COS 425:
Database and Information
Management Systems

Continue exploring our first model for databases:

Entity-relationship (ER) model

Board Example

Entity *Books*: (title, ISBN#, edition, date)

Entity *Authors*:
   (name, gender, birth date, place of birth, date of death)

Entity *Publishers*: (name, country, address)

Relationship *written by*: (**books, authors**)

Relationship *published by*:
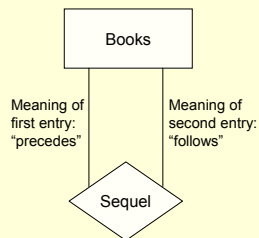   (**books, publishers**, in print)

Another relationship

Relationship *sequel*:
(*books, books*)

Any book can be on either
   side of relationship
If sequence longer than 2,
   middle book appears in
   tuple on each side

Example tuples for *Lord of the Rings*:
   (*Fellowship of the Ring, Twin Towers*)
   (*Twin Towers, Return of the King*)

Books

Meaning of
first entry:
"precedes"

Meaning of
second entry:
"follows"

Sequel

Identifying entities

Key: a minimal* set of attributes whose values uniquely identify each entity in an entity set

Books
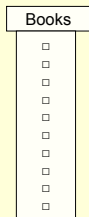
□ represents a book

* No subset will do the job

Identifying entities

Key: a minimal set of attributes whose values uniquely identify each entity in an entity set

Candidate Key: any key

Primary key: a candidate key defined to be primary by person who defines entity

Superkey: any set of attributes that contains a candidate key

Denote primary key by underlining attributes

Entity Books: (title, ISBN#, edition, date)

Entity Authors:
   (name, gender, birth date, place of birth, date of death)

Entity Publishers: (name, country, address)

Constraints

- Declaring a candidate key constrains values of attributes

- Example: ISBN# as key
  - No book without an ISBN#
  - No two books with same ISBN#

What about constraints on relationships?

- Constraints are statements about structure

Two major constraints for relationships

- Key constraint on an entity type participating in a relationship type:
  - Each entity of the entity type appears in at most one tuple of the relationship type
    - Equivalently, the value of the key-constrained entity determines the values of the other entities in a relationship tuple

- Total Participation constraint of an entity type participating in a relationship type:
  - Every entity in the entity set of the entity type appears in a tuple of the relationship

Board examples

Constraints cannot denote in basic ER model

- Domain attribute constraints within entity
  - Need to test values of attributes not simply membership properties in sets
  - Example:
    Attribute *legal_adult*: yes/no flag
    Attribute *age*: number
    Constraint "if *legal_adult* == "no" then *age* < 18"

Constraints cannot denote in basic ER model

- Functional constraints
  Example:
    person entity with 6 attributes:
      first name, last name, street address, state, area code, 7-digit phone number.
  Constraint:
    if *area code* of person 1 = *area code* of person 2
      then *state* of person 1 = *state* of person 2

    Equivalently,   *area code* determines *state*

Constraints cannot denote in basic ER model

- Functional constraints

    General form:
    Let A and B be subsets of attributes for an entity type.
    For any entities e_j and e_k of the type:

    If the values of attributes in set A for tuple e_j equal
      the values of attributes in set A for tuple e_k

    Then the values of attributes in set B for tuple e_j equal
        the values of attributes in set B for tuple e_k

Constraints cannot denote in basic ER model

- Functional constraints

    More complicated example:
        customer entity with 8 attributes:
        height, weight, arm length, leg length, color preference, jacket size, pant size, shirt size

    Constraint:
        Height, weight, arm length determine *shirt size*
        Height, weight, leg length determine *pant size*