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Enhanced Entity-Relationship Models

Prerequisites for Next Section

🔆 **Readings:**

🔹 **Required:** Connolly and Begg, sections 12.1-12.3

🔆 **Assessments**

🔹 Multiple-Choice Quiz 5

In this section you will learn:

① Limitations of basic concepts of the ER

② Specialization is the process of maximizing differences between members of an entity by identifying their distinguishing features

③ Generalization is the process of minimizing differences between entities by identifying their common features.

④ Two constraints that may apply to a specialization/ generalization: participation constraints and disjoint constraints.

⑤ A diagrammatic technique for displaying specialization/ generalization in an EER diagram using UML.

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1. Limitations of ER models

2. Specification and Generalization

3. Constraints on Specification / Generalization

Example

⬥ The relation AllStaff holds the details of members of staff no matter what position they hold.

Attributes appropriate for all staff				Attributes appropriate for branch Managers		Attributes appropriate for Sales Personnel		Attribute appropriate for Secretarial staff
staffNo	name	position	salary	mgrStartDate	bonus	sales Area	car Allowance	typing Speed
SL21	John White	Manager	30000	01/02/95	2000			
SG37	Ann Beech	Assistant	12000					
SG66	Mary Martinez	Sales Manager	27000			SA1A	5000	
SA9	Mary Howe	Assistant	9000					
SL89	Stuart Stern	Secretary	8500					100
SL31	Robert Chin	Snr Sales Asst	17000			SA2B	3700	
SG5	Susan Brand	Manager	24000	01/06/91	2350			

- Problems:

  While the attributes appropriate to all staff are filled (namely, staffNo, name, position, and salary), those are only applicable to particular job roles are only partially filled.

- Solution:

  - Introduce the concepts of **superclasses** and **subclasses** into an ER model.

  - Use **superclasses** and **subclasses** to avoid describing different types of staff with possible different attributes within a single entity

- Superclass

  - An entity type that includes one or more distinct subgroupings of its occurrences.

- Subclass

  - A distinct subgrouping of occurrences of an entity type.

Superclass/Subclass Relationships

⊕ Superclass/subclass relationship is one-to-one (1:1).

⊕ Superclass may contain overlapping or distinct subclasses.

⊕ Not all members of a superclass need be a member of a subclass.

⊕ Attribute Inheritance

  ⊞ An entity in a subclass represents the same 'real world' object as in superclass, and may possess subclass-specific attributes, as well as those associated with the superclass.

Enhanced Entity-Relationship Model

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

⊕ One additional concept of the EER model is called specialization / generalization.

Agenda

1. Limitations of ER models

2. Specification and Generalization

3. Constraints on Specification / Generalization

Specialization / Generalization

- **Specialization**

  - Process of maximizing differences between members of an entity by identifying their distinguishing characteristics.

  - Specialization is a **top-down** approach to identifying a set of subclasses of an entity type.

- **Generalization**

  - Process of minimizing differences between entities by identifying their common characteristics.

  - Generalization is a bottom-up approach to identifying a superclass from the original entity types.

⊕ The superclass and subclasses, being entities, are represented as rectangles.

⊕ The subclasses are attached by lines to a triangle that points toward the superclass.

⊕ The label below the specialization/generalization triangle, shown as {Optional/Mandatory, And/Or}, describes the constraints on the relationship between the superclass and its subclasses.

Example 1 -- AllStaff Relation

| Attributes appropriate for all staff				Attributes appropriate for branch Managers		Attributes appropriate for Sales Personnel		Attribute appropriate for Secretarial staff
staffNo	name	position	salary	mgrStartDate	bonus	sales Area	car Allowance	typing Speed
SL21	John White	Manager	30000	01/02/95	2000			
SG37	Ann Beech	Assistant	12000					
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Example 1 -- Specialization Process

- Specialization is a **top-dow**n approach to defining a set of superclasses and their related subclasses.

  - All members of staff are represented as an entity called Staff.

  - Apply the process of specialization on the Staff entity:

    - Take Staff as the superclass.

    - Specialize the Staff superclass into subclasses Manager, SalesPersonnel, and Secretary that represent job roles.
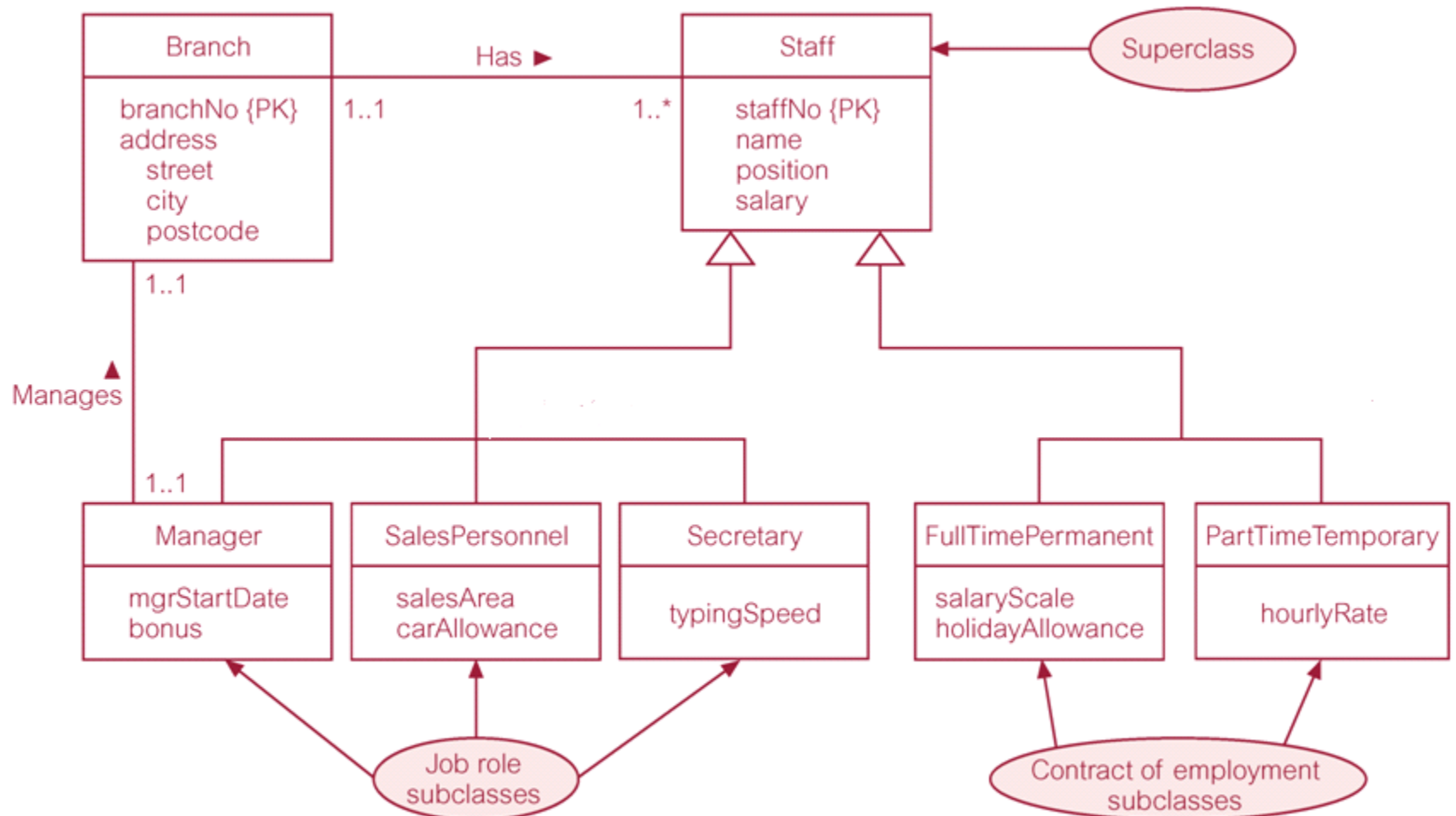
Example 1 – Diagrammatic Representation

- Specialization of Staff entity into subclasses representing job roles
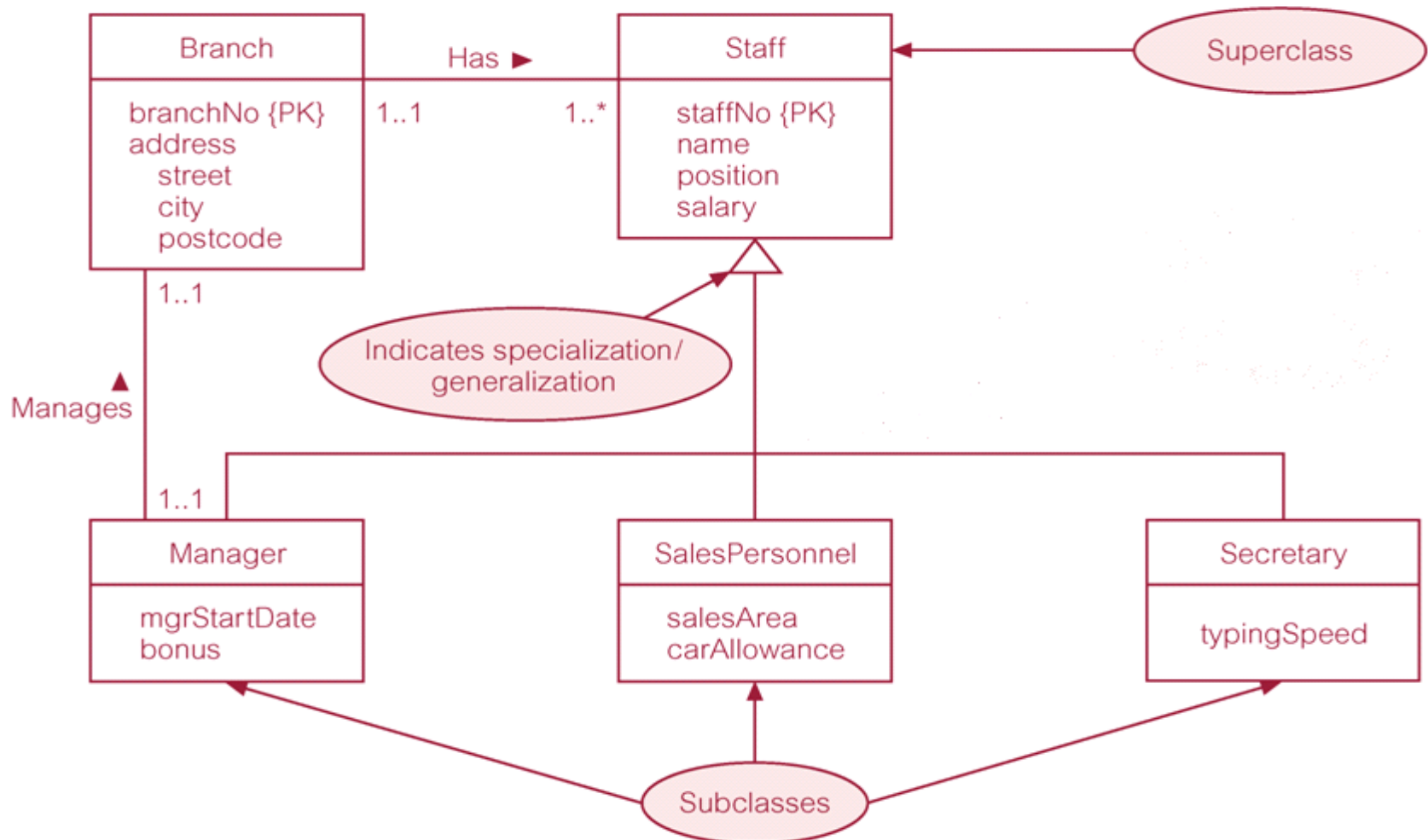
Example 2 – Several Specializations of Same Entity

❖ Specialization/Generalization of Staff entity into job roles and contracts of employment

1. Limitations of ER models

2. Specification and Generalization

3. Constraints on Specification / Generalization

◈ Two constraints that may apply to a specialization/generalization:

▪ **participation constraints**

- Determines whether every member in a superclass must participate as a member of a subclass.

- May be *mandatory* or *optional*.

▪ **disjoint constraints**

- Describes the relationship between members of the subclasses and indicates whether a member of a superclass can be a member of one, or more than one, subclass.

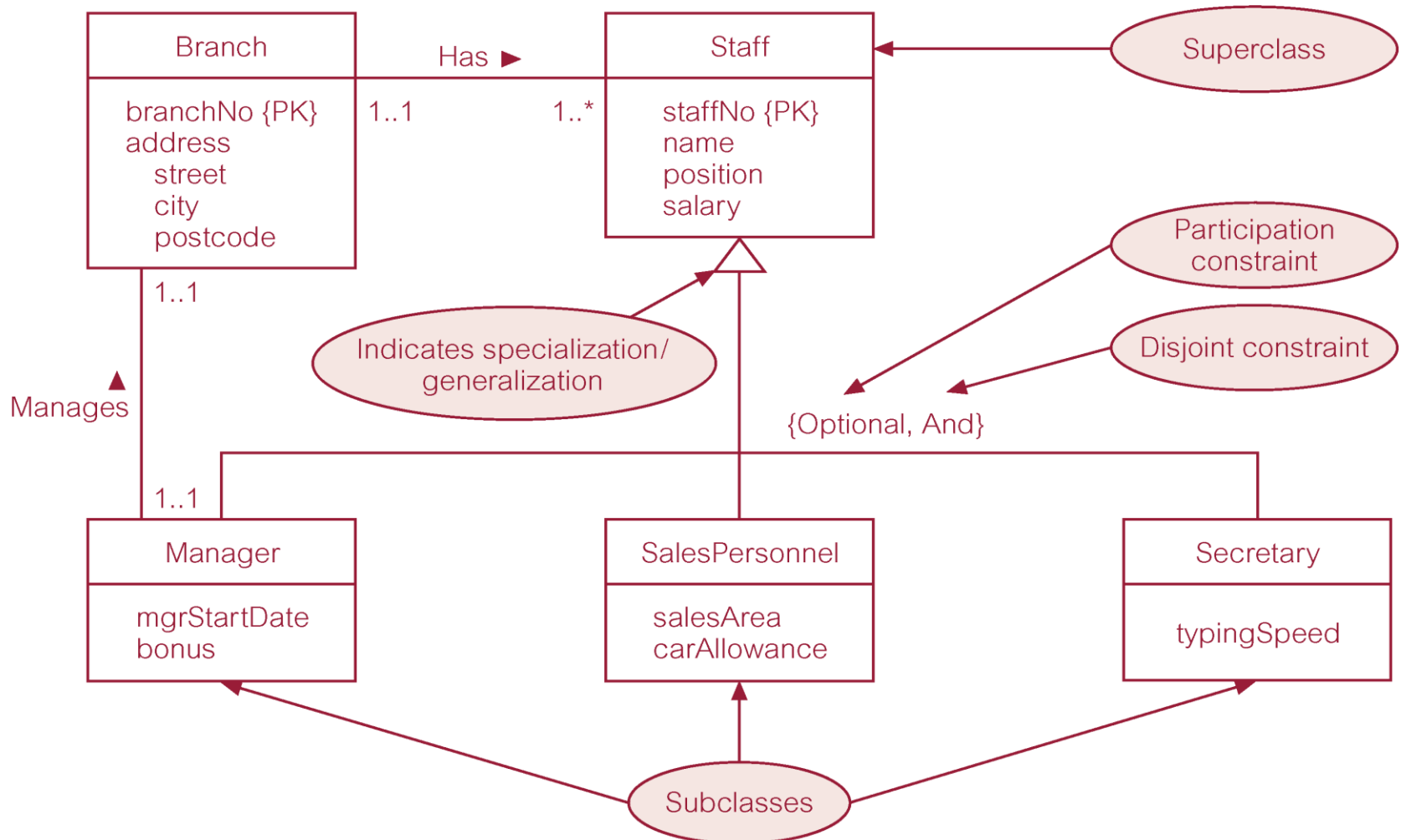- May be *disjoint* (**Or**) or *nondisjoint(And)*.

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♦ There are four categories of constraints of specialization and generalization:

- **mandatory** and **disjoint**

- **optional** and **disjoint**

- **mandatory** and **nondisjoint**

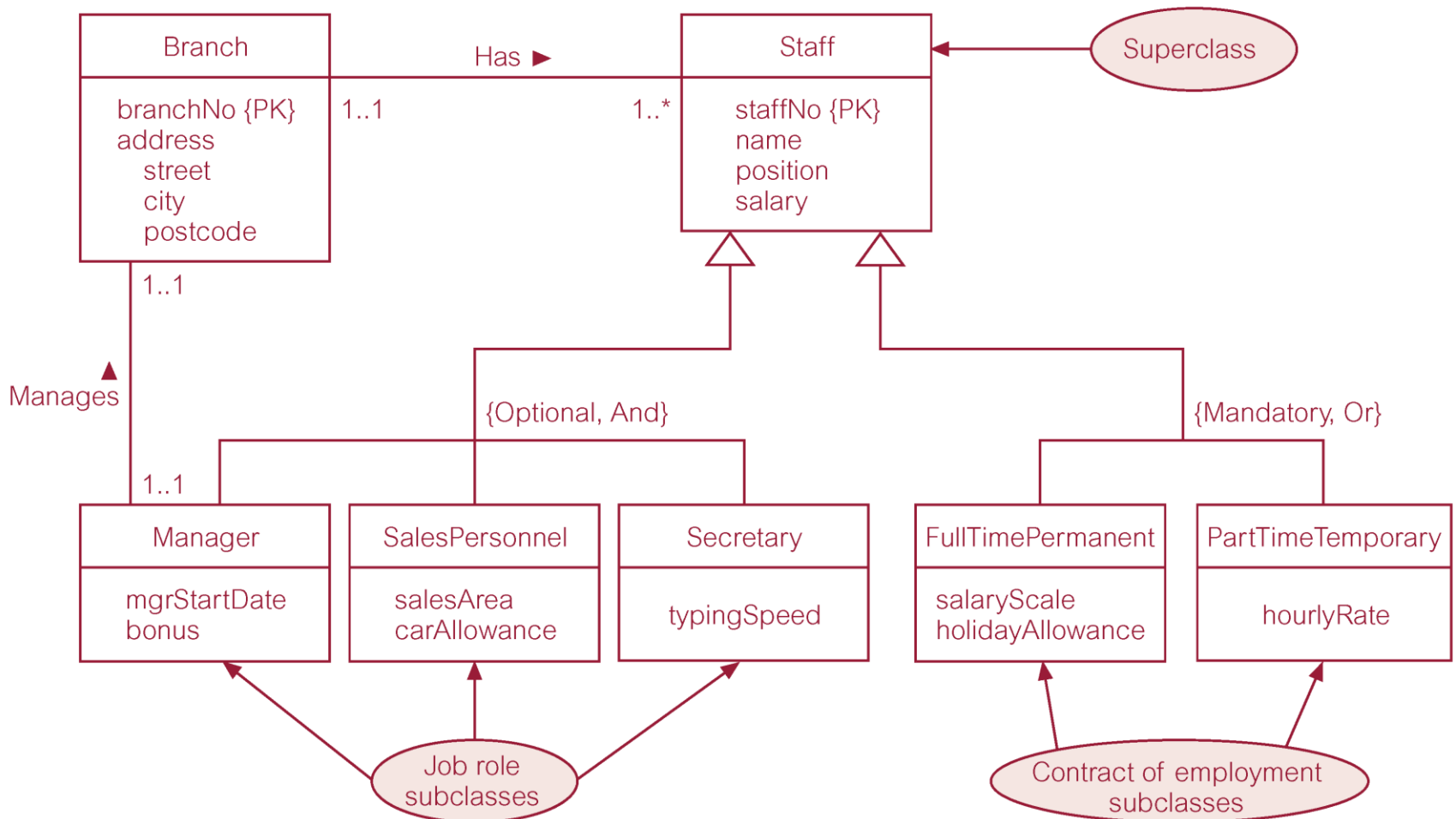- **optional** and **nondisjoint**

Example 1 – {Optional, And}

- Specialization of Staff entity into subclasses representing job roles

Example 2 – {Optional, And}and {Mandatory, Or}

- Specialization/Generalization of Staff entity into job roles and contracts of employment

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④ Two constraints that may apply to a specialization/ generalization: participation constraints and disjoint constraints.

⑤ A diagrammatic technique for displaying specialization/ generalization in an EER diagram using UML.

Questions?

Assignments

- **Multiple-Choice Quiz 5**

- **Exercise 4**

- **Readings:**

  - **Required:** Connolly and Begg, sections 15.1

- **Assessments**

  - Multiple-Choice Quiz 5