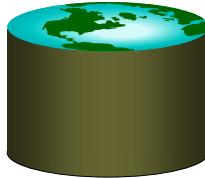


The Entity-Relationship Model

CS 186 Fall 2002: Lecture 2
R & G - Chapter 2

Treasure your relationships,
not your possessions.

Anthony J. D'Angelo,
The College Blue Book



Administrivia

- **Don't forget appeals process deadline.**
- **Discussion sessions to start next week.**
 - course accounts will be handed out in section.

Databases Model the Real World

- **"Data Model"** allows us to translate real world things into structures computers can store
- **Many models: Relational, E-R, O-O, Network, Hierarchical, etc.**
- **Relational**
 - Rows & Columns
 - Keys & Foreign Keys to link Relations

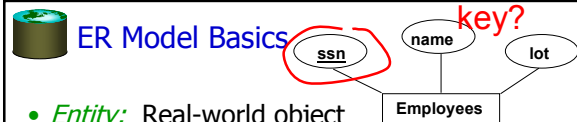
Enrolled			Students				
sid	cid	grade	sid	name	login	age	gpa
53666	Carnatic101	C	53666	Jones	jones@cs	18	3.4
53666	Reggae203	B	53688	Smith	smith@eecs	18	3.2
53650	Topology112	A	53650	Smith	smith@math	19	3.8
53666	History105	B					

Database Design

- **Requirements Analysis**
 - user needs; what must database do?
- **Conceptual Design**
 - high level descr (often done w/ER model)
- **Logical Design**
 - translate ER into DBMS data model
- **Schema Refinement**
 - **consistency, normalization**
- **Physical Design** - indexes, disk layout
- **Security Design** - who accesses what

Conceptual Design

- What are the *entities* and *relationships* in the enterprise?
- What information about these entities and relationships should we store in the database?
- What are the *integrity constraints* or *business rules* that hold?
- A database `schema` in the ER Model can be represented pictorially (*ER diagrams*).
- Can map an ER diagram into a relational schema.



- **Entity:** Real-world object distinguishable from other objects. An entity is described (in DB) using a set of *attributes*.
- **Entity Set:** A collection of similar entities. E.g., all employees.
 - All entities in an entity set have the same set of attributes. (Until we consider hierarchies, anyway!)
 - Each entity set has a *key* (*underlined*).
 - Each attribute has a *domain*.

ER Model Basics (Contd.)

- **Relationship:** Association among two or more entities. E.g., Attishoo works in Pharmacy department.
 - relationships can have their own attributes.
- **Relationship Set:** Collection of similar relationships.
 - An n-ary relationship set R relates n entity sets E1 ... En; each relationship in R involves entities e1 E1, ..., en En

ER Model Basics (Cont.)

- Same entity set can participate in different relationship sets, or in different "roles" in the same set.

Key Constraints

An employee can work in **many** departments; a dept can have **many** employees.

In contrast, each dept has **at most one** manager, according to the **key constraint** on Manages.

Many-to-Many **1-to-Many** **1-to-1**

Participation Constraints

- Does every employee work in a department?
- If so, this is a **participation constraint**: the participation of Departments in Manages is said to be **total (vs. partial)**.
- Basically means "at least one"

Means: "exactly one"

Weak Entities

A **weak entity** can be identified uniquely only by considering the primary key of another (**owner**) entity.

- Owner entity set and weak entity set must participate in a one-to-many relationship set (one owner, many weak entities).
- Weak entity set must have total participation in this **identifying** relationship set.

Weak entities have only a "partial key" (dashed underline)

Binary vs. Ternary Relationships

If each policy is owned by just 1 employee:

Bad design

Key constraint on Policies would mean policy can only cover 1 dependent!

Better design

- What are the additional constraints in the 2nd diagram?

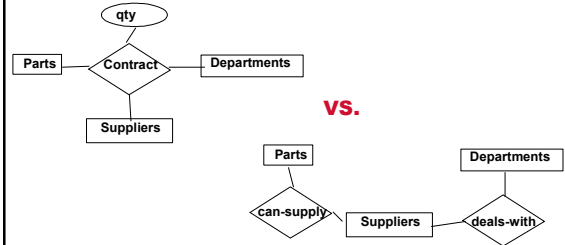


Binary vs. Ternary Relationships (Contd.)

- Previous example illustrated a case when two binary relationships were better than one ternary relationship.
- An example in the other direction: a ternary relation **Contracts** relates entity sets **Parts**, **Departments** and **Suppliers**, and has descriptive attribute *qty*. No combination of binary relationships is an adequate substitute.



Binary vs. Ternary Relationships (Contd.)



- S "can-supply" P, D "needs" P, and D "deals-with" S does not imply that D has agreed to buy P from S.
- How do we record *qty*?



Summary so far

- **Entities and Entity Set (boxes)**
- **Relationships and Relationship sets (diamonds)**
 - binary
 - n-ary
- **Key constraints (1-1,M-1, M-M, arrows on 1 side)**
- **Participation constraints (bold for Total)**
- **Weak entities - require strong entity for key**



Now you try it

Assignment - Courses database:

- **Courses, Students, Teachers**
- **Courses have ids, titles, credits, ...**
- **Courses have multiple sections that have time/rm and exactly one teacher**
- **Must track students course schedule and transcript including grades, semester taken, etc.**
- **Must track which classes a professor has taught**
- **Database should work over multiple semesters**