Database Design and the E-R Model (7.1-7.3, 7.5)

Department of Computer Science and Engineering
Indian Institute of Technology Ropar

Narayanan (CK) Chatapuram Krishnan
Summary

• Design Phases
  – User requirement specification
  – Conceptual Design
  – Functional Requirement specification
  – Logical Design
  – Physical Design
• Pitfalls to avoid
  – Redundancy
  – Incompleteness
• The Entity-Relationship model
  – Entity sets
    • Entity
    • Attributes
  – Relationship sets
    • Descriptive attributes
    • Degree of relation

• Attributes
  • Simple and composite
  • Single and Multi-Valued
  • Derived
  • Null values

• Constraints
  – Mapping cardinalities
    • one to one
    • one to many
    • many to one
    • many to many
  – Participation constraints
    • total
    • partial
  – Keys
Summary

- **E-R Diagrams**
  - **Basic Structure**
    - Rectangles, Diamonds, Lines, Undivided rectangles, Dashed lines, Double lines, Double diamonds
  - **Mapping cardinality**
    - using arrows or 1..h, 0..*, 1..1
  - **Attribute Specification**
    - simple, composite, multi-values and derived
  - **Roles**
  - **Nonbinary relationship sets**
  - **Weak entity sets**
    - Discriminator
7.1 Construct an E-R diagram for a car insurance company whose customers own one or more cars each. Each car has associated with it zero to any number of recorded accidents. Each insurance policy covers one or more cars, and has one or more premium payments associated with it. Each payment is for a particular period of time, and has an associated due date, and the date when the payment was received.
7.2.a Consider a database used to record the marks that students get in different exams of difference course offerings (sections). Construct an E-R diagram that models exams as entities, and uses a ternary relationship for the database.
7.2.b Consider a database used to record the marks that students get in different exams of different course offerings (sections). Construct an alternative E-R diagram that uses only a binary relationship between a particular student and section pair, yet you can represent marks that a student gets in different exams.
7.4 Consider an E-R diagram in which the same entity set appears several times, with its attributes repeated in more than one occurrence. Why is allowing this redundancy a bad practice that one should avoid?
7.5.a An E-R diagram can be viewed as a graph. What do the following mean in terms of the structure of an enterprise schema?
- The graph is disconnected
7.5.b An E-R diagram can be viewed as a graph. What do the following mean in terms of the structure of an enterprise schema?

- The graph has a cycle
7.7 A weak entity set can always be made into a strong entity set by adding to its attributes the primary-key attributes of its identifying entity set. Outline what sort of redundancy will result if we do so?
7.15 Construct an E-R diagram for a hospital with a set of patients and a set of medical doctors. Associate with each patient a log of various tests and examinations conducted.
7.3 Design an E-R diagram for keeping track of the exploits of your favorite sports team. You should store the matches played, scores in each match, players in each match, and individual player statistics for each match. Summary statistics should be modeled as derived attributes.
7.22 Design a database for a world-wide package delivery company (e.g., DHL or FedEx). The database must be able to keep track of customers (who ship items) and customers (who receive items); some customers may do both. Each package must be identifiable and trackable, so the database must be able to store the location of the package and its history of locations. Locations include trucks, planes, airports, and warehouses.
7.23 Design a database for an airline. The database must keep track of customers and their reservations, flights and their status, seat assignments on individual flights, and the schedule and routing of future flights.
7.21 Design the E-R diagram of a database for an automobile company to provide its dealers to assist them in maintaining customer records and dealer inventory and to assist sales staff in ordering cars.

Each vehicle is identified by a vehicle identification number (VIN). Each individual vehicle is a particular model of a particular brand offered by the company (e.g., the XF is a model of the car brand Jaguar of Tata Motors). Each model can be offered with a variety of options, but an individual car may have only some (or none) of the available options. The database needs to store information about models, brands, and options, as well as information about individual dealers, customers, and cars.