COS 597A:
Principles of
Database and Information Systems

Entity-relationship (ER) model

Database Design Phases

1. characterize user needs
2. conceptual design
   – structure of data
   – nature of functionality
     • questions
     • modifications
3. implement in database system
   – logical design
   – physical design

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Entity-relationship model

➢ Goal: Capture semantics of information objects
➢ Goal: Capture complexity of relationships between objects

• Used first for database modeling but now expanded use

History

• Developed 1976 by Peter Chen
        after relational model
• Chen felt relational model not rich enough
  – relational model: everything a (mathematical) relation on collection of domains D_i
    • e.g. name from domain of strings
    • Relation subset of D_1 x D_2 x …x D_k (k-ary)
  – ER model differentiate between objects described by attributes and relationships among objects

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ER model basics

• An *entity* is a distinct object in the "real" world
  – person, book, movie character, disease, …
  – *conceptual*
• *Attributes* are basic properties of entities
  – some defs. don't allow substructure for attributes
    • name ↔ first name, last name
• An *entity* is described/defined by its attributes
  – entity is *tuple* (or set) *of attributes*
  – attribute is function: entity set → domain of attribute values

ER model basics II

- A *relationship* is a *tuple* of *entities*
  - entities are thus related
  - relationship has some meaning
    - (PU store, "cute tiger" baby shirt)
- A relationship set is a set of relationships of the same type
  - "same type" = same component types
    - {stores} X {items for sale}
- A relationship can have its own *attributes*
  - different from entity attributes
  - descriptive only
    - cannot use to distinguish two tuples of a relationship set
    - (PU store, "cute tiger" baby shirt), "in stock?"

Example

- Entity course with attributes:
  department, number, semester
- Entity student with attributes:
  first name, last name, ID number

- Relationship "take" relating:
  A student to a course

- Both entities and relationships are tuples but at different granularities
- We choose which are entities and which are relationships
- We choose attributes that best describe entities
- We choose semantics of a relationship between entities

Types

- Entity type :
  - Defined by A_1 x A_2 x … x A_k where A_1 ,…, A_k are attribute types (for entity with k attributes)
  - Defines kind of object (e.g. student)
  - Set of entities of same type – entity set
- Relationship type :
  - Defined by E_1 x E_2 x … x E_m where E_1 ,…, E_m are entity types (for relationship between m entities)
  - Defines kind of relationship (e.g. "take")
  - Set of relationships of same type – relationship set
- Then have instances of entity type and relationship type (e.g. (fred, smith, 123456))

Board Example