**Chapter 3: Modeling Data in the Organization**

*Modern Database Management*

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**E-R Model Constructs**

- **Entity (instance)** - person, place, object, event, concept (often corresponds to a row in a table)
  - *Entity Set or Type* – collection of entities (often corresponds to a table)
- **Attribute** - property or characteristic of an entity type (often corresponds to a column in a table)
- **Relationship (instance)** – link between entities (corresponds to primary key-foreign key equivalencies in related tables)
  - *Relationship set or type* – category of relationship…link between entity types

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**Entity-Relationship Model (E-R Model)**

- Models conceptual database design in terms of entities, attributes, and relationships between entities
- Developed by Chen in 1976
- Enhanced by others over the years
  - Enhanced E-R model (EER model)

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**What Should an Entity Be?**

- **SHOULD BE:**
  - An object that will have many instances in the database
  - An object that will be composed of multiple attributes
  - An object that we are trying to model
- **SHOULD NOT BE:**
  - A user of the database system
  - An output of the database system (e.g. a report)
Attributes

- Attribute - property or characteristic of an entity type
- Classifications of attributes:
  - Simple versus Composite Attribute
  - Single-Valued versus Multivalued Attribute
  - Stored versus Derived Attributes
  - Identifier Attributes

Identifiers (Keys)

- Identifier (Key) - An attribute (or combination of attributes) that uniquely identifies individual instances of an entity type
- Simple Identifier (Key) versus Composite Identifier (Key)
- Do not include foreign keys in ER diagram
More on Relationships

- **Relationship Types vs. Relationship Instances**
  - The relationship type is modeled as the diamond and lines between entity types…the instance is between specific entity instances
- **Relationships can have attributes**
  - These describe features pertaining to the association between the entities in the relationship
- **Two entities can have more than one type of relationship between them (multiple relationships)**

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Degree of Relationships

- **Degree of a Relationship** is the number of entity types that participate in it
  - **Unary Relationship**
  - **Binary Relationship**
  - **Ternary Relationship**
Cardinality of Relationships

- One – to – One
  - Each entity in the relationship will have exactly one related entity

- One – to – Many
  - An entity on one side of the relationship can have many related entities, but an entity on the other side will have a maximum of one related entity

- Many – to – Many
  - Entities on both sides of the relationship can have many related entities on the other side

Cardinality Constraints

- Cardinality Constraints - the number of instances of one entity that can or must be associated with each instance of another entity.

- Minimum Cardinality
  - If zero, then optional
  - If one or more, then mandatory

- Maximum Cardinality
  - The maximum number

Unary relationships -- figure 3-12a

Binary relationships -- figure 3-12b

Ternary relationships –figure 3-12c

Note: a relationship can have attributes of its own
Basic relationship with only maximum cardinalities showing – figure 3-16a

Mandatory minimum cardinalities – figure 3-17a

Optional cardinalities with unary degree, one-to-one relationship – figure 3-17c

Representing a bill-of-materials structure

Examples of multiple relationships – entities can be related to one another in more than one way

Strong vs. Weak Entities, and Identifying Relationships

- **Strong entities**
  - exist independently of other types of entities
  - has its own unique identifier
  - represented with single-line rectangle

- **Weak entity**
  - dependent on a strong entity…cannot exist on its own
  - does not have a unique identifier
  - represented with double-line rectangle

- **Identifying relationship**
  - links strong entities to weak entities
  - represented with double line diamond
**Associative Entities**

- It’s an **entity** – it has attributes
- AND it’s a **relationship** – it links entities together
- When should a relationship with attributes instead be an associative entity?
  - All relationships for the associative entity should be many
  - The associative entity could have meaning independent of the other entities
  - The associative entity preferably has a unique identifier, and should also have other attributes
  - The associative may be participating in other relationships other than the entities of the associated relationship

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**Figure 3-5: Strong and weak entities**

![Strong and weak entities](image)

**Figure 3-11b: An associative entity (CERTIFICATE)**

![CERTIFICATE](image)

**Figure 3-22**

E-R diagram for Pine Valley Furniture