


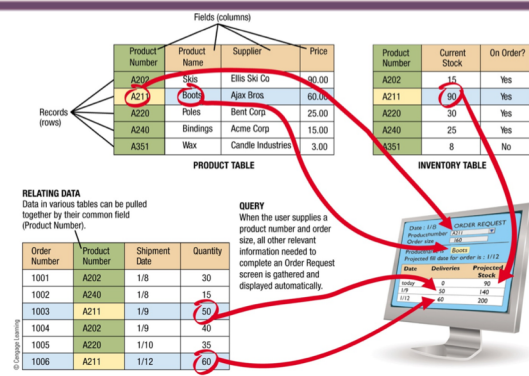
Databases



- ❖ **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

Copyright © 2019 R.M. Laurie 1

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

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

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.

Copyright © 2019 R.M. Laurie 2

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

Copyright © 2019 R.M. Laurie 3

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

Copyright © 2019 R.M. Laurie 4

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

Copyright © 2019 R.M. Laurie 5

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

Copyright © 2019 R.M. Laurie 6

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

Copyright © 2019 R.M. Laurie 7

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

Copyright © 2019 R.M. Laurie 8

Designing Database Tables

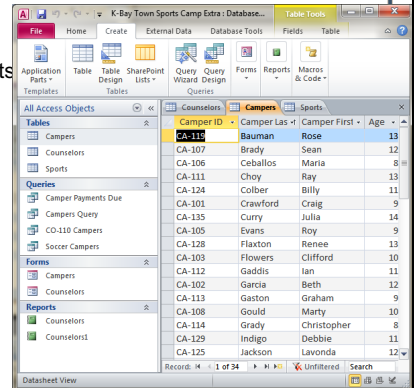
First create a paper sketch of the tables and the kind of data that will be put into each field

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

Copyright © 2019 R.M. Laurie 9

MS Access Navigation

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



Copyright © 2019 R.M. Laurie 12

Table Design View

Design Field Structure

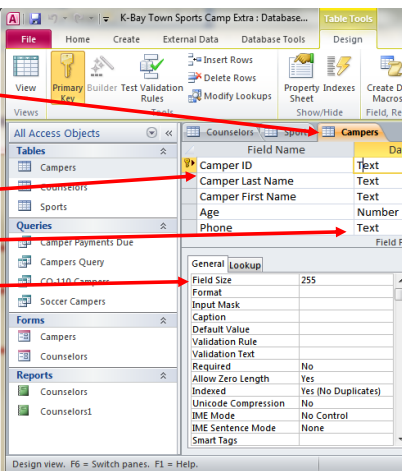
Table Name: **Campers**

Field Name: **Camper ID**

Data Types: **Text**

Field Width: **255**

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



Copyright © 2019 R.M. Laurie 12

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

Copyright © 2019 R.M. Laurie 12

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

Copyright © 2019 R.M. Laurie 13

Enter Data into Tables or Forms

Copyright © 2019 R.M. Laurie 14

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

Copyright © 2019 R.M. Laurie 15

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

Copyright © 2019 R.M. Laurie 16

IFSM201: Slide Set 3 - Databases

Removing Data Redundancy

RestaurantID	Address	City	Phone	TypeofService	VisaCard	OwnerFstName	OwnerLstName	OwnerPhone
R0001	2345 SW Miam	(305) 44	Table Service	<input checked="" type="checkbox"/>	Jim	Antonucci	(305) 777-8888	
R0002	3487 Mai Pens	(850) 88	Table & Take	<input type="checkbox"/>	Dottie	Balchunas	(850) 222-1111	
R0003	89 Turnt Orlan	(407) 55	Table Service	<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 & Take	<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 Service	<input checked="" type="checkbox"/>	Jim	Antonucci	(305) 777-8888	
R0008	298 W 75 Vero	(407) 22	Table & Take	<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 Service	<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 Service	<input checked="" type="checkbox"/>	Jim	Antonucci
R0002	3487 Mai Pens	(850) 88	Table & Take	<input type="checkbox"/>	Dottie	Balchunas
R0003	89 Turnt Orlan	(407) 55	Table Service	<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 & Take	<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 Service	<input checked="" type="checkbox"/>	Jim	Antonucci
R0008	298 W 75 Vero	(407) 22	Table & Take	<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 Service	<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

Copyright © 2019 R.M. Laurie 17

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

Copyright © 2019 R.M. Laurie 18

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

Edit Relationships

Table/Query: Employee

Related Table/Query: Job

JOE_CODE JOB_CODE

☒ Enforce Referential Integrity

☐ Cascade Update Related Fields

☐ Cascade Delete Related Records

Relationship Type: One-To-Many

Copyright © 2019 R.M. Laurie 19

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

Go to Last Record

Create New Record

Copyright © 2019 R.M. Laurie 20

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

SQL Code

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

QUERY By Example and SQL: Multi Table

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

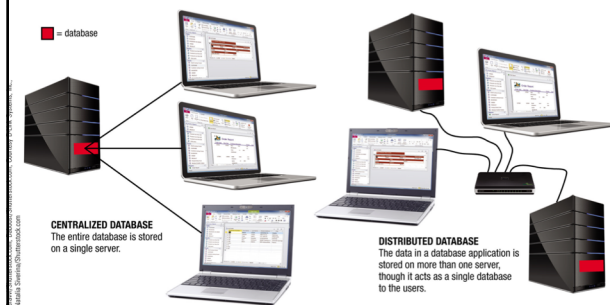
Copyright © 2019 R.M. Laurie 25

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)

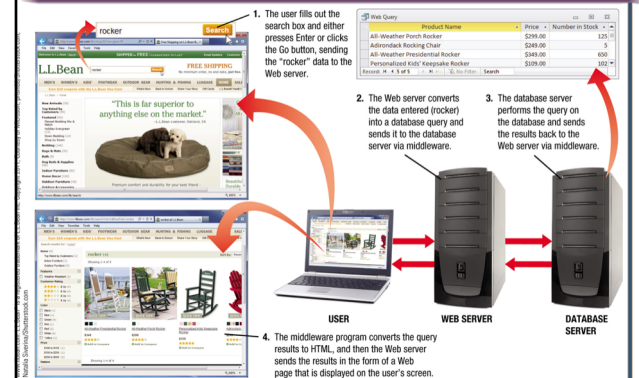
Copyright © 2019 R.M. Laurie 26

Centralized vs. Distributed DBMS



Copyright © 2019 R.M. Laurie 27

Databases and the Web



Copyright © 2019 R.M. Laurie 28