

Databases Illuminated

Chapter 3

The Entity Relationship Model

Purpose of E-R Model

- Facilitates database design
- Express logical properties of mini-world of interest within enterprise - **Universe of Discourse**
- Conceptual level model
- Not limited to any particular DBMS
- E-R diagrams used as design tools
- A semantic model – captures meanings

Symbols used in E-R Diagram

- Entity – rectangle
- Attribute – oval
- Relationship – diamond
- Link - line

Entity

- Object that exists and that can be distinguished from other objects
- Can be person, place, event, object, concept in the real world
- Can be physical object or abstraction
- Entity **instance** is a particular person, place, etc.
- Entity **type** is a category of entities
- Entity **set** is a collection of entities of same type
- Entity set must be well-defined
- Entity type and set definition form **intension** of entity – permanent definition part
- Entity instances and actual set form **extension** of entity – all instances that fulfill the definition at the moment
- In E-R diagram, rectangle represents entity set

Attributes

- Defining properties or qualities of entity type
- Represented by oval on E-R diagram
- **Domain** – set of allowable values for attribute
- Attribute maps entity set to domain
- May have **null values** for some entity instances
– no mapping to domain for those instances
- May be **multi-valued** – use double oval on E-R diagram
- May be **composite** – use oval for composite attribute, with ovals for components connected to it by lines
- May be **derived** – use dashed oval

Keys

- **Superkey:** an attribute or set of attributes that uniquely identifies an entity
- **Composite key:** key with more than one attribute
- **Candidate key:** superkey such that no proper subset of its attributes is also a superkey (minimal superkey – has no unnecessary attributes)
- **Primary key:** the candidate key actually used for identifying entities and accessing records
- **Alternate key:** candidate key not used for primary key
- **Secondary key:** attribute or set of attributes used for accessing records, but not necessarily unique
- **Foreign key:** term used in relational model (but not in the E-R model) for an attribute that is primary key of a table and is used to establish a relationship, usually with another table, where it appears as an attribute also

Relationships

- Connections or interactions between entity instances
- Represented by diamond on E-R diagram
- Relationship **type** – category of relationships
- Relationship **set** – collection of relationships of same type
- Relationship instances – relationships that exist at a given moment
- Type forms intension; set with instances forms extension of relationship
- Relationship can have descriptive attributes
- **Degree** of relationship
 - **Binary** – links two entity sets; set of ordered pairs
 - **Ternary** – links three entity sets; ordered triples
 - **N-ary** – links n entity sets; ordered n-tuples
 - Note: ternary relationships may sometimes be replaced by two binary relationships (see **Figure 3.5** and **Figure 3.13**)

Cardinality of Relationships

- Number of entity instances to which another entity set can map under the relationship
- **One-to-one:** X:Y is 1:1 if each entity in X is associated with at most one entity in Y and each entity in Y with at most one entity in X.
- **One-to-many:** X:Y is 1:M if each entity in X can be associated with many entities in Y, but each entity in Y with at most one entity in X.
- **Many-to-many:** X:Y is M:M if each entity in X can be associated with many entities in Y, and each entity in Y with many entities in X (many=more than one)
- **Figure 3.7** shows several representation methods

Relationship Participation Constraints

- **Total participation**

- Every member of entity set must participate in the relationship
- Represented by double line from entity rectangle to relationship diamond

- **Partial participation**

- Not every entity instance must participate
- Represented by single line from entity rectangle to relationship diamond

Roles

- **Role:** function that an entity plays in a relationship
- Optional to name role of each entity, but helpful in cases of
 - Recursive relationship – entity set relates to itself
 - Multiple relationships between same entity sets

Existence Dependency and Weak Entities

- **Existence dependency:** Entity Y is existence dependent on entity X is each instance of Y must have a corresponding instance of X
- In that case, Y must have **total participation** in its relationship with X
- If Y does not have its own candidate key, Y is called a **weak entity**, and X is **strong entity**
- Weak entity may have a partial key, called a **discriminator**, that distinguishes instances of the weak entity that are related to the same strong entity
- Use double rectangle for weak entity, with double diamond for relationship connecting it to its associated strong entity
- Note: not all existence dependent entities are weak – the lack of a key is essential to definition

ER Diagram Example

- See **Figure 3.12**