Chapter 5

Entity-Relationship Modeling (Continued)

Structural Constraints

• Two main types of restrictions on relationships are:
  • Cardinality Constraints
  • Participation Constraints
Cardinality Constraints

- Determines the number of possible relationships for each participating entity.

- Most common degree for relationships is binary with cardinality ratios of:
  - one-to-one (1:1),
  - one-to-many (1:M) or
  - many-to-many (M:N)

Staff Manages Branch (1:1) Relationship

A Semantic Net Model of Staff Manages Branch Relationship
**Staff Oversees Property for Rent (1:M) Relationship**

Staff No

\[\text{Staff} \rightarrow 1 \text{Oversees} \rightarrow M \text{Property for Rent}\]

**Semantic Net Diagram of Staff Oversees Property for Rent Relationship**

- Staff No
  - Name
  - Position
- Property No
  - Address
  - Type
- Staff No 1
  - Name
  - Position
- Property No 1
  - Address
  - Type
- PG21 16 Dale Rd
  - Glasgow House
- PG36 2 Manor Rd
  - Glasgow Flat
- PA14 16 Holhead
  - Aberdeen House

**Newspaper Advertises Property for Rent (M:N) Relationship**

Newspaper Name

\[\text{Newspaper} \rightarrow M \text{Advertises} \rightarrow N \text{Property for Rent}\]

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**Semantic Net Diagram of Newspaper Advertises Property_for_Rent Relationship**

![Semantic Net Diagram](image)

**Participation Constraints**

- Determines whether the existence of an entity depends on its being related to another entity through the relationship.
  - **Total Participation**
  - **Partial Participation**

- **Total Participation**
  - The participation is total if an entity’s existence requires the existence of an associated entity in a particular relationship.

- **Partial Participation**
  - The participation is partial for the vice versa.
**Participation Constraints of Branch IsAllocated Staff Relationship**

Every Branch Office is allocated members of Staff

Total Participation

**Participation Constraints of Branch IsAllocated Staff Relationship**

A member of Staff need not work at a Branch office

Partial Participation

**Semantic Net Model of the Branch IsAllocated Staff Relationship**
Displaying Participation Constraints using 
(Min, Max) Notation

At least 5 staff are allocated to a Branch

No more double-line

If Min > 0, always Total
Displaying Participation Constraints using (Min, Max) Notation

A Staff can work at a maximum of one Branch

Problems with ER Models

- Problems may arise when designing a conceptual data model called connection traps.
- Often due to a misinterpretation of the meaning of certain relationships.

The Enhanced ER Models
Since the 1980s there has been an increase in the emergence of new database applications with more demanding requirements.

Basic concepts of ER modeling are not sufficient to represent the requirements of the newer, more complex applications.

Response is development of additional ‘semantic’ modeling concepts.

Semantic concepts are incorporated into the original ER model and is called the Enhanced Entity-Relationship (EER) model.

Additional concepts of EER model includes specialization / generalization, and categorization.

An entity type that includes distinct Subclasses that require to be represented in a data model.
**Subclass**

- A Subclass is an entity type that has a distinct role and is also a member of the Superclass.

**Superclass/Subclass**

```
  Staff
    /\    \    /
   /  \   /  \\
Manager Secretary Sales
```

**Inheritance**

- **Attribute Inheritance**
  
  - An entity in a Subclass may possess subclass specific attributes, as well as those associated with the Superclass.
**Concept of Specialization / Generalization**

- **Specialization**
  – The process of maximizing the differences between members of an entity by identifying their distinguishing characteristics.

- **Generalization**
  – The process of minimizing the differences between entities by identifying their common features.
Specialization of Staff Entity into Job Roles Subclasses

Concept of Specialization / Generalization

- Specialization and generalization has:
  
  - Disjoint Constraints
  
  - Participation Constraints

Disjoint Constraints

- Disjoint
  - Members in different Subclasses from the same Superclass are completely different.

- Non-Disjoint
  - Members in a Superclass can be enrolled in more than one Subclass.
Specialization of Staff Entity into Job Roles and Contract of Employment Subclasses

Disjoint Constraints

Non-Disjoint Constraints

A Sales Manager is Manager & Sales Personnel

Participation Constraints

• Total
  – All member in the Superclass must participate in either one Subclass.

• Partial
  – At least one member in the Superclass does not participate in the Subclass.
**Specialization of Staff Entity into Job Roles and Contract of Employment Subclasses**

- **Partial Constraints**
  - Manager
  - Secretary
  - Sales Personnel

- **Total Constraints**
  - At least one staff is not Manager, Secretary, or Sales Personnel

**Summary of Specialization/Generalization Notation**

<table>
<thead>
<tr>
<th>Notation</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>Supervisors/Managers relationship - Regular, Full-time</td>
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<td>Supervisors/Managers relationship - Regular, Part-time</td>
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<td>Supervisors/Managers relationship - Full-time, Part-time</td>
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</tbody>
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**Categorization**

- The modeling of a single subclass (called a category) with a relationship that involves more than one distinct superclass.

- A category subclass has selective inheritance.

- Divided based on total or partial participation.
  - Total - every occurrence of all superclasses must appear in the category.
  - Partial - constraint is removed.
Building an EER Model

- Identify entity types.
- Identify relationship types.
- Determine cardinality and participation constraints of relationship types.
- Identify and associate attributes with entity or relationship types.

Building an EER Model

- Determine candidate and primary key attributes.
- Specialize / generalize entity types.
- Categorize entity types.
- Draw the EER Diagram.

Summary of Entity-Relationship Notation

<table>
<thead>
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<tr>
<td></td>
<td>True Strong Entity Type</td>
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<td></td>
<td>True Weak Entity Type</td>
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<td></td>
<td>True Relationship Type</td>
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<td>True Weak Relationship Type</td>
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<td>The Attribute</td>
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<td>The Primary Key Attribute</td>
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<td>The Multivalued Attribute</td>
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<td>The Composite Attribute</td>
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