

Content

- Related to **intellectual property**
 - form of creative endeavour that can be protected through a trademark, patent, copyright, industrial design, or integrated circuit topography
- Varies by industry

Content

- Organizations may store
 - Data
 - Documents
 - Spreadsheets
 - Presentations
 - web pages
 - text from blogs and discussion boards
 - graphics,
 - video files
 - audio files ...

Organizing Content

- Content management challenge
 - processing and storing the right content
 - getting the right content to the right person in the right format at the right time

Content Management

- Management of content data
 - database management systems (DBMS)
 - Effectively & Efficiently storing & processing data
- Presentation of content
 - content management system (CMS)
 - Organizing documents
 - Seek out documents & organize access

Spreadsheet vs Database

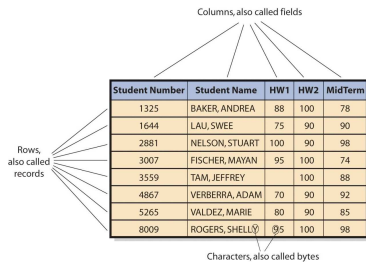
- Keeping track of things
 - Spreadsheets
 - Keep lists of single concept
 - Databases
 - Keep lists that involve multiple themes

Relational Database

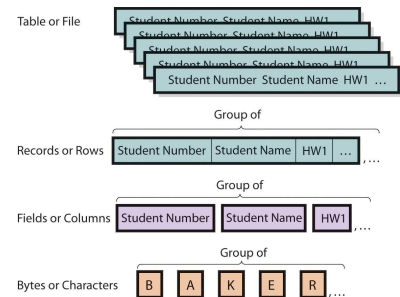
- Conceptually simple
- Easy to understand
- Relationships aren't predefined
- Database can evolve as required
- Relationships are implied in the data

A Database

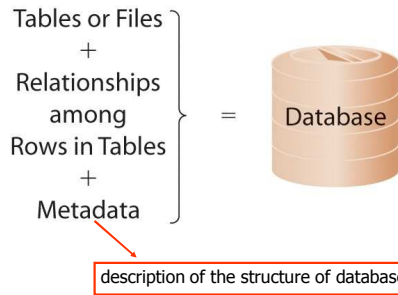
- Self-describing collection of integrated records



Hierarchy of data elements



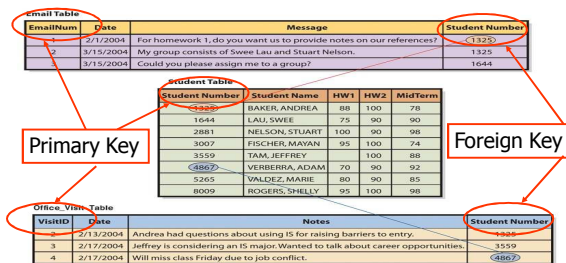
Components of a Database



Relationships Among Records

- Primary Keys
 - Column(s) that identify unique row in table
 - Each table has a key
- Foreign keys
 - Primary Keys from a different table
- Relational database
 - Databases using tables, primary keys & foreign keys

Relationships Among Records



Metadata

- Databases are self-describing
 - Contain description of its content
- Metadata
 - Data that describes data
 - Makes databases more useful
 - Makes databases easier to use

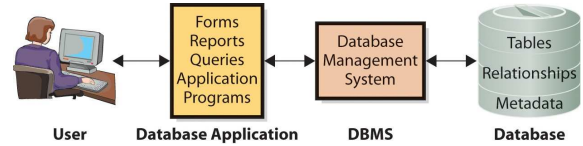
Metadata (Access)

Field Name	Data Type	Description
EmailNum	AutoNumber	Primary key -- values provided by Access
Date	Date/Time	Date the message is recorded into the database
Message	Memo	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

The data type determines the kind of values that users can store in the field. Press F1 for help on data types.

Components of a Database Application System



Database Management System (DBMS)

- Program
 - Creates database
 - Processes database
 - Administers database
- Usually licensed from vendors
 - Microsoft: Access, SQL server
 - Oracle: Oracle
 - IBM: DB2
 - Open Source: MySQL

They are Different!

- Database
 - Collection of tables, relationships & metadata
- DBMS
 - Software program

DBMS - Function

- Creation
 - Tables
 - Relationships in databases

DBMS - Function

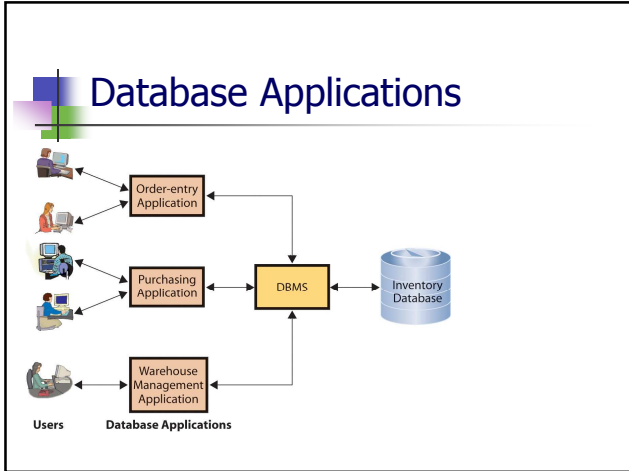
- Process database
- Applications use DBMS
 - Read data
 - Insert data
 - Modify data
 - Delete data

DBMS - Function

- Administration
 - Security (levels)
 - Access to the database
 - Backup
 - Improve performance
 - Removal of data no longer needed

Database Application

- Collection
 - Forms
 - Reports
 - Queries
 - Application programs that process a database



Forms

- Read data
- Insert data
- Modify data
- Delete data

The screenshot shows a 'STUDENT' form with fields for Student Name (BAKER, ANDREA), Student Number (1325), Hw1 (88), Hw2 (100), and Hw3 (70). Below these fields is an 'EMAIL' section with a table of messages. The table has columns for 'Date' and 'Message'. The first row shows a message from 2/12/2004 about homework 1, and the second row shows a message from 3/15/2004 about a group consisting of Steve Lau and Stuart Nelson. Record navigation controls are visible at the bottom.

Example: Data entry form

Reports

- Shows data in structured context
- Able to compute values

The screenshot shows a report titled 'Student Report with Emails'. It displays a table of student information with columns for Student Name, Student Number, Hw1, Hw2, Hw3, and Total weighted average. Below the table, there are sections for 'Emails Received' with columns for Date and Message. Red arrows point from the text 'Shows data in structured context' and 'Able to compute values' to the table and the 'Total weighted average' column, respectively.

Example: Report

Queries

- Comprehensive & robust method to query data

The first screenshot shows an 'Enter Parameter Value' dialog box with the text 'Enter words or phrase for search' and a text input field containing '[barriers to entry]'. Below it is the caption 'a. Form used to enter phrase for search'. The second screenshot shows the 'Office Visits Keyword Query : Select Query' window. It displays a table with columns for Student Name, Date, and Notes. The first row shows 'BAKER, ANDREA' with the date '2/13/2004' and the note 'Andrea had questions about using IS for raising barriers to entry.' Record navigation controls are visible at the bottom.

b. Results of query operation

Queries

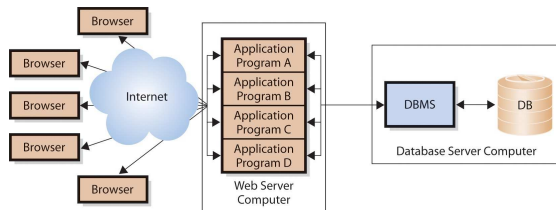
- Structured Query Language (SQL)
 - International standard for processing database

```
INSERT INTO Student
([Student Number], [Student Name], HW1, HW2, MidTerm)
Values
(10000, "Franklin Benjamin", 90, 95, 100)
```

Database Application Programs

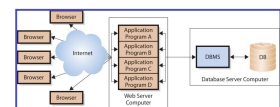
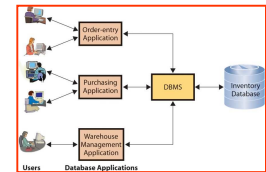
- Forms, reports & queries
 - Standard functions
- Application programs
 - Process logic specific to business need
 - Enables database processing over Internet
 - Intermediary between Web server & database
 - Responds to events (Reads, inserts, modifies, deletes data)

Application Programs on a Web Server



Multi-User Processing

- Problems
 - Lost-update problem
 - Locking used to coordinate activities of multiple users



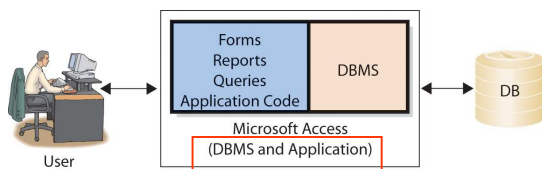
Enterprise DBMS

- Process organizational & workgroup databases
- Large Databases
- Support many, many users
- Examples: DB2, SQL Server, Oracle

Personal DBMS

- Designed for smaller, simpler database applications
- Supports fewer than 100 users
- Examples: Access, dBase, FoxPro, Paradox, R:Base

Personal Database System



Relational Database Design

- Designer creates table for every entity
- Key Attribute is primary key of table
- Attributes of entity become columns
- Tables normalized to single theme
- Represent relationships between tables
 - Add foreign key to one or more tables

Normalization

- Process
 - Converts table into two or more tables
 - Changes from poorly structured to well-structured
- Data integrity problems
 - Different names for the same entity
 - Produces incorrect and inconsistent information
 - Resolve by eliminating duplicated data
- Normalized tables
 - Eliminate data duplication
 - Slower to process
 - Every table has single topic

Poorly Designed Tables

Employee

Name	HireDate	Email	DeptNo	DeptName
Jones	Feb 1, 2002	Jones@ourcompany.com	100	Accounting
Smith	Dec 3, 2004	Smith@ourcompany.com	200	Marketing
Chau	March 7, 2004	Chau@ourcompany.com	100	Accounting
Greene	July 17, 2003	Greene@ourcompany.com	100	Accounting

a. Table Before Update

Employee

Name	HireDate	Email	DeptNo	DeptName
Jones	Feb 1, 2002	Jones@ourcompany.com	100	Accounting and Finance
Smith	Dec 3, 2004	Smith@ourcompany.com	200	Marketing
Chau	March 7, 2004	Chau@ourcompany.com	100	Accounting and Finance
Greene	July 17, 2003	Greene@ourcompany.com	100	Accounting

b. Table with Incomplete Update

Two Normalized Tables

Employee

Name	HireDate	Email	DeptNo
Jones	Feb 1, 2002	Jones@ourcompany.com	100
Smith	Dec 3, 2004	Smith@ourcompany.com	200
Chau	March 7, 2004	Chau@ourcompany.com	100
Greene	July 17, 2003	Greene@ourcompany.com	100

Department

DeptNo	DeptName
100	Accounting
200	Marketing
300	Information Systems

Database Elements

- Storing data:
 - An **entity** is anything about which the organization wishes to store as data.
 - Example: At Western, one entity would be the student.

STUDENTS				
Student ID	Last Name	First Name	Phone Number	Birth Date
333-33-3333	Simpson	Alice	333-3333	10/11/84
111-11-1111	Sanders	Ned	444-4444	11/24/86
123-45-6789	Moore	Artie	555-5555	04/20/85

Database Elements

- Information about **attributes** of an entity stored in **fields**
- Example: (e.g., the student number & birth date)

STUDENTS				
Student ID	Last Name	First Name	Phone Number	Birth Date
333-33-3333	Simpson	Alice	333-3333	10/11/84
111-11-1111	Sanders	Ned	444-4444	11/24/86
123-45-6789	Moore	Artie	555-5555	04/20/85

Database Elements

- All the fields containing data about one entity form a **record**
- Example: one student

STUDENTS				
Student ID	Last Name	First Name	Phone Number	Birth Date
333-33-3333	Simpson	Alice	333-3333	10/11/84
111-11-1111	Sanders	Ned	444-4444	11/24/86
123-45-6789	Moore	Artie	555-5555	04/20/85

Database Elements

- A set of all related records forms a **file** (e.g., student file)
- Example: If Western only had three students and five fields for each student, then the entire file would be depicted below.

STUDENTS				
Student ID	Last Name	First Name	Phone Number	Birth Date
333-33-3333	Simpson	Alice	333-3333	10/11/84
111-11-1111	Sanders	Ned	444-4444	11/24/86
123-45-6789	Moore	Artie	555-5555	04/20/85

Database elements

- Tables** in a relational database consist of rows & columns
 - Rows represent the instances of the entity
 - Columns represent the attributes
 - Every table **should** have a key attribute (primary key).

Employee ID	Last Name	First Name	Title	Title Of	Birth Date	Hire Date	Address	City
1	Orlando	Nancy	Sales Representative	Ms.	08-Dec-1960	01-May-1992	507 - 20th Ave. E.	Seattle
2	Falke	Andrew	Vice President, Sales	Dr.	19-Feb-1962	14-Aug-1992	289 W. Capital Way	Tacoma
3	Leverling	Janet	Sales Representative	Ms.	30-Aug-1963	01-Apr-1992	722 Moss Bay Blvd	Kirkland
4	Peacock	Margaret	Sales Representative	Mrs.	19-Sep-1958	03-May-1993	4110 Old Redmond Rd.	Redmond
5	Buchanan	Sтивен	Sales Manager	Mr.	04-Mar-1955	17-Oct-1993	14 Garrett Hill	London
6	Suyama	Michael	Sales Representative	Mr.	02-Jul-1963	17-Oct-1993	Coventry House	London
7	King	Robert	Sales Representative	Mr.	29-May-1960	02-Jan-1994	Edgeham Hollow	London
8	Callahan	Laura	Inside Sales Coordinator	Ms.	09-Jan-1959	05-Mar-1994	4726 - 11th Ave. N.E.	Seattle
9	Dodsworth	Anne	Sales Representative	Ms.	02-Jul-1969	15-Nov-1994	7 Houndstooth Rd.	London

Relational Database

- Data model based on a relation
 - represented as a 2-D table
- Entities & Relationships in an E-R Model become tables in the Relational Model
- Rows in a table constitute the instances of the entity or relationship
- Attributes of the entities and relationships in an E-R Model are the columns in the tables
- Table that stores a relationship inherits the key attributes from all of the entities involved in the relationship

STUDENT Entity

- Assume that the attributes of the STUDENT entity are
 - Student Number (ST-NUM)
 - Name (NAME)
 - Address (ADDRESS)

STUDENT Entity Table

<u>ST-NUM</u>	NAME	ADDRESS
250078563	Rhonda Odanski	65-927 Richmond St.
250004423	Peter Chen	1848 Downes Cr.
250016788	Susanne Ferber	39 Danielle Cr.
250012745	Rick Mattatall	87 Dillabough St.

COURSE Entity

- Assume that the attributes of the COURSE entity are
 - Internal Course Identification number (COURSE-ID)
 - Course name (NAME)
 - Course number (NUMBER)
 - Term offered (TERM)

COURSE Entity Table

<u>COURSE-ID</u>	NAME	NUMBER	TERM
6701901	COMP SCI	1033	A
6701402	COMP SCI	1033	B
6701203	COMP SCI	1032	A
6701604	COMP SCI	1032	B

TAKES Relationship

- The TAKES relationship exists between the STUDENT and COURSE entities (STUDENT takes COURSE)
- The key from the STUDENT relation (ST-
NUM) and the key from the COURSE relation (COURSE-ID) are the key to the TAKES relation

TAKES Relationship Table

<u>ST- NUM</u>	<u>COURSE-ID</u>
250016788	6701402
250004423	6701901
250012745	6701901
250004423	6701604
250078563	6701402
250016788	6701203
250012745	6701604

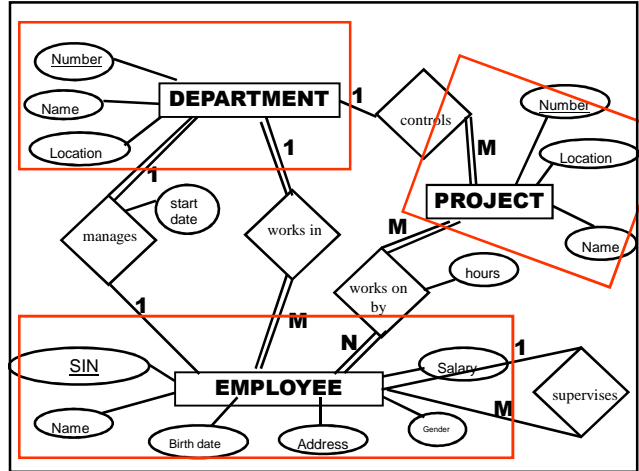
TAKES Relationship

- The TAKES relationship captures the course registration of the students
- From the example
 - Rhonda is taking COMP SCI 1033B
 - Peter is taking COMP SCI 1033A & COMP SCI 1032B
 - Susanne is taking Comp SCI 1032A & COMP SCI 1033B
 - Rick is taking Comp SCI 1033A and COMP SCI 1032B

Converting an E-R Diagram into a Relational Database

Step 1:

- For each entity in the diagram:
 - Create a table with the same name as the entity.
 - Each attribute becomes a column.
 - Key attribute of the entity becomes the primary key of the table



Step 1, Example

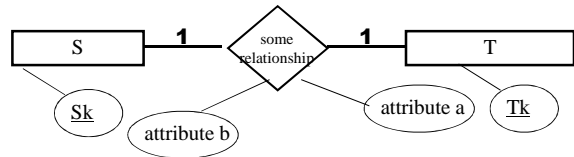
Employee Number	Name	BirthDate	Address	Sex	Salary
11455555	Maggie Simpson	3/19/2004	87 Springfield	F	\$9,000.00
12345567	Homer Simpson	5/19/1975	87 Springfield	M	\$20,000.00
222898444	Sponge Bob	12/24/1959	2 Waterway Road	M	\$62,000.00
333444555	Fred Flinstone	2/19/1964	65 Compton Cres	M	\$45,000.00
555511111	Luis Griffith	4/20/1992	0 Durey Lane	F	\$35,000.00
656565656	Sideshow Bob	12/20/1964	8 Prison Lane	M	\$10,000.00
889988998	Meg Griffith	6/24/1990	2 Durey Lane	F	\$60,000.00

Department Number	Name	Location
111	Personnel	Toronto
222	Sales	Toronto
333	Head Office	Vancouver
444	Finance	Toronto

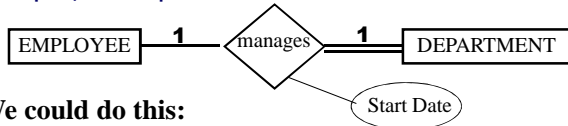
Project Number	Name	Location
12345	Alpha	London
55555	Beta	London
22333	Delta	Toronto
55533	Pi	Vancouver
88822	Lambda	Vancouver
26262	Omega	London
77765	Kappa	London

Step 2:

- For each 1:1 relationship in your model:
 - Identify the two participating tables (entities), say S and T and their respective key attributes, say Sk and Tk.
 - Choose one, say S, & make Sk the *foreign key* in table T.
 - Table T now has a new column, which holds Sk values.
 - If there are any attributes on the relationship, move them into table T as new columns.



Step 2, Example



We could do this:
Solution 1

SocialIdNumber	Name	BirthDate	Address	Sex	Salary	ManagerDeptNum	ManagerStartDate
111155555	Maggie Simpson	3/19/2004 87 Springfield		F	\$8,000.00		
123344567	Homer Simpson	5/19/1975 87 Springfield		M	\$20,000.00	444	2/2/2002
222888444	Sponge Bob	12/24/1959 2 Waterway Road		M	\$62,000.00		
333444555	Fred Flinstone	2/19/1964 65 Compton Cres		M	\$45,000.00	333	5/19/2000
555511111	Lois Griffith	4/20/1982 2 Durey Lane		F	\$25,000.00	111	8/20/1999
666655556	Sideshow Bob	12/20/1964 8 Prison Lane		M	\$10,000.00	222	7/6/1997
889888998	Meg Griffith	6/24/1990 2 Durey Lane		F	\$60,000.00		

OR we could do this:

Solution 2

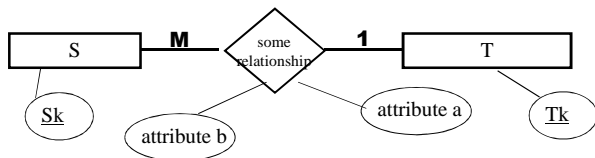
SocialIdNumber	Name	BirthDate	Address	Sex	Salary
111155555	Maggie Simpson	3/19/2004 87 Springfield		F	\$8,000.00
123344567	Homer Simpson	5/19/1975 87 Springfield		M	\$20,000.00
222888444	Sponge Bob	12/24/1959 2 Waterway Road		M	\$62,000.00
333444555	Fred Flinstone	2/19/1964 65 Compton Cres		M	\$45,000.00
555511111	Lois Griffith	4/20/1982 2 Durey Lane		F	\$25,000.00
666655556	Sideshow Bob	12/20/1964 8 Prison Lane		M	\$10,000.00
889888998	Meg Griffith	6/24/1990 2 Durey Lane		F	\$60,000.00

Number	Name	Location	ManagerSecId	ManagerStart
111	Personnel	Toronto	555511111	7/6/1997
222	Sales	Toronto	666655556	8/20/1999
333	Head Office	Vancouver	333444555	5/19/2000
444	Finance	Toronto	123344567	2/2/2002

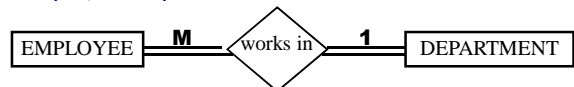
Which solution is better and why?

Step 3:

- For each 1:M relationship in your model:
 - Identify the two participating tables (entities), say S and T and their respective key attributes, say Sk and Tk.
 - Assume that S is the table on the M (many) side and that T is the table on the 1 (one) side.
 - Take the key from the one side, Tk and make it be a foreign key in the many (S) table.
 - Table S has a new column which hold Tk values.
 - If there are any attributes on the relationship, they would also become new columns in table S.

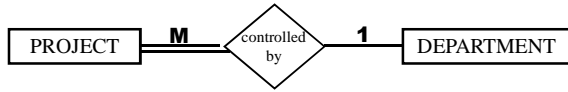


Step 3, Example



SocialIdNumber	Name	BirthDate	Address	Sex	Salary	WorksInDeptNum
111155555	Maggie Simpson	3/19/2004 87 Springfield		F	\$8,000.00	
123344567	Homer Simpson	5/19/1975 87 Springfield		M	\$20,000.00	444
222888444	Sponge Bob	12/24/1959 2 Waterway Road		M	\$62,000.00	222
333444555	Fred Flinstone	2/19/1964 65 Compton Cres		M	\$45,000.00	333
555511111	Lois Griffith	4/20/1982 2 Durey Lane		F	\$25,000.00	111
666655556	Sideshow Bob	12/20/1964 8 Prison Lane		M	\$10,000.00	222
889888998	Meg Griffith	6/24/1990 2 Durey Lane		F	\$60,000.00	222

Also have 1:M relationships:

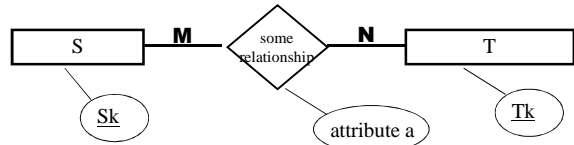


Number	Name	Location	ManagerSocId	ManagerStart
111	Personnel	Toronto	555511111	7/8/1997
222	Sales	Toronto	656666666	8/20/1999
333	Head Office	Vancouver	333444555	5/19/2000
444	Finance	Toronto	123345667	2/2/2002

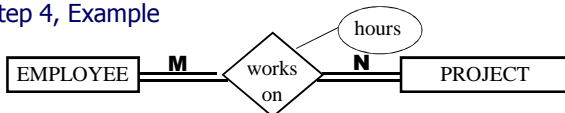
Number	Name	Location	ControllingDeptNum
12345	Alpha	London	111
22333	Delta	Toronto	444
25252	Omega	London	111
55533	Phi	Vancouver	111
55555	Beta	London	444
77765	Kappa	London	444
88822	Lambda	Vancouver	444

Step 4:

- For each M:N relationship in your model:
 - Identify the two participating tables (entities), say S and T and their respective key attributes, say Sk and Tk.
 - Create a new table, called R.
 - R's attributes(columns) should be Sk, Tk and any other attributes on the relationship.
 - The primary key of R will be the combination of Sk and Tk.



Step 4, Example



SocialIdNumber	Name	BirthDate	Address	Sex	Salary	WorksInDeptNum	SupervisorSocIdNum
111155555	Maggie Simpson	3/19/2004	97 Springfield	F	\$0,000.00	444	123345667
123345667	Phone Simpson	5/19/1975	87 Springfield	F	\$20,000.00	444	123345667
223388444	Sponge Bob	12/24/1959	2 Watney Road	M	\$62,000.00	222	123345667
333444555	Fred Flinstone	2/19/1964	65 Compton Cies	M	\$45,000.00	333	223388444
555511111	Lone Goffbe	4/20/1982	2 Dunsy Lane	F	\$25,000.00	111	123345667
656565656	Sideshow Bob	12/20/1964	8 Prison Lane	M	\$10,000.00	222	223388444
888888888	Neg Griffith	8/24/1990	2 Durey Lane	F	\$0,000.00	222	656565656

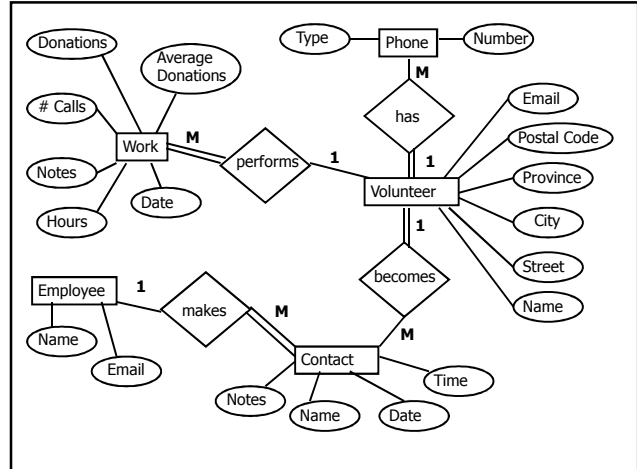
Number	Name	Location	ControllingDeptNum	SocialIdNumber	ProjectNumber	HoursWorked
12345	Alpha	London	111	111555555	1	5
22333	Delta	Toronto	444	123345667	2	20
25252	Omega	London	111	223388444	1	12
55533	Phi	Vancouver	111	333444555	1	20
55555	Beta	London	444	333444555	2	1
77765	Kappa	London	444	333444555	5	40
88822	Lambda	Vancouver	444	333444555	6	5
				555511111	2	5
				656565656	2	13
				888888888	2	10
				888888888	5	25
				888888888	5	0

Your Role...

- Decide on
 - What data should be contained
 - How records are related to each other
- Review & Correct data model
 - Ensure it is an accurate view

Who Will Volunteer?

- Consultant creates data model
 - Based on interviews with users
- Data model reviewed and approved
- Database tables constructed
 - Primary and foreign keys selected
 - Based on interviews
- Microsoft Access database created
 - Relationships indicated
 - Forms and reports constructed



Prospect

Name: Mary Smith EmailAddress: MaryS@somewhere.com

Phone:

PhoneType	PhoneNumber	Street
Mobile	(206) 555-1234	123 Elm Street
Home	(425) 555-5587	City Bellevue
Office	(206) 555-7767	State WA
ZipCode: 98069-1234		

Contact:

Date/Time	Notes	EmployeeName
3/17/2003 10:03:30 AM	Not sure about schedule	David
4/2/2003 8:08:12 AM	Willing to work on Thursdays	Selma
6/2/2003 4:24:02 PM		

Work:

Date	Notes	NumCalls	TotalDonations	AvgDonation
7/10/2003	Enjoyable Team Member	37	\$7,350.00	\$198.65
		1	\$0.00	\$0.00

Things To Consider:

- No order or sequence in the table
 - Order of the rows does not matter
 - Order of the columns does not matter
- Primary keys and foreign keys, show the relationships between the instances
- Relational databases are conceptually simple and easy to understand
 - Simply need to understand tables, rows & columns
- Steps 1 to 4 work for mapping to any DBMS