Introduction to Data Management

Lecture #3
E-R Model, Continued

Instructor: Mike Carey
mjcarey@ics.uci.edu

It’s time for....

Friday Nights
With Databases

Brought to you by

Starbucks Coffee
Today’s Reminders

- Read (and live by!) the course wiki page:
  - http://www.ics.uci.edu/~cs122a/
- Also follow (and live by) the Piazza page:
  - https://piazza.com/uci/spring2019/cs122a/home
  - Everyone needs to get signed up!
  - The first HW assignment is now available…
  - Personal Health Logger – PHLOG.com (©)
- I will be out of town next week (sorry!!)
  - ICDE (http://conferences.cis.umac.mo/icde2019/)
  - Shiva (and Xikui) will cover the next three lectures
  - I expect to pay attention to Piazza while in Macau

Cardinality Constraints

- Consider Works In:  
  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 cardinality constraint on Manages above.

(Note: A given employee can manage several departments)
Participation Constraints

- Does every department have a manager?
  - If so, this is a participation constraint: the participation of Departments in Manages is said to be total (vs. partial).
  - Every Departments entity below must appear in an instance of the Manages relationship
  - Ditto for both Employees and Departments for Works_In

ER Basics: Another Example

- Let’s see if you can read/interpret the ER diagram above…! (❼)
  - What attributes are unique (i.e., identify their associated entity instances)?
  - What are the rules about (the much coveted) parking passes?
  - What are the rules (constraints) about professors being in departments?
  - And, what are the rules about professors heading departments?
Another Example (Answers)

- Unique attributes:
  - Professor.fac_id, Dept.dno, Parking Space.pid

- Faculty parking:
  - 1 space/faculty, one faculty/space
  - Some faculty can bike or walk (:flex)
  - Some parking spaces may be unused

- Faculty in departments:
  - Faculty may have appointments in multiple departments
  - Departments can have multiple faculty in them
  - No empty departments, and no unaffiliated faculty

- Department management:
  - One head per department (exactly)
  - Not all faculty are department heads

**NOTE:** These things are all “rules of the universe” that are just being modeled here!

Q: Can a faculty member head a department that he or she isn’t actually in?

Another Example (E’s & R’s)

- Entity instance
- Relationship instance

Diagram:

- Parking Spaces
  - S1
  - S2
  - S3

- Assigned (1:1)
  - Professors
  - P1
  - P2
  - P3
  - P4

- In (M:N)
  - Departments
  - D1
  - D2
  - D3

- Head (1:N)

Diagram inset:

- Professor
- Parking Space
- Assigned
- Head
- Dept
- Main Office

Database Management Systems 3ed, R. Ramakrishnan and J. Gehrke
Weak Entities

- A weak entity can be identified uniquely only by considering the primary key of some other (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.
  - Dependent identifier is unique only within owner context ( ), so its fully qualified key here is (ssn, dname)

Ternary Relationships (and beyond)

- A prescription is a 3-way relationship between a patient, a doctor, and a drug; with the cardinality constraints above:
  - A given patient+drug will be associated with one doctor (1)
  - A given patient+doctor may be associated with several drugs (N)
  - A given doctor+drug may be associated with several patients (M)

- General note: Relationship key ≤ (entity keys)
ISA (“is a”) Hierarchies

- As in Java or other PLs, ER attributes are inherited (including the key attribute).
- If we declare A ISA B, every A entity is also considered to be a B entity.
- **Covering constraints:** Must every Employees entity be either an Hourly_Emps or a Contract_Emps entity? *(Yes or no)*
  - Ex: Hourly_Emps AND Contract_Emps COVER Employees (pick 1 of 2 vs. 1 of 3)
- **Overlap constraints:** Can some Employees entity be an Hourly_Emps as well as a Contract_Emps entity? *(Allowed or disallowed)*
  - Ex: Hourly_Emps OVERLAPS Contract_Emps (else pick 1 of the 3 types)
- Reasons for using ISA:
  - To add descriptive attributes specific to a subclass.
  - To identify subclasses that participate in a relationship.
- Design: specialization (top-down), generalization (bottom-up)

Aggregation

- Used when we have to model a relationship involving (entity sets and) a relationship set.
  - **Aggregation** allows us to treat a relationship set as an entity set for purposes of participating in (other) relationships.

**Aggregation vs. ternary relationship:**
- Monitors is a distinct relationship; even has its own attribute here.
- Each sponsorship can monitored by zero or more employees (as above).
Additional Advanced ER Features

- Multi-valued (vs. single-valued) attributes
- Optional attributes
- Composite (vs. atomic) attributes
- Derived (vs. base/stored) attributes