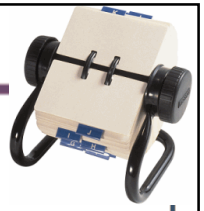
Databases



- *Database* – An organized collection of related data
- *Database Management System* – Software that helps organize data for fast and easy access (*DBMS*)
- Phone books, file cabinets, and index cards are non-computer versions of a database

 1

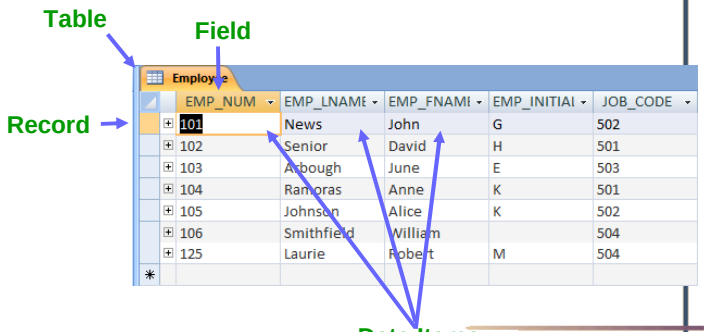
Database Provides Information

- 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

 2

A Database Table

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



 3

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

 4

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

 5

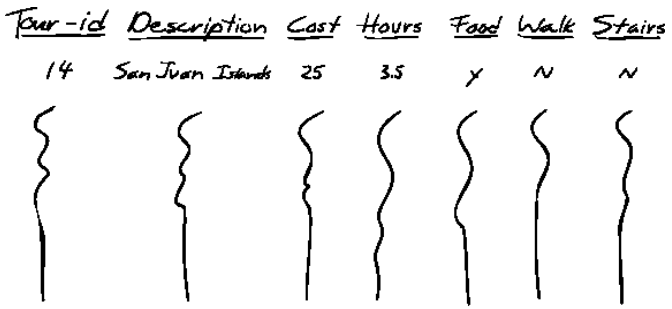
Creating a Database

- 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

 6

Designing Database Tables

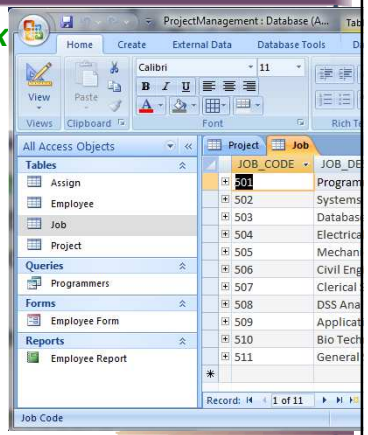
First create a paper sketch of the tables and the kind of data that will be put into each field



 7

MS Access Navigation

- *Database Dialog Box*
  Provides interface to database components
  - *Tables*
    Containers for data
  - *Forms*
    Input one record
  - *Reports*
    Information output
  - *Queries*
    Acquires information



 8

Table Design View

Table Name

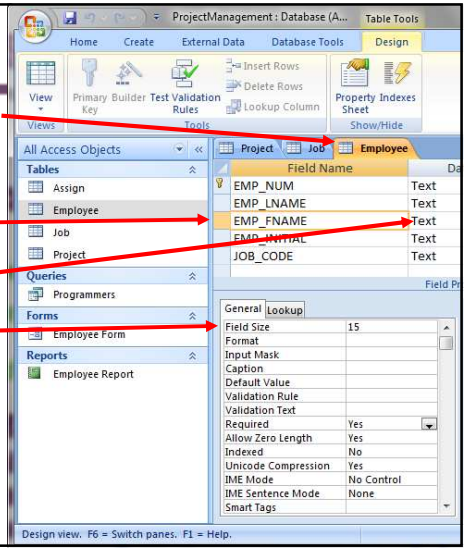
Design Field Structure

Field Name

Data Types

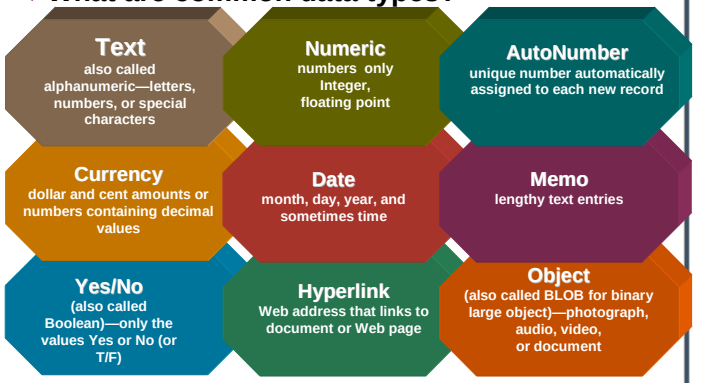
Field Width

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



The Hierarchy of Data

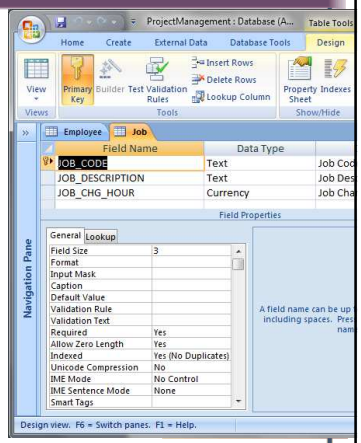
What are common data types?



 10

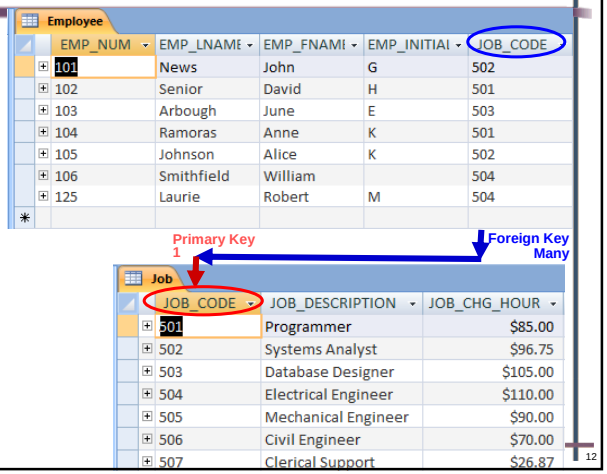
Key Fields

- 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



 11

Enter Data into Tables or Forms



12

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

 13

Data Anomalies: Restaurant Owner Database

Enter Record data items into each Field of the Table

Microsoft Access - [OwnersResturaunts : Select Query]

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

Record: 3 of 10 — Datasheet View

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

 14

Removing Data Redundancy

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

RestaurantID	Address	City	Phone	TypeofService	VisaCard	FranchiseeID

OwnerID	OwnerFstNa	OwnerLstNan	OwnerPhone

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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	☑	F001
R0002	3487 Main High	Pensacola	(850) 886-5555	Table & Take	☐	F002
R0003	89 Turnberry Dri	Orlando	(407) 555-9999	Table Service	☑	F004
R0004	4598 SW 136 S	Miami	(305) 444-4444	Take-out	☑	F001
R0005	9000 Biscayne	Tallahassee	(904) 222-1111	Table & Take	☑	F003
R0006	2 State Street	Boca Raton	(561) 444-1100	Take-out	☐	F003
R0007	8990 SE 2 Aver	Miami	(305) 787-7889	Table Service	☑	F001
R0008	298 W 75 Terra	Vero Beach	(407) 222-9999	Table & Take	☑	F005
R0009	1000 Grand Ave	Gainesville	(352) 666-7788	Take-out	☐	F006
R0010	6767 NW 75 St	Miami	(305) 887-8877	Table Service	☑	F005

Primary Key — Foreign Key

OwnerID	OwnerFstNa	OwnerLstNan	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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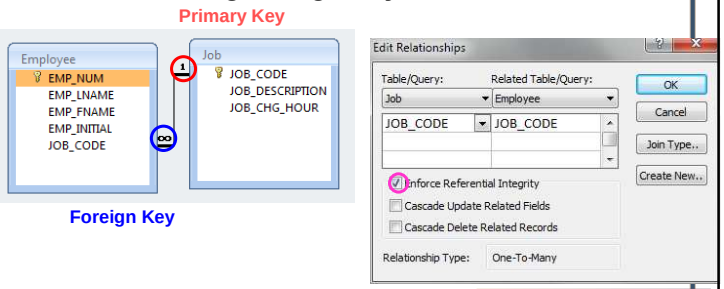
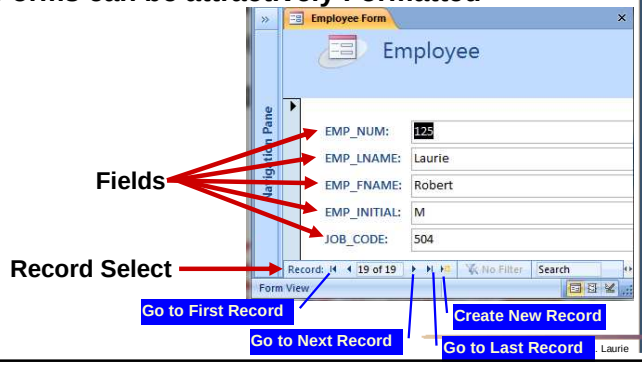
Enforcing Referential Integrity

- 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



Database Form

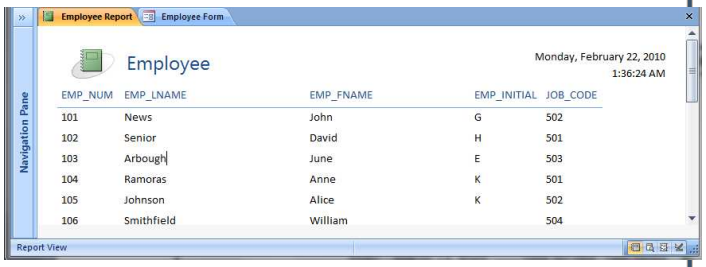
- Forms allow the user to enter or view fields for one record at a time
- Forms can be attractively Formatted



REPORTS: Information Output

Reports are for information output only

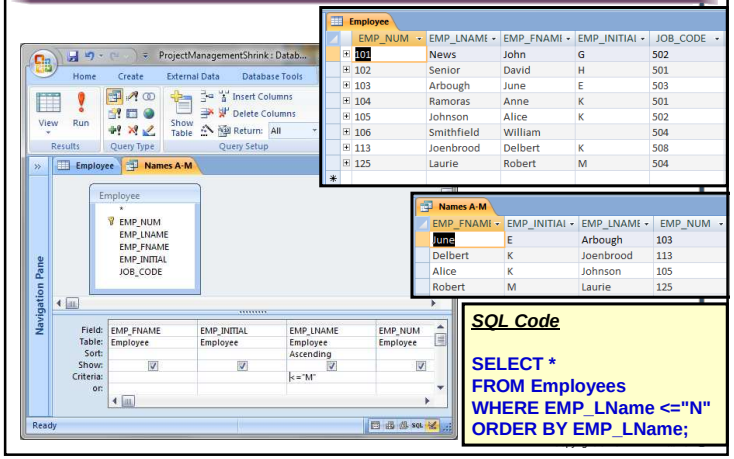
You cannot enter data or edit data using reports



QUERY: What If?

- Queries can be used to a 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 Then
  - <= Less Then or Equal To
  - > Greater Then
  - >= Greater Then or Equal To
  - = Equal To
  - <> Not Equal To

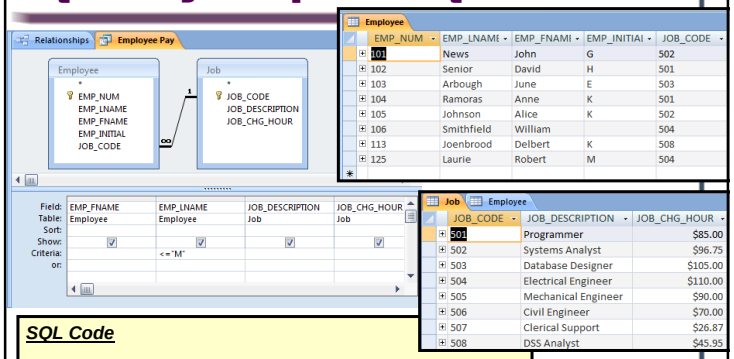
QUERY By Example and SQL: Single Table



SQL Code

```
SELECT *
FROM Employees
WHERE EMP_LName <="N"
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";
```


Database Model Determines the Type of DBMS

- What is a **data model**?
  - Rules and standards that define how database organizes data
  - Defines how users view organization of data
  - Four popular data models
    - Relational
    - Object-oriented
    - Object-relational
    - Multidimensional
  - Relational is the most common type of DBMS currently in use

DATA MODELS FOR POPULAR DBMSs

Data Model	Popular DBMSs
Relational	Access Adabas Informix Ingres InterBase MySQL SQL Server Sybase Teradata
Object-oriented	FastObjects GemFire KE Texpress ObjectStore Versant
Object-relational	DB2 JDataStore Oracle Polyhedra PostgreSQL Visual FoxPro Teradata
Multidimensional	D^3 Essbase Oracle Express

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

What is a data warehouse?

Huge database system that stores and manages data required to analyze historical and current transactions

- Quick and efficient way to access large amounts of data
- Often uses a process called data mining to find patterns and relationships among data
- Uses multidimensional databases
- Data mart is smaller version of data warehouse

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What is a Web database?

- Database you access through the Web by filling in a form on a Web page
- Usually resides on a database web server
  - Database Server is a computer that stores and provides access to a database
  - Web Server is a computer connected to WWW through Internet

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Database Administration

- Guidelines for developing a database?

1. Determine the purpose of the database
2. Design the tables
   - Design tables on paper first
   - Each table should contain data about one subject
3. Design the records and fields for each table
   - Be sure every record has a unique primary key
   - Use separate fields for logically distinct items
   - Do not create fields for information that can be derived from entries in other fields
   - Allow enough space for each field
   - Set default values for frequently entered data
4. Determine the relationships among the tables or files

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Database Administration

- What is the role of the database analyst and administrator?

Database analyst (DA)

- Focuses on meaning and usage of data
- Decides proper placement of fields, defines relationships, and identifies users' access privileges

Database administrator (DBA)

- Creates and maintains data dictionary, manages database security, monitors database performance, and checks backup and recovery procedures

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