


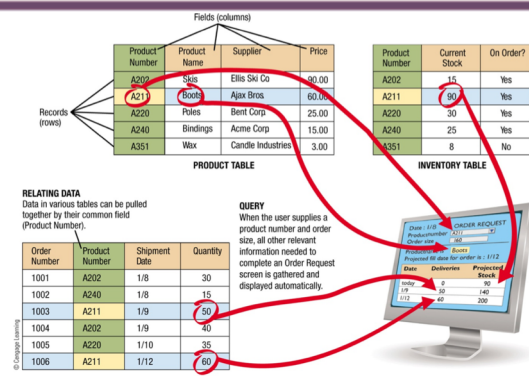
Databases



- ❖ **Database** – A collection of related data stored in a manner so it can be retrieved as needed
- ❖ **Database Management System**
 - ◆ Software that organizes data for fast and easy access (**DBMS**)
 - ◆ Used to create, maintain, and access databases
- ❖ Phone books, file cabinets, and index cards are non-computer versions of a database

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What is a Database?



PRODUCT TABLE

| Product Number | Product Name | Supplier | Price |
|----------------|--------------|-------------------|-------|
| A202 | Ski | Ellis Ski Co | 50.00 |
| A211 | Book | Alma Bros | 60.00 |
| A220 | Poles | Bent Corp | 25.00 |
| A240 | Bindings | Acme Corp | 15.00 |
| A351 | Wax | Candle Industries | 3.00 |

INVENTORY TABLE

| Product Number | Current Stock | On Order? |
|----------------|---------------|-----------|
| A202 | 15 | Yes |
| A211 | 90 | Yes |
| A220 | 30 | Yes |
| A240 | 25 | Yes |
| A351 | 8 | No |

RELATING DATA
Data in various tables can be pulled together by their common field (Product Number).

QUERY
When the user supplies a product number and order size, all other relevant information needed to complete an Order Request screen is gathered and displayed automatically.

INVENTORY ON ORDER TABLE

| Order Number | Product Number | Shipment Date | Quantity |
|--------------|----------------|---------------|----------|
| 1001 | A202 | 1/8 | 30 |
| 1002 | A240 | 1/8 | 15 |
| 1003 | A211 | 1/9 | 50 |
| 1004 | A202 | 1/9 | 40 |
| 1005 | A220 | 1/10 | 35 |
| 1006 | A211 | 1/12 | 60 |

ORDER REQUEST SCREEN

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Evolution of Databases

| MODEL | FLAT FILES | HIERARCHICAL | NETWORK | RELATIONAL | OBJECT-ORIENTED | MULTI-DIMENSIONAL |
|-------------------------------------|------------------|--|--|---------------------------------------|--|--|
| YEAR BEGAN | 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 |

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Database Provides Information

- ❖ Information created from data
 - ◆ Timely relevant information key to decision making
 - ◆ Good decision making key to organization survival
- ❖ Database Management System (DBMS)
 - ◆ Manages database structure -- tables and relationships
 - ◆ Controls access to data -- Security
 - ◆ Contains query language -- SQL
- ❖ Relational DBMS advantages
 - ◆ Integrated data (All items accessible)
 - ◆ Integrity (Accurate, up to date, no duplication)
 - ◆ Reduced redundancy (Enter data once)
 - ◆ User Security Level Access
 - ◆ Easy Data Archive

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A Database Table

- ❖ Columns are the **fields**
- ❖ Rows are the **records**

| EMP_NUM | EMP_LNAME | EMP_FNAME | EMP_INITIAL | JOB_CODE |
|---------|------------|-----------|-------------|----------|
| 101 | News | John | G | 502 |
| 102 | Senior | David | H | 501 |
| 103 | Abough | June | E | 503 |
| 104 | Ranoras | Anne | K | 501 |
| 105 | Johnson | Alice | K | 502 |
| 106 | Smithfield | William | | 504 |
| 125 | Laurie | Robert | M | 504 |

Data Items

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Relational DB Model Data Structure

- ❖ **Data Value** (Cell), Characters in textbook
 - ◆ Contents of a field contained in a record
 - ◆ “Raw Facts” that can be recognized
- ❖ **Field** or Attribute (Column)
 - ◆ Group of characters representing something with same data format
- ❖ **Record** or Entity or Tuple (Row)
 - ◆ Collection of related fields
- ❖ **Table** or Entity Set (File)
 - ◆ Collection of related records and fields
 - ◆ Ordering of Columns and Rows is immaterial

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Field Name and Data Type

- ❖ Each Field must have a unique name.
LastName **FirstName** **HomeAddress**
PhoneNum **CustID** **AgentCode**
- ❖ Fields may contain one of four data types:
 - ◆ **Character** = descriptive data (text).
 - ◆ **Numeric** = numbers used for calculation
 - ◆ **Date** = Month Day Year and/or time
 - ◆ **Logic** = T/F, Y/N, Checked/Unchecked
- ❖ Field width determines the maximum number of characters or digits to be contained in the field

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Creating a Database

- ❖ Design Database Table Field Structure
 - ◆ Field Names
 - ◆ Field Types (Character, Numbers, Logical)
 - ◆ Field Widths (Max Characters for Entry)
 - ◆ Unique Primary Key Field (For Query Use)
- ❖ Link Tables using **Relationships**
 - ◆ Primary Key fields must be unique
 - ◆ Foreign Key fields must join with primary key field data in another table
- ❖ Entering Data
 - ◆ Using Tables
 - ◆ Using Forms

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Designing Database Tables

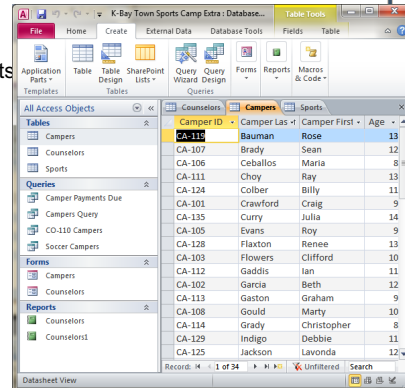
First create a paper sketch of the tables and the kind of data that will be put into each field

| Year-id | Description | Cost | Hours | Food | Walk | Stairs |
|---------|------------------|------|-------|------|------|--------|
| 14 | San Juan Islands | 25 | 3.5 | X | N | N |

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MS Access Navigation

- ❖ **Access Objects**
Provides interface to database components
 - ♦ **Tables**
Containers for data
 - ♦ **Forms**
Input one record
 - ♦ **Reports**
Information output
 - ♦ **Queries**
Ask?



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Table Design View

Design Field Structure

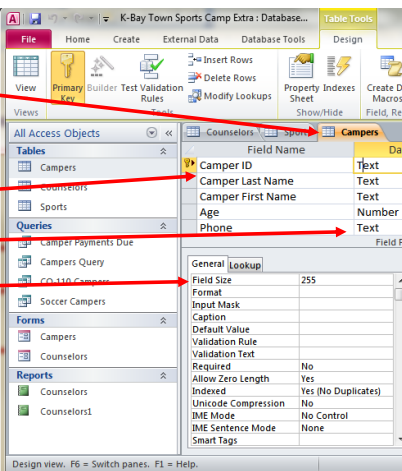
Table Name: Campers

Field Name: Camper ID, Camper Last Name, Camper First Name, Age, Phone

Data Types: Text, Text, Text, Number, Text

Field Width: 255

Data Dictionary:
Contains data about each file in database and each field within those files



Design view: F6 = Switch panes. F1 = Help.

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The Hierarchy of Data

- ❖ **What are common data types?**
 - Text**
also called alphanumeric—letters, numbers, or special characters
 - Numeric**
numbers only Integer, floating point
 - AutoNumber**
unique number automatically assigned to each new record
 - Currency**
dollar and cent amounts or numbers containing decimal values
 - Date**
month, day, year, and sometimes time
 - Memo**
lengthy text entries
 - Yes/No**
(also called Boolean)—only the values Yes or No (or T/F)
 - Hyperlink**
Web address that links to document or Web page
 - Object**
(also called BLOB for binary large object)—photograph, audio, video, or document

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IFSM201: Slide Set 3 - Databases

Key Fields

- ❖ A **key field** is determines table relationships
 - ◆ A Key field determines all other fields in a record
- ❖ **Primary Key Field**
 - ◆ Uniquely identifies all other fields in a record
 - ◆ The One side of a 1 to Many Relationship
- ❖ **Foreign key**
 - ◆ Field that links records in table to records in another table
 - ◆ The Many side of a 1 to Many Relationship

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Enter Data into Tables or Forms

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Data and Information

- ❖ What is data integrity?
 - ◆ Degree to which data is correct
 - ◆ Garbage in, garbage out (GIGO)
 - ◆ Computer phrase that means you cannot create correct information from incorrect data

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Data Anomalies: Restaurant Owner Database

Enter Record data items into each Field of the Table

- ❖ Do you see any potential problems with this table?
 - ◆ Data Redundancy leads to Data Inconsistencies
 - ◆ Update Data Anomaly
 - ◆ Deletion Data Anomaly

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IFSM201: Slide Set 3 - Databases

Removing Data Redundancy

| RestaurantID | Address | City | Phone | TypeofService | VisaCard | OwnerFstName | OwnerLstName | OwnerPhone |
|--------------|-----------------|----------|-------------|-------------------------------------|----------|--------------|----------------|------------|
| R0001 | 2345 SW Miam | (305) 44 | Table Serv | <input checked="" type="checkbox"/> | Jim | Antonucci | (305) 777-8888 | |
| R0002 | 3487 Mai Pens | (850) 88 | Table & Tak | <input type="checkbox"/> | Dottie | Balchunas | (850) 222-1111 | |
| R0003 | 89 Turnt Orlan | (407) 55 | Table Serv | <input checked="" type="checkbox"/> | Benjamin | Grauer | (407) 444-8888 | |
| R0004 | 4598 SW Miam | (305) 44 | Take-out | <input checked="" type="checkbox"/> | Jim | Antonucci | (305) 777-8888 | |
| R0005 | 9000 Bis Tallal | (904) 22 | Table & Tak | <input checked="" type="checkbox"/> | Steve | Spann | (561) 999-1199 | |
| R0006 | 2 State S Boca | (561) 44 | Take-out | <input type="checkbox"/> | Steve | Spann | (561) 999-1199 | |
| R0007 | 8990 SE Miam | (305) 78 | Table Serv | <input checked="" type="checkbox"/> | Jim | Antonucci | (305) 777-8888 | |
| R0008 | 298 W 75 Vero | (407) 22 | Table & Tak | <input checked="" type="checkbox"/> | Megan | Miller | (407) 333-0033 | |
| R0009 | 1000 Grr Gainv | (352) 66 | Take-out | <input type="checkbox"/> | Jessica | Kinzer | (352) 999-0044 | |
| R0010 | 6767 NW Miam | (305) 88 | Table Serv | <input checked="" type="checkbox"/> | Megan | Miller | (407) 333-0033 | |

1. Remove any duplicate records
2. Determine Primary Key Fields: RestaurantID
3. Normalize to remove non key data dependencies

| RestaurantID | Address | City | Phone | TypeofService | VisaCard | FranchiseeID |
|--------------|-----------------|----------|-------------|-------------------------------------|----------|--------------|
| R0001 | 2345 SW Miam | (305) 44 | Table Serv | <input checked="" type="checkbox"/> | Jim | Antonucci |
| R0002 | 3487 Mai Pens | (850) 88 | Table & Tak | <input type="checkbox"/> | Dottie | Balchunas |
| R0003 | 89 Turnt Orlan | (407) 55 | Table Serv | <input checked="" type="checkbox"/> | Benjamin | Grauer |
| R0004 | 4598 SW Miam | (305) 44 | Take-out | <input checked="" type="checkbox"/> | Jim | Antonucci |
| R0005 | 9000 Bis Tallal | (904) 22 | Table & Tak | <input checked="" type="checkbox"/> | Steve | Spann |
| R0006 | 2 State S Boca | (561) 44 | Take-out | <input type="checkbox"/> | Steve | Spann |
| R0007 | 8990 SE Miam | (305) 78 | Table Serv | <input checked="" type="checkbox"/> | Jim | Antonucci |
| R0008 | 298 W 75 Vero | (407) 22 | Table & Tak | <input checked="" type="checkbox"/> | Megan | Miller |
| R0009 | 1000 Grr Gainv | (352) 66 | Take-out | <input type="checkbox"/> | Jessica | Kinzer |
| R0010 | 6767 NW Miam | (305) 88 | Table Serv | <input checked="" type="checkbox"/> | Megan | Miller |

| OwnerID | OwnerFstName | OwnerLstName | OwnerPhone |
|---------|--------------|--------------|----------------|
| F001 | Jim | Antonucci | (305) 777-8888 |
| F002 | Dottie | Balchunas | (850) 222-1111 |
| F003 | Steve | Spann | (561) 999-1199 |
| F004 | Benjamin | Grauer | (407) 444-8888 |
| F005 | Megan | Miller | (407) 333-0033 |
| F006 | Jessica | Kinzer | (352) 999-0044 |
| F007 | Carlos | Portu | (305) 787-8778 |

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Making a Better Database

| RestaurantID | Address | City | Phone | TypeofService | VisaCard | FranchiseeID |
|--------------|----------------------------|----------------|---------------|-------------------------------------|----------|--------------|
| R0001 | 2345 SW 98 St Miami | (305) 444-8787 | Table Service | <input checked="" type="checkbox"/> | F001 | |
| R0002 | 3487 Main High Pensacola | (850) 886-5555 | Table & Take | <input type="checkbox"/> | F002 | |
| R0003 | 89 Turnberry Dri Orlando | (407) 555-9999 | Table Service | <input checked="" type="checkbox"/> | F004 | |
| R0004 | 4598 SW 136 S Miami | (305) 444-4444 | Take-out | <input checked="" type="checkbox"/> | F001 | |
| R0005 | 9000 Biscayne Tallahassee | (904) 222-1111 | Table & Take | <input checked="" type="checkbox"/> | F003 | |
| R0006 | 2 State Street Boca Raton | (561) 444-1100 | Take-out | <input type="checkbox"/> | F003 | |
| R0007 | 8990 SE 2 Awer Miami | (305) 787-7889 | Table Service | <input checked="" type="checkbox"/> | F001 | |
| R0008 | 298 W 75 Terrai Vero Beach | (407) 222-9999 | Table & Take | <input checked="" type="checkbox"/> | F005 | |
| R0009 | 1000 Grand Ave Gainesville | (352) 666-7788 | Take-out | <input type="checkbox"/> | F006 | |
| R0010 | 6767 NW 75 St Miami | (305) 887-8877 | Table Service | <input checked="" type="checkbox"/> | F005 | |

Primary Key: RestaurantID

Foreign Key: FranchiseeID

| OwnerID | OwnerFstName | OwnerLstName | OwnerPhone |
|---------|--------------|--------------|----------------|
| F001 | Jim | Antonucci | (305) 777-8888 |
| F002 | Dottie | Balchunas | (850) 222-1111 |
| F003 | Steve | Spann | (561) 999-1199 |
| F004 | Benjamin | Grauer | (407) 444-8888 |
| F005 | Megan | Miller | (407) 333-0033 |
| F006 | Jessica | Kinzer | (352) 999-0044 |
| F007 | Carlos | Portu | (305) 787-8778 |

Data Redundancy Eliminated

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Enforcing Referential Integrity

- ❖ Foreign key must match primary key values or be null value
- ❖ Impossible to delete row whose primary key has matching foreign key values in other table

Primary Key

Foreign Key

Employee

| EMP_NUM | EMP_LNAME | EMP_FNAME | EMP_INITIAL | JOB_CODE |
|---------|-----------|-----------|-------------|----------|
| 105 | Laurie | Robert | M | 504 |

Job

| JOB_CODE | JOB_DESCRIPTION | JOB_CHG_HOUR |
|----------|-----------------|--------------|
| 504 | | |

Edit Relationships

Table/Query: Job

Related Table/Query: Employee

JOE_CODE JOE_CODE

☒ Enforce Referential Integrity

☐ Cascade Update Related Fields

☐ Cascade Delete Related Records

Relationship Type: One-To-Many

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Database Form

- ❖ Forms allow the user to enter or view fields for one record at a time
- ❖ Forms can be attractively Formatted

Fields

Record Select

Go to First Record

Go to Next Record

Create New Record

Go to Last Record

Employee Form

Employee

EMP_NUM: 105

EMP_LNAME: Laurie

EMP_FNAME: Robert

EMP_INITIAL: M

JOB_CODE: 504

Records: 1 of 19 of 19

Form View

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REPORTS: Information Output

Reports are for information output only

You cannot enter data or edit data using reports

| EMP_NUM | EMP_LNAME | EMP_FNAME | EMP_INITIAL | JOB_CODE |
|---------|------------|-----------|-------------|----------|
| 101 | News | John | G | 502 |
| 102 | Senior | David | H | 501 |
| 103 | Arbough | June | E | 503 |
| 104 | Ramoras | Anne | K | 501 |
| 105 | Johnson | Alice | K | 502 |
| 106 | Smithfield | William | | 504 |

QUERY: What If?

- ❖ Queries can be used to answer “What If?” type questions by selecting and displaying records and fields that match a relational expression
- ❖ Structured Query Language = SQL
- ❖ SQL became an ANSI Standard 1992
- ❖ Relational Functions:
 - ◆ SELECT, PROJECT, JOIN, INTERSECT, UNION, DIFFERENCE, PRODUCT, and DIVIDE.
- ❖ Relational Operators are described below:
 - ◆ < Less Than
 - ◆ > Greater Than
 - ◆ = Equal To
 - ◆ <= Less Than or Equal To
 - ◆ >= Greater Than or Equal To
 - ◆ <> Not Equal To

QUERY By Example and SQL: Single Table

| EMP_NUM | EMP_LNAME | EMP_FNAME | EMP_INITIAL | JOB_CODE |
|---------|------------|-----------|-------------|----------|
| 103 | Arbough | June | E | 503 |
| 104 | Ramoras | Anne | K | 501 |
| 105 | Johnson | Alice | K | 502 |
| 106 | Smithfield | William | | 504 |
| 113 | Joebrood | Delbert | K | 508 |
| 125 | Laurie | Robert | M | 504 |

SQL Code

```
SELECT *
FROM Employees
WHERE EMP_LName <="M"
ORDER BY EMP_LName;
```

QUERY By Example and SQL: Multi Table

| JOB_CODE | JOB_DESCRIPTION | JOB_CHG_HOUR |
|----------|---------------------|--------------|
| 501 | Programmer | \$85.00 |
| 502 | Systems Analyst | \$96.75 |
| 503 | Database Designer | \$105.00 |
| 504 | Electrical Engineer | \$110.00 |
| 505 | Mechanical Engineer | \$90.00 |
| 506 | Civil Engineer | \$70.00 |
| 507 | Clerical Support | \$26.87 |
| 508 | DSS Analyst | \$45.95 |

SQL Code

```
SELECT Employee.EMP_FNAME, Employee.EMP_LNAME,
Job.JOB_DESCRIPTION, Job.JOB_CHG_HOUR
FROM Job INNER JOIN Employee ON Job.JOB_CODE =
Employee.JOB_CODE
WHERE Employee.EMP_LName <="M";
```

What is data security?

- ❖ DBMS provides means to ensure only authorized users can access data
- ❖ Access privileges define activities that specific user or group of users can perform
 - ◆ Read-only privileges - user can view data, but cannot change it
 - ◆ Full-update privileges - user can view and change data

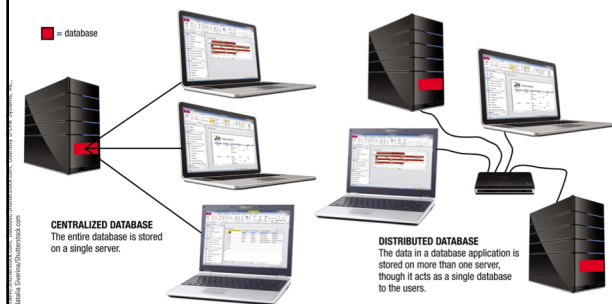
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Single-User vs. Multiuser DBMS

- ❖ Single-User Database System
 - ◆ Located on a single computer
 - ◆ Designed to be accessed by one user
 - ◆ Widely used for personal applications
- ❖ Multiuser Database System
 - ◆ Designed to be accessed by multiple users
 - ◆ Most business databases today
 - ◆ Client-Server Database Systems
 - ◆ Has both clients (front end) and at least one database server (back end)

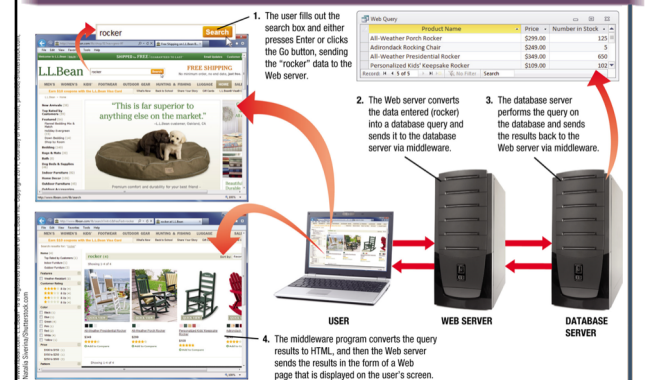
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Centralized vs. Distributed DBMS



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Databases and the Web



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