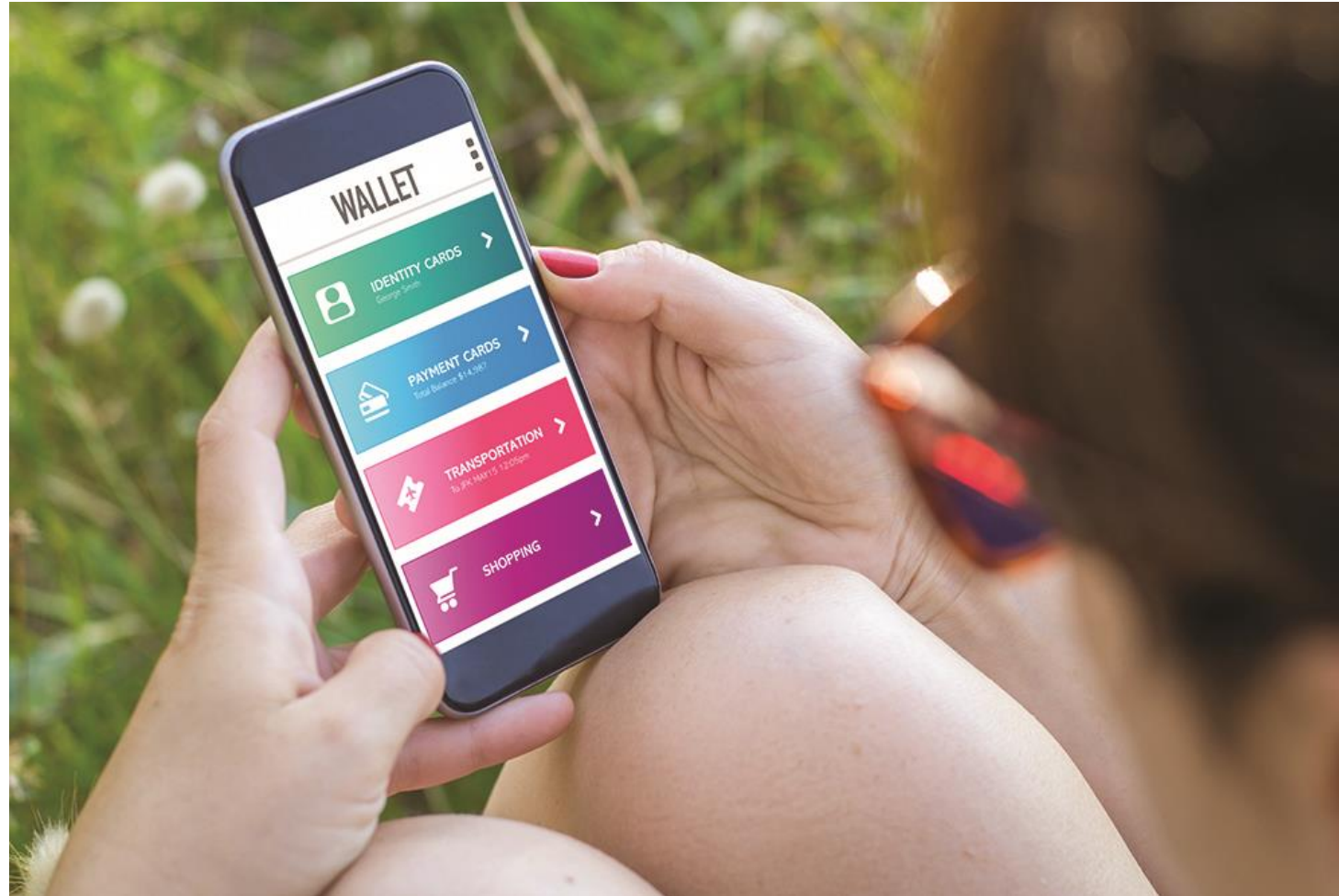
Seventh Edition



## Chapter 11

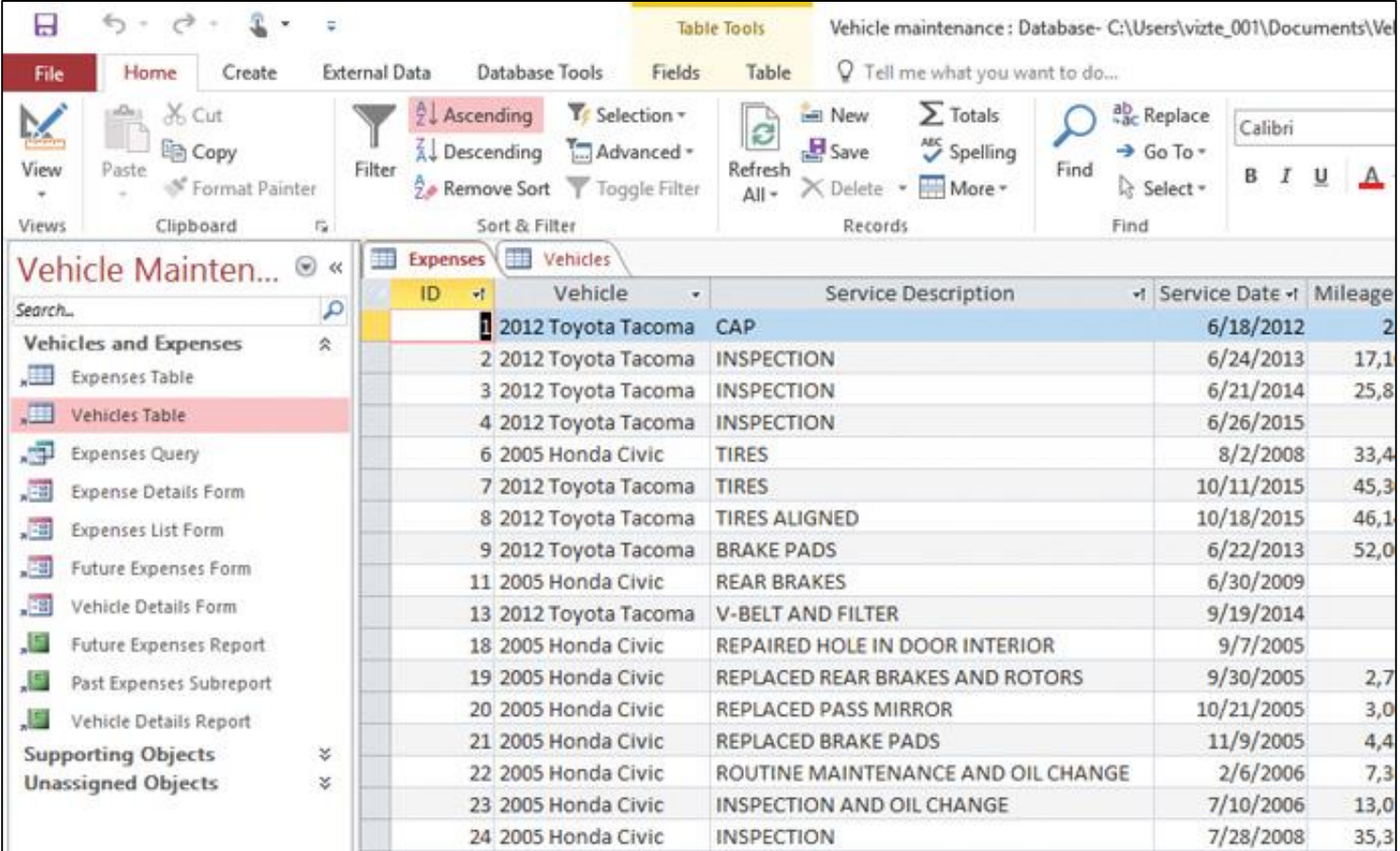
Databases

# 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



Vehicle maintenance : Database- C:\Users\vizte\_001\Documents\Ve

File Home Create External Data Database Tools Fields Table Tell me what you want to do...

View Paste Cut Copy Format Painter Filter Sort & Filter Ascending Descending Remove Sort Selection Advanced Toggle Filter Refresh All New Save Delete Records Replace Go To Find

Vehicle Mainten... Search...

Vehicles and Expenses

- Expenses Table
- Vehicles Table**
- Expenses Query
- Expense Details Form
- Expenses List Form
- Future Expenses Form
- Vehicle Details Form
- Future Expenses Report
- Past Expenses Subreport
- Vehicle Details Report

Supporting Objects

Unassigned Objects

ID	Vehicle	Service Description	Service Date	Mileage
1	2012 Toyota Tacoma	CAP	6/18/2012	2
2	2012 Toyota Tacoma	INSPECTION	6/24/2013	17,1
3	2012 Toyota Tacoma	INSPECTION	6/21/2014	25,8
4	2012 Toyota Tacoma	INSPECTION	6/26/2015	
6	2005 Honda Civic	TIRES	8/2/2008	33,4
7	2012 Toyota Tacoma	TIRES	10/11/2015	45,3
8	2012 Toyota Tacoma	TIRES ALIGNED	10/18/2015	46,1
9	2012 Toyota Tacoma	BRAKE PADS	6/22/2013	52,0
11	2005 Honda Civic	REAR BRAKES	6/30/2009	
13	2012 Toyota Tacoma	V-BELT AND FILTER	9/19/2014	
18	2005 Honda Civic	REPAIRED HOLE IN DOOR INTERIOR	9/7/2005	
19	2005 Honda Civic	REPLACED REAR BRAKES AND ROTORS	9/30/2005	2,7
20	2005 Honda Civic	REPLACED PASS MIRROR	10/21/2005	3,0
21	2005 Honda Civic	REPLACED BRAKE PADS	11/9/2005	4,4
22	2005 Honda Civic	ROUTINE MAINTENANCE AND OIL CHANGE	2/6/2006	7,3
23	2005 Honda Civic	INSPECTION AND OIL CHANGE	7/10/2006	13,0
24	2005 Honda Civic	INSPECTION	7/28/2008	35,3

# 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

UMIS Chapter 5 Student Grades - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW Team David Kroenke

Paste Font Alignment Number Styles Cells Editing

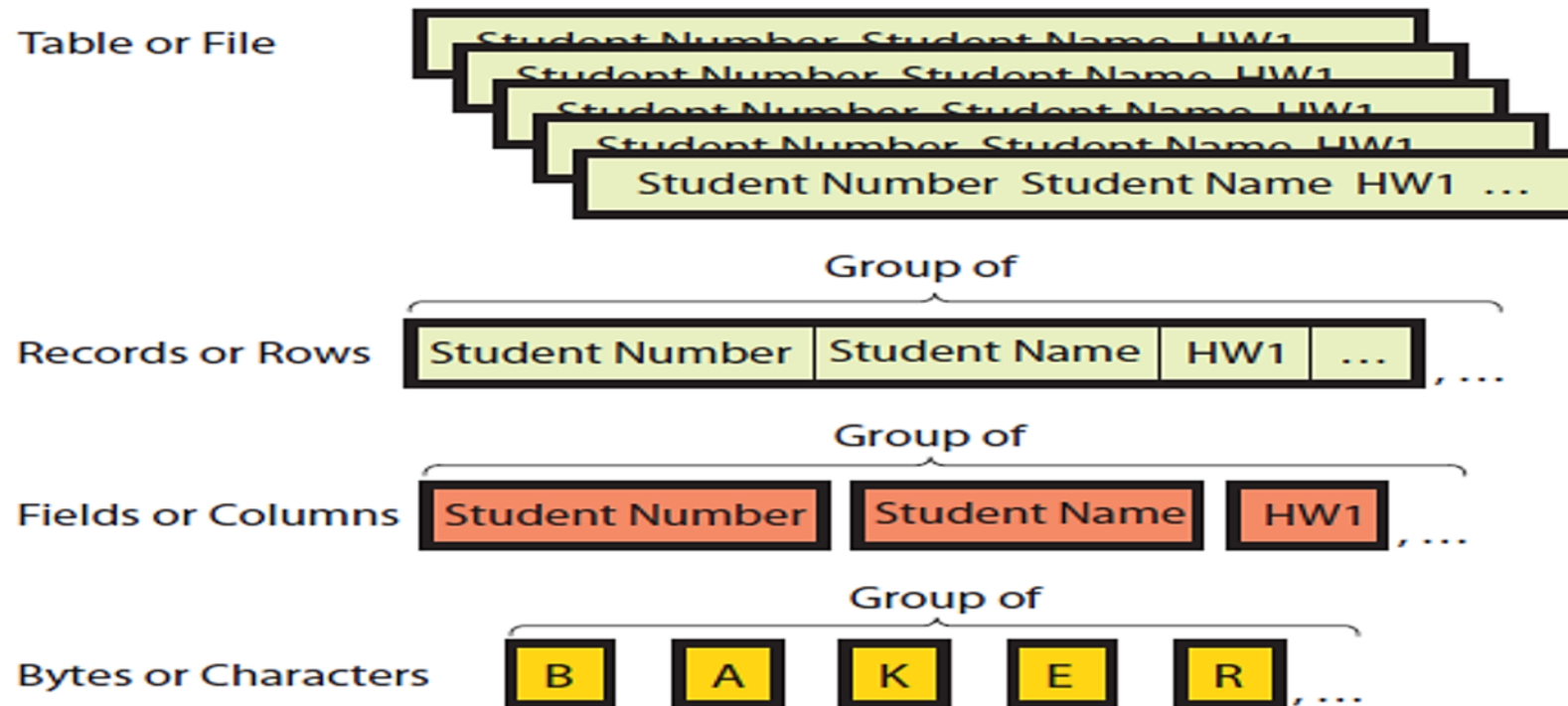
K1

	A	B	C	D	E	F	G	H
1	Student Name	Student Number	HW1	HW2	MidTerm	HW3	HW4	Final
2								
3	BAKER, ANDREA	1325	88	100	78			
4	FISCHER, MAYAN	3007	95	100	74			
5	LAU, SWEE	1644	75	90	90			
6	NELSON, STUART	2881	100	90	98			
7	ROGERS, SHELLY	8009	95	100	98			
8	TAM, JEFFREY	3559		100	88			
9	VALDEZ, MARIE	5265	80	90	85			
10	VERBERRA, ADAM	4867	70	90	92			
11								

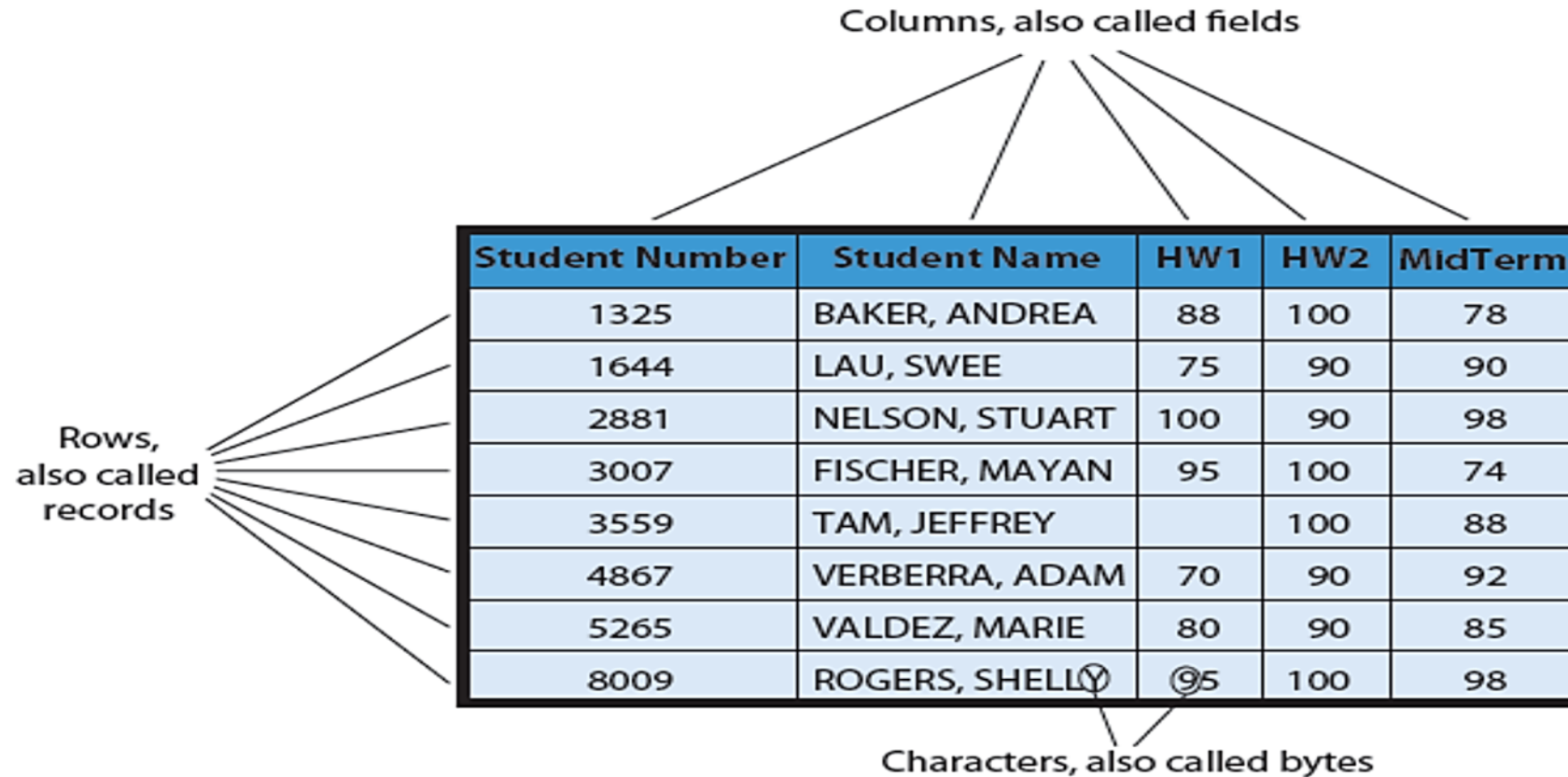
Sheet1 Sheet2 Sheet3

READY 100%

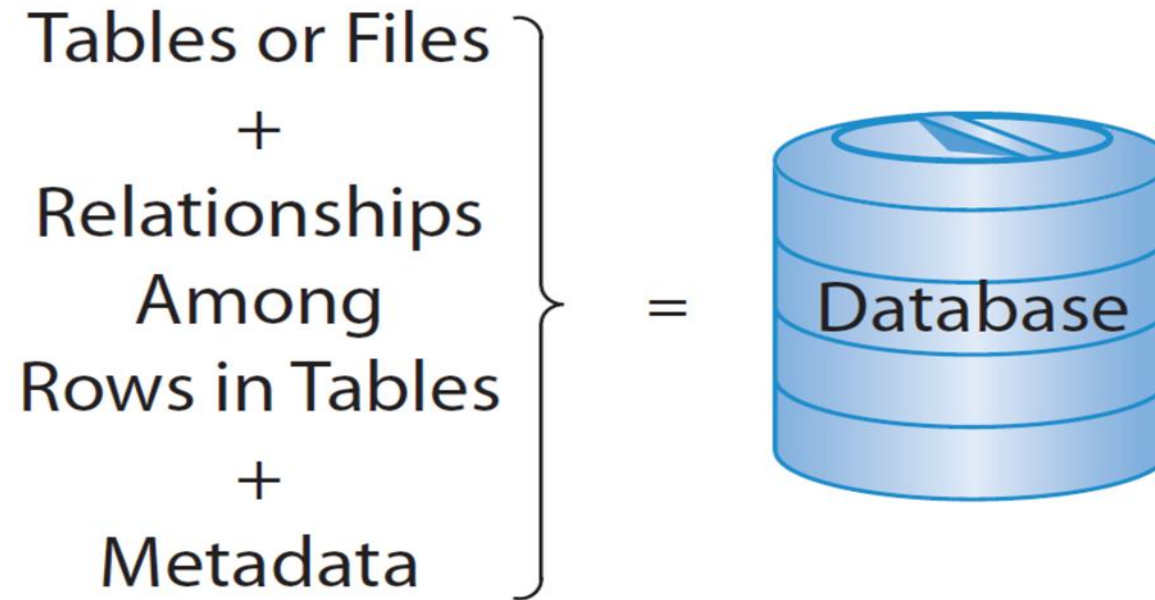
# Hierarchy of Data Elements



# What Is a Database?



# Components of a 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

# Sample Metadata (in Access)

EMAIL

Field Name	Data Type	Description (Optional)
EmailNum	AutoNumber	Primary key -- values provided by Access
Date	Date/Time	Date and time the message is recorded
Message	Long Text	Text of the email
Student Number	Number	Foreign key to row in the Student Table

Field Properties

General Lookup


Format	Short Date
Input Mask	99/99/0000;0;#
Caption	
Default Value	=Now()
Validation Rule	
Validation Text	
Required	Yes
Indexed	No
IME Mode	No Control
IME Sentence Mode	None
Text Align	General
Show Date Picker	For dates

A field name can be up to 64 characters long, including spaces. Press F1 for help on field names.

# 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

The screenshot shows a web application window titled 'Vehicle Details'. The main heading is '2012 Toyota Tacoma'. Below the heading are three buttons: 'Save and New', 'Print Vehicle Details', and 'Print Future Expenses', followed by a 'Close' button. The form has three tabs: 'Vehicle' (selected), 'Past Expenses', and 'Future Expenses'. Under the 'Vehicle' tab, there are several input fields: 'Year' (2012), 'Make' (Toyota), 'Model' (Tacoma), 'Color' (Black), 'License Plate Number' (WR9030E), and 'VIN Number' (1FTRX18W93NB11431). To the right of these fields is a photograph of a dark blue Toyota Tacoma. Below the photograph are fields for 'Purchase Date' (7/15/2012), 'Purchase Price' (\$35,068.85), and 'Purchase Mileage' (5,094). To the right of these are fields for 'Sold Date', 'Sold Price', and 'Sold Mileage'. At the bottom of the form is a 'Notes' section with the text 'Joe'. The footer of the window shows 'Record: 1 of 5', 'No Filter', and a 'Search' button.

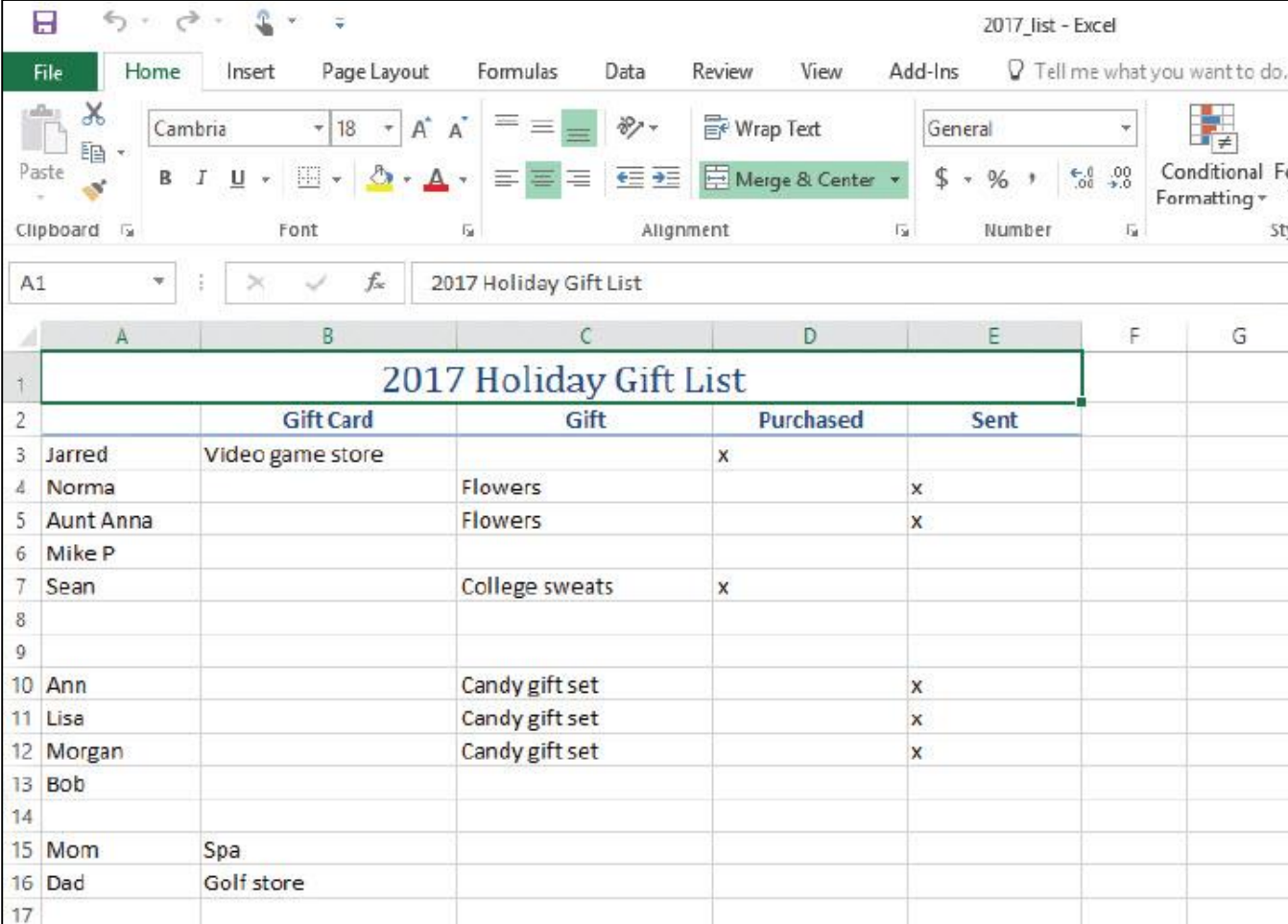
Vehicle Details			
2012 Toyota Tacoma			
<a href="#">Save and New</a> <a href="#">Print Vehicle Details</a> <a href="#">Print Future Expenses</a> <a href="#">Close</a>			
Vehicle   Past Expenses   Future Expenses			
Year	2012		
Make	Toyota		
Model	Tacoma		
Color	Black		
License Plate Number	WR9030E		
VIN Number	1FTRX18W93NB11431		
			
Purchase Date	7/15/2012	Sold Date	
Purchase Price	\$35,068.85	Sold Price	
Purchase Mileage	5,094	Sold Mileage	
Notes Joe			
Record: 1 of 5   No Filter   Search			

# 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



The screenshot shows an Excel spreadsheet titled "2017 Holiday Gift List". The spreadsheet is organized into columns: A (Name), B (Gift Card), C (Gift), D (Purchased), and E (Sent). The data is as follows:

	A	B	C	D	E
1	2017 Holiday Gift List				
2		Gift Card	Gift	Purchased	Sent
3	Jarred	Video game store		x	
4	Norma		Flowers		x
5	Aunt Anna		Flowers		x
6	Mike P				
7	Sean		College sweats	x	
8					
9					
10	Ann		Candy gift set		x
11	Lisa		Candy gift set		x
12	Morgan		Candy gift set		x
13	Bob				
14					
15	Mom	Spa			
16	Dad	Golf store			
17					

# A Database for Every Purpose—Relational Databases

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

Expenses		Vehicles						
	ID	Make	Model	Year	Color	Notes	Purchase Date	Purchase Price
	1	Toyota	Tacoma	2012	Black	Joe	7/15/2012	\$35,000
+	3	Honda	Civic	2005	Silver	Mike	8/11/2005	\$22,000
+	4	Ford	Taurus	2012	Blue	Joe	4/5/2015	\$9,000
+	5	Honda	Accord	2016	White	Bailey	9/2/2016	\$31,000
+	6	Mazda	CX-7	2012	Black	Mike	7/3/2011	\$17,000
+	11			2017				
*	(New)							

Expenses		Vehicles		
ID	Vehicle	Service Description	Service Date	Mileage
1	2012 Toyota Tacoma	CAP	6/18/2012	250
2	2012 Toyota Tacoma	INSPECTION	6/24/2013	17,108
3	2012 Toyota Tacoma	INSPECTION	6/21/2014	25,831
4	2012 Toyota Tacoma	INSPECTION	6/26/2015	
6	2005 Honda Civic	TIRES	8/2/2008	33,448
7	2012 Toyota Tacoma	TIRES	10/11/2015	45,301
8	2012 Toyota Tacoma	TIRES ALIGNED	10/18/2015	46,147
9	2012 Toyota Tacoma	BRAKE PADS	6/22/2013	52,000
11	2005 Honda Civic	REAR BRAKES	6/30/2009	
13	2012 Toyota Tacoma	V-BELT AND FILTER	9/19/2014	
18	2005 Honda Civic	REPAIRED HOLE IN DOOR INTERIOR	9/7/2005	
19	2005 Honda Civic	REPLACED REAR BRAKES AND ROTORS	9/30/2005	2,777
20	2005 Honda Civic	REPLACED PASS MIRROR	10/21/2005	3,000
21	2005 Honda Civic	REPLACED BRAKE PADS	11/9/2005	4,417

# 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



# 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 screenshot displays the Microsoft Access interface. At the top, the 'Expenses' table structure is shown with the following fields and data types:

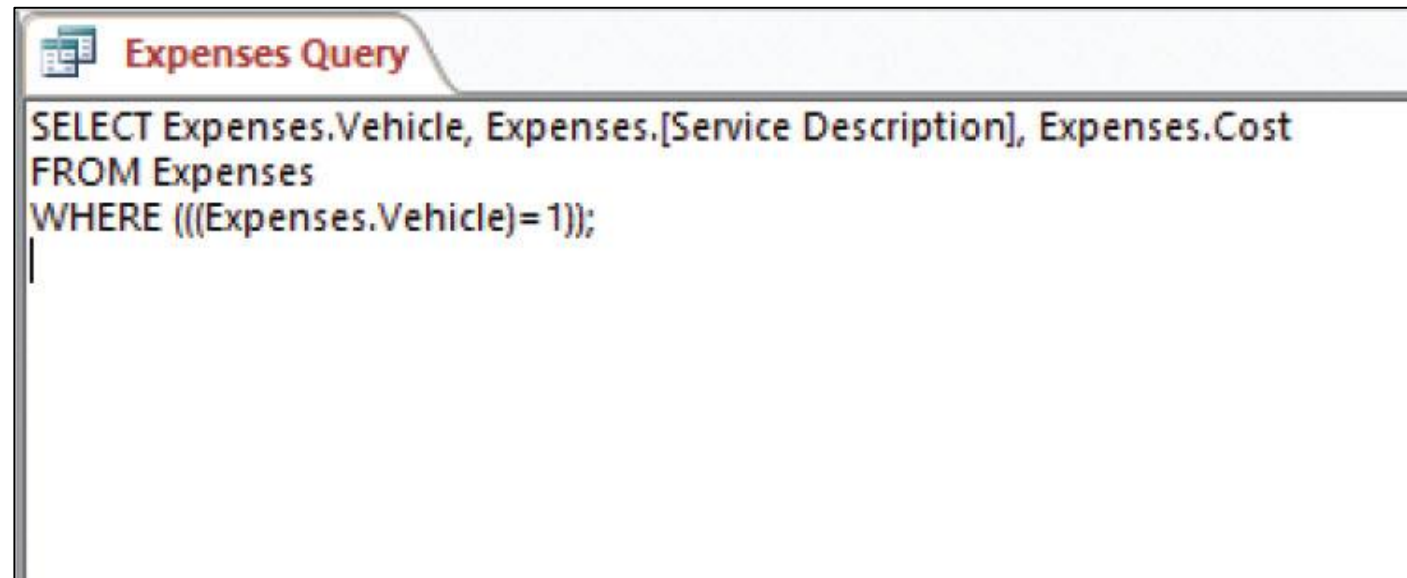
Field Name	Data Type
ID	AutoNumber
Vehicle	Number
Service Description	Short Text
Service Date	Date/Time
Mileage	Number
Expense Type	Short Text
Cost	Currency
Shop	Short Text
Invoice Number	Short Text
Warranty Number	Short Text
Notes	Long Text
Attachment	Attachment

Below the table structure, the 'Service Date' field's properties are shown in the 'General' tab:

Property	Value
Format	
Input Mask	
Caption	
Default Value	
Validation Rule	>=#1/1/1900#
Validation Text	Value must be greater than 1/1/1900.
Required	No
Indexed	No
IME Mode	Off
IME Sentence Mode	None
Text Align	General
Show Date Picker	For dates

# 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



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

# The Tools of the Trade—Output

Future Expenses Report				
Future Expenses Report				
Sunday, September 6, 2015				
Vehicle Name	Make	Model	Year	License Plate Number
<a href="#">2012 Toyota Tacoma</a>	Toyota	Tacoma	2012	WR9030E
<u>Service Description</u>				<u>Estimate</u>
<a href="#">OIL CHANGE</a>				\$60.00
Total Estimate:				\$60.00
<a href="#">2016 Honda Accord</a>	Honda	Accord	2016	HGL-114
<u>Service Description</u>				<u>Estimate</u>
<a href="#">OILCHANGE</a>				\$40.00
<a href="#">INSPECTION</a>				\$80.00
Total Estimate:				\$120.00
<a href="#">2012 Mazda CX-7</a>	Mazda	CX-7	2012	DFS-5249
<u>Service Description</u>				<u>Estimate</u>
<a href="#">OIL CHANGE AND TIRES ROTATE</a>				\$0.00
Total Estimate:				\$0.00

# Discuss Important Types of Information Systems

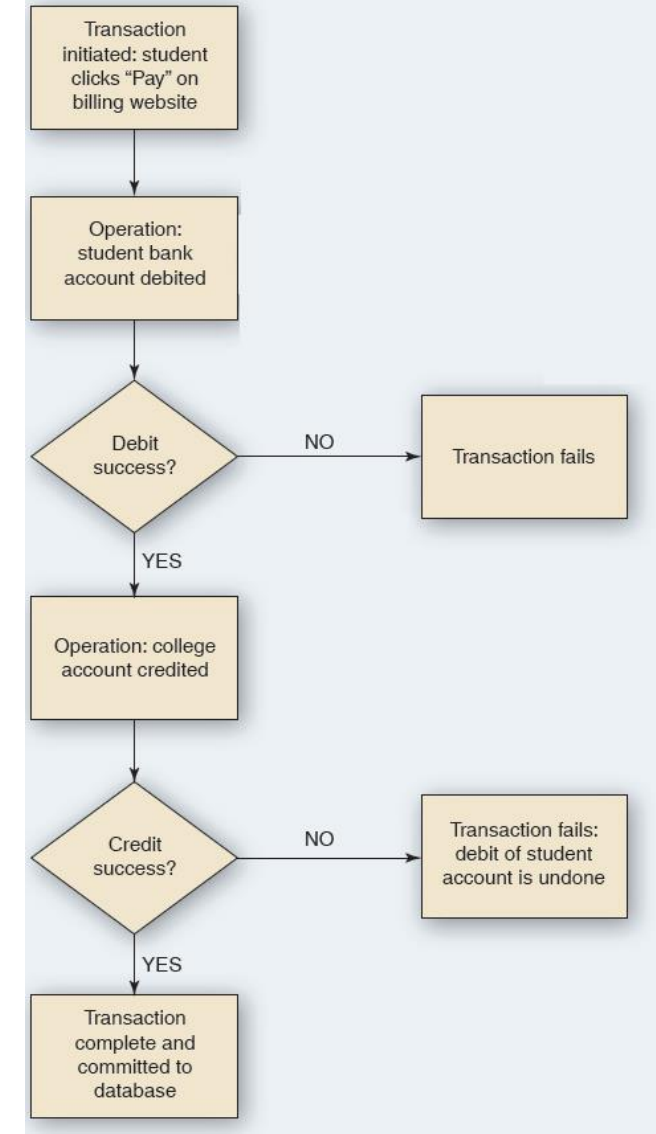


# Data In ... Information Out—Office Support Systems (OSS)

- 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

# 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



# 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



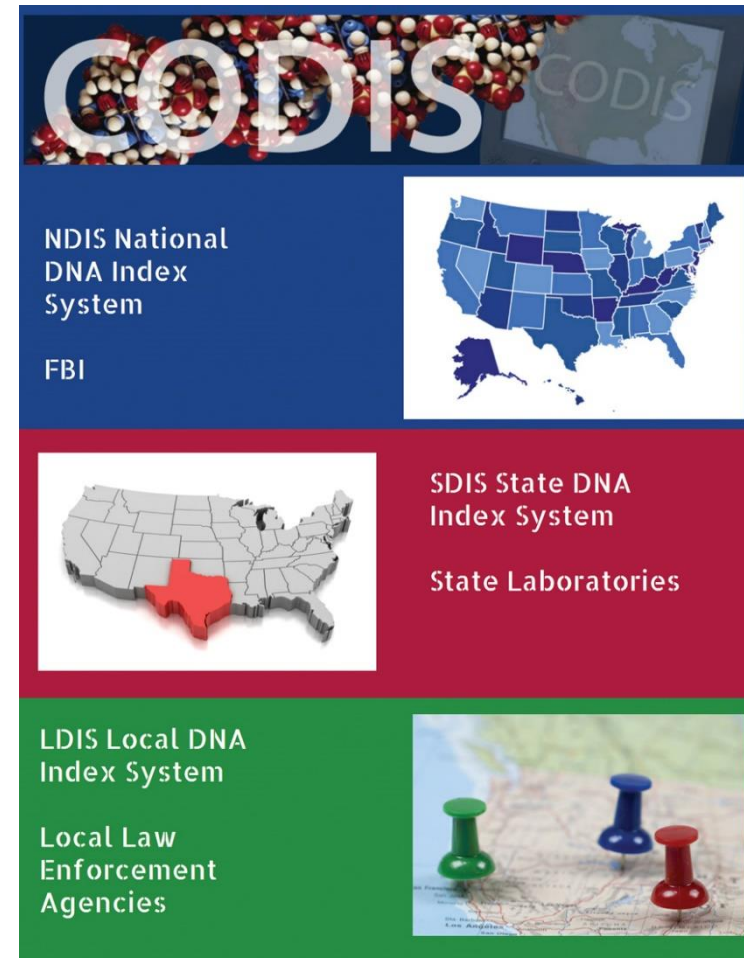
# Real-World Databases—Law Enforcement

- 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



# 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



# Copyright

