THE ENHANCED ER (EER) MODEL

CHAPTER 8 (6/E)
CHAPTER 4 (5/E)
LECTURE OUTLINE

- Extending the ER model
  - Created to design more accurate database schemas
    - Reflect the data properties and constraints more precisely
    - Address more complex requirements
  - Subclasses, Superclasses, and Inheritance
  - Specialization and Generalization
  - Modeling of UNION Types Using Categories
SPECIALIZATION AND INHERITANCE

- **Specialization**
  - Process of defining a set of subclasses of an entity type
  - Defined on the basis of some distinguishing characteristic of the entities in the superclass

- Describing the relationship
  - *Superclass/subclass* or *Class/subclass*
  - *Supertype/subtype* or *Type/subtype*

- Subclass can define:
  - Specific attributes
  - Specific relationship types

- Subclass can be a subclass wrt more than one superclass

- **Type inheritance**
  - Subclass entity has all attributes and participates in all relationships of superclass
  - **Multiple inheritance** if more than one superclass
GENERALIZATION

- Generalization
  - Process of defining a more general entity type from given entity types
- Reverse process of specialization
- Generalize into a single superclass
  - Original entity types are specialized subclasses
  - Entities in generalization must *all* come from subclasses
Every technician/secretary/engineer is an employee.

Not every employee of superclass must be in a subclass (unless specified as generalization).

All properties of employee (attributes and relationships) are inherited by specialized subclasses.

Specialized entities might have additional attributes and be involved in additional relationships.

Subclasses may be disjoint or overlapping.
CONSTRATNTS ON SUBCLASSES

- **Disjointness constraint**
  - Specifies that the subclasses of the specialization must be disjoint

- **Completeness constraint**
  - Specifies that every superclass entity must be in a subclass
  - Required of generalization

- Disjointness and completeness constraints are *independent* constraints
EER DIAGRAM WITH SUBCLASSES

Figure 8.1
EER diagram notation to represent subclasses and specialization.

Three specializations of EMPLOYEE:
{SECRETARY, TECHNICIAN, ENGINEER}
{MANAGER}
{HOURLY_EMPLOYEE, SALARIED_EMPLOYEE}
REFINING CONCEPTUAL SCHEMAS

- Using specialization
  - Starting with entity type, define subclasses by successive specialization
  - **Top-down conceptual refinement**

- Using generalization
  - Starting with entity type, define superclasses by successive generalization
  - **Bottom-up conceptual synthesis**
MODELING WITH UNION TYPES

- **Union type** or **category**
  - Represents a single superclass/subclass relationship with more than one superclass
  - Subclass represents a collection of objects that is a subset of the UNION of distinct entity types
  - Attribute inheritance works more selectively
  - Category can be **total** or **partial**

- Some modeling methodologies do not have union types
  - Usually (always?) clearer to use specification/generalization
Figure 8.8
Two categories (union types): OWNER and REGISTERED_VEHICLE.
REWRITING UNION AS SPECIALIZATION

- PERSON
- BANK
- COMPANY

- OWNER

- OWNS

- REGISTERED VEHICLE
  - CAR
  - TRUCK

- oPERSON
- oBANK
- oCOMPANY

- OWNER

- OWNS

- REGISTERED VEHICLE
  - rCAR
  - rTRUCK
Figure 8.9
An EER conceptual schema for a UNIVERSITY database.
Many specializations/generalizations can be defined to make the conceptual model accurate
- Constrain as disjoint/overlapping or total/partial as needed
- Driven by rules in miniworld being modeled

If all the subclasses of a specialization/generalization have few specific attributes and no specific relationships
- Can be merged into the superclass $C$
- Include in $C$ one or more “type” attributes that specify the (virtual) subclasses to which each entity belongs

Union types should generally be avoided
LECTURE SUMMARY

- Enhanced ER or EER model
  - Extensions to ER model that improve its representational capabilities
  - Subclass and its superclass
  - Category or union type
  - EER diagrams