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Entity-Relationship Model – Part 2

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Basic Modeling Concepts

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Entity-Relationship (ER) Model

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- Originally proposed by Peter Chen in 1976.
- Shortly after its introduction, the ER model became the most popular data model used in conceptual database design.

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Entity-Relationship (ER) Model

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- Originally proposed by Peter Chen in 1976.
- Shortly after its introduction, the ER model became the most popular data model used in conceptual database design.

- A data model normally has three key aspects:

(1) **Data structure:**

Data in the ER model is represented as **entities** and **relationships** with **attributes**.

(2) **Data integrity:**

For the ER model, **keys** are for entity/relationship types, and **cardinality/participation constraints** for relationship types.

(3) **Data manipulation:**

No standard data manipulation operations are associated with the ER model.

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Entity-Relationship (ER) Model

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- Comparing key concepts in the relational data model and the ER model:

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Relational Data Model	Entity-Relationship Model
Attribute	
Domain	
Superkey/primary key/candidate key	
Role	Entity/Relationship
Relation	Entity set/Relationship set
Relation schema	Entity type/Relationship type



Entity-Relationship (ER) Model

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- **ER diagrams** diagrammatic notation associated with the ER model.
 - They are relatively simple;
 - They are user-friendly;
 - They can provide a unified view of data which is independent of any implemented data model.
- There are a number of ER diagrammatic notations available. We shall closely follow the one used by Chen and its variations.
 - **Attributes** are represented as *ovals*;
 - **Key attributes** are *underlined*;
 - **Entity types** are represented as *rectangles*;
 - **Relationship types** are represented as *diamonds*.

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Entities and Attributes

- **Entities:** "Things" in the real world (with independent existence).

- e.g., an individual person

- **Relationships:** Associations between entities.

- e.g., a person is a friend of another person

- **Attributes:** Properties that describe entities and relationships.

- **Composite** versus **simple** (atomic) attributes

- **Single-valued** versus **multivalued** attributes

- **Stored** versus **derived** attributes

- **NULL** values

- **Complex** (nesting of composite and multivalued) attributes

- **Domains of attributes:** For each attribute, a domain is associated, i.e., a set of permitted values for an attribute.



Entity Types and Entity Sets

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- An **entity type** defines a collection (or set) of entities that have the same attributes.

- Described by its name and attributes.

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- An **entity set** is a collection of all entities of a particular entity type in the database at any point in time.

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Relationship Types and Relationship Sets

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- A **relationship type** is an association between two or more entity types, and can have attributes as well.

(We also say: such entity types **participate in** a relationship type)

Example:

- Employee **works for** Department
- Employee **registers** a Customer at Branch office
- **Degree of relationship type:** the number of participating entity types. We can have binary, ternary, ..., n-ary.
- A **relationship set** is the set of associations between entities of the entity types that participate in the relationship type.





Keys

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- The definitions for **superkey/primary key/candidate key** of an entity type is the same as for a relation schema.

• A **superkey** of an entity type is a set of one or more attributes whose values uniquely determine each entity in an entity set.

- A **candidate key** of an entity type is a minimal (in terms of number of attributes) superkey.

• For an entity type, several candidate keys may exist. During conceptual design, one of the candidate keys is selected to be the **primary key** of the entity type.

- A **primary key** of a relationship type is the combination of primary keys of the entity types that participate in the relationship type.

Constraints on Relationships

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- Below are useful constraints in describing binary relationship types:

~~• Cardinality ratios~~
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- Specifies the *maximum* number of relationships that an entity can participate in.

~~• Participation constraints (total, partial)~~
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- Specifies whether the existence of any entity depends on its being related to another entity via the relationship type.

Constraints on Relationships - Cardinality Ratios

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- **Many-To-Many**



Meaning: An employee can work for many departments (≥ 0), and a department can have several employees.

- **One-To-Many**



Meaning: An employee can work for at most one department (≤ 1), and a department can have several employees.

- **One-To-One**

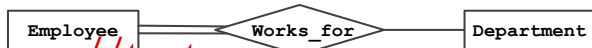


Meaning: An employee can work for at most one department, and a department can have at most one employee.

Constraints on Relationships - Participation constraints

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- **Total**



Meaning: Each employee must work for a department and each department may or may not have employees.

- **partial (default)**



Meaning: An employee may or may not work for a department and each department may or may not have employees.

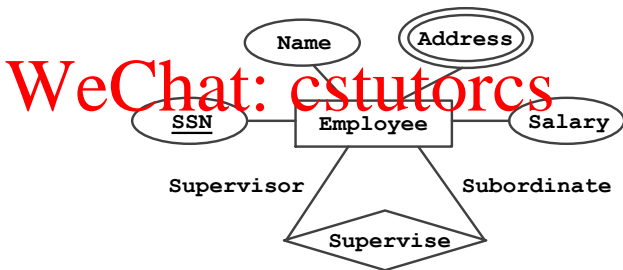


Recursive Relationships

- Recursive relationships

Same entity type can participate more than once in a relationship type in different roles, e.g., marriage between persons and parent-child between persons

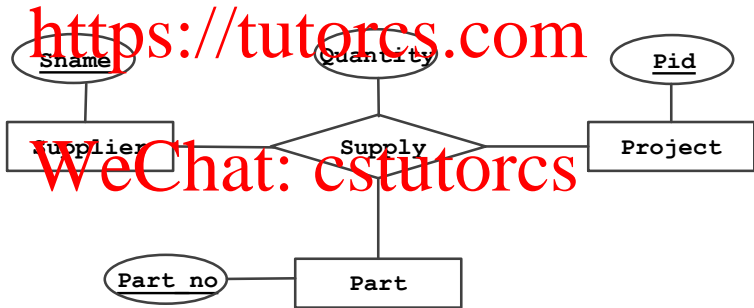
- A **role name** signifies the role that a participating entity plays in each relationship.



Higher-Degree Relationship Types

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- We may use higher-degree relationship types to model more complicated relationships, i.e., involving multiple entity types.





Weak Entity Types

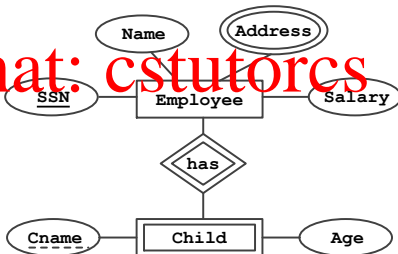
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- A **weak entity type** is an entity type that does not have sufficient attributes to form a primary key.

- Its existence depends on the existence of an identifying entity type, and the relationship between them is called an **identifying relationship**.

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Design Choices for the ER Model

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- It is possible to define entities and their relationships in a number of different ways.

- Some questions: <https://tutorcs.com>

- Should a concept be modeled as **an entity type or an attribute**?

- Should a concept be modeled as **an entity type or a relationship type**?

- Should a concept be modeled as **a ternary relationship type or several binary relationship types**?