
Ministry of Higher Education and Scientific

Research

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قسم الأعلام الالي

Chapter II: Conceptual Data Model Entity/Association (Reminders and Additions)

2nd Year LMD - Relational Databases

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Basic Concepts

- Since the Entity-Association (EA) model is a conceptual model, it describes the real world using generic concepts:
- **Objects → Entities**
- **Links → Associations**
- **Properties → Attributes**
- **Entity:** A representation of a real-world object (concrete or abstract) that has an independent existence. Each entity is associated with attributes or properties.
Example: The external world object "employee" corresponds to the entity "Employee" in the EA model, with attributes like employee ID, name, surname, address, etc.
- **Association:** A link between multiple entities, which can also have properties.
Example: The "Assigned to" link between the entity "Employee" and the entity "Department" with the attribute "Assignment Date."
- **Role of an Association:** In an association, each entity plays a specific role. An association can be:
 - **Binary** (2 roles)
 - **Cyclic** (2 roles linking the same entity, requiring named roles)
 - **Ternary** (3 roles are mandatory)
- **Cardinality:** The minimum/maximum number of times each entity occurrence participates in the association.

Multiple Representations:

Generalization/Specialization

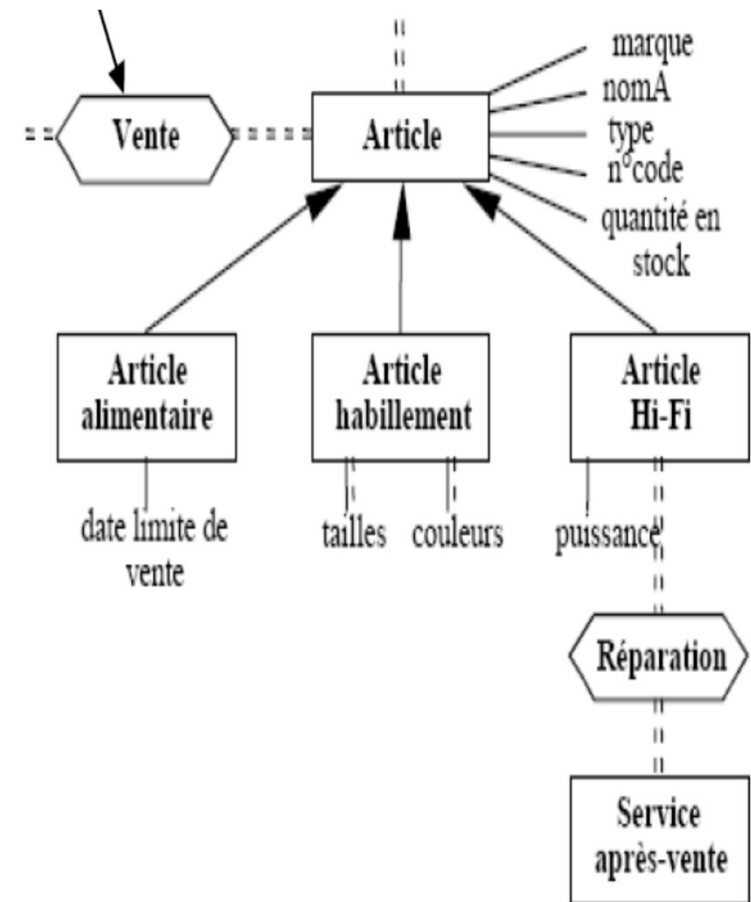
- An object set can be viewed in two ways:
 1. As a **single entity**
 2. As **multiple different entities** despite having common characteristics.
- To model such situations, recent data models include **generalization/specialization**:
- A **directed link** from a **specific entity** to a **generic entity**.
- Often called "**IS-A**" links.

Generalization/Specialization Example

In a supermarket database:

- The entity "**Article**" groups all sold items.
- The entity "**Article**" is **generic**, with specialized entities:
 - "Food Article"
 - "Clothing Article"
 - "Hi-Fi Article"
- These specialized entities inherit attributes from the **generic entity** and may have their own specific attributes (e.g., "expiration date" for food articles).

Inheritance of Association Roles: Specific entities inherit the associations of their generic entity (vente association is generic and is then inherited) also it may exist additional specific associations (réparation is a spécifique association available for hifi-article)



EA Schema Description: Attributes

- **Simple Attribute:** Cannot be decomposed further; values are atomic (e.g., salary, phone number).
- **Complex Attribute:** Can be decomposed into smaller attributes (e.g., address → street, city, postal code).
- **Single-Valued Attribute:** Holds a single value per occurrence (e.g., name, birthdate).
- **Multi-Valued Attribute:** Can hold multiple values per occurrence (e.g., phone numbers).
- **Mandatory Attribute:** Must have at least one value per occurrence (e.g., name, surname).
- **Optional Attribute:** May or may not have a value (e.g., salary, phone numbers).

EA Schema Description: Integrity Constraints

- **Integrity constraints (ICs)** define the rules that data must follow to ensure database consistency. They must be simple to express and automatically verified during insertions, modifications, or deletions.
- IC should be identified early in the **requirements analysis** and **design phase**.
- Apply to **attributes**, **entities**, and **associations**.
- **Examples:**
 - **Attribute constraint:** Values must follow a specific format or range (e.g., Gender {M/F}, DeliveryDate > OrderDate).
 - **Entity constraint:** Ensuring correct entity relationships.
 - **Association constraint:** Defining valid links between entities.
- ICs are implemented using: **Data Definition Language (DDL)**, **Triggers (automated database rules)** and **Application programs**
- If the database values **do not satisfy these constraints**, the database is considered **inconsistent**.

Integrity Constraints in Generalization/Specialization

- In generalization/specialization, constraints define how populations are divided among subclasses.
- **Basic Constraints:**
 - 1.Coverage Constraint:** The union of populations of specialized entities must equal the population of the generic entity.
Formula: $\{ES1\} \cup \{ES2\} \cup \dots \{ESn\} = \{EG\}$
 - 2.Disjunction Constraint:** The populations of specialized entities must not overlap.
Formula: $\{ES1\} \cap \{ES2\} = \emptyset$

Combinations:

- **Partition Constraint** = Coverage + Disjunction (population is fully and exclusively divided).
- **Exclusion Constraint** = No Coverage + Disjunction (population is partially divided with no overlap).
- **Totality Constraint** = Coverage + No Disjunction (population is fully divided with overlap).
- **No Constraint** = Neither coverage nor disjunction is enforced.

EA Model: Conclusion

- A **conceptual entity-association schema** consists of: **Entity types**
Association types (with attributes and generalization links) **Integrity constraints (ICs)**
- **Schema Representation:**
EA Conceptual Schema = ({Entities}, {Associations}, {ICs})