Continue exploring our first model for databases:

Entity-relationship (ER) model

Board Example


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)
**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

**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

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

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

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

**Denote primary key by underlining attributes**
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"

- **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 $e_k$.

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*