# Enhanced Entity Relationship Modeling

## SECP2523 DATABASE

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# Learning Objective

- At the end of the topic, students are able to:
  - Define basic concepts associated with EER diagram
  - Produce EER model to represent information to application system.

# Introduction

- Limitations of basic concepts of the ER model and requirements to represent more complex applications using additional data modeling concepts.

- Most useful additional data modeling concept of Enhanced ER (EER) model is called specialization/generalization.

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

# Enhanced Entity-Relationship Model

- To respond to increase requirements of more complex applications

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

- Response is development of additional 'semantic' modeling concepts.

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

- Examples of additional concept of EER model is called **specialization** / **generalization**.

# Specialization / Generalization

- **Superclass**
  - An entity type that includes one or more distinct subgroupings of its occurrences, which must be represented in a data model.

- **Subclass**
  - A distinct subgrouping of occurrences of an entity type, which must be represented in a data model.

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# Specialization / Generalization

- 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.

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# Specialization / Generalization

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

- **Specialization**
  - Process of maximizing differences between members of an entity by identifying their distinguishing characteristics.
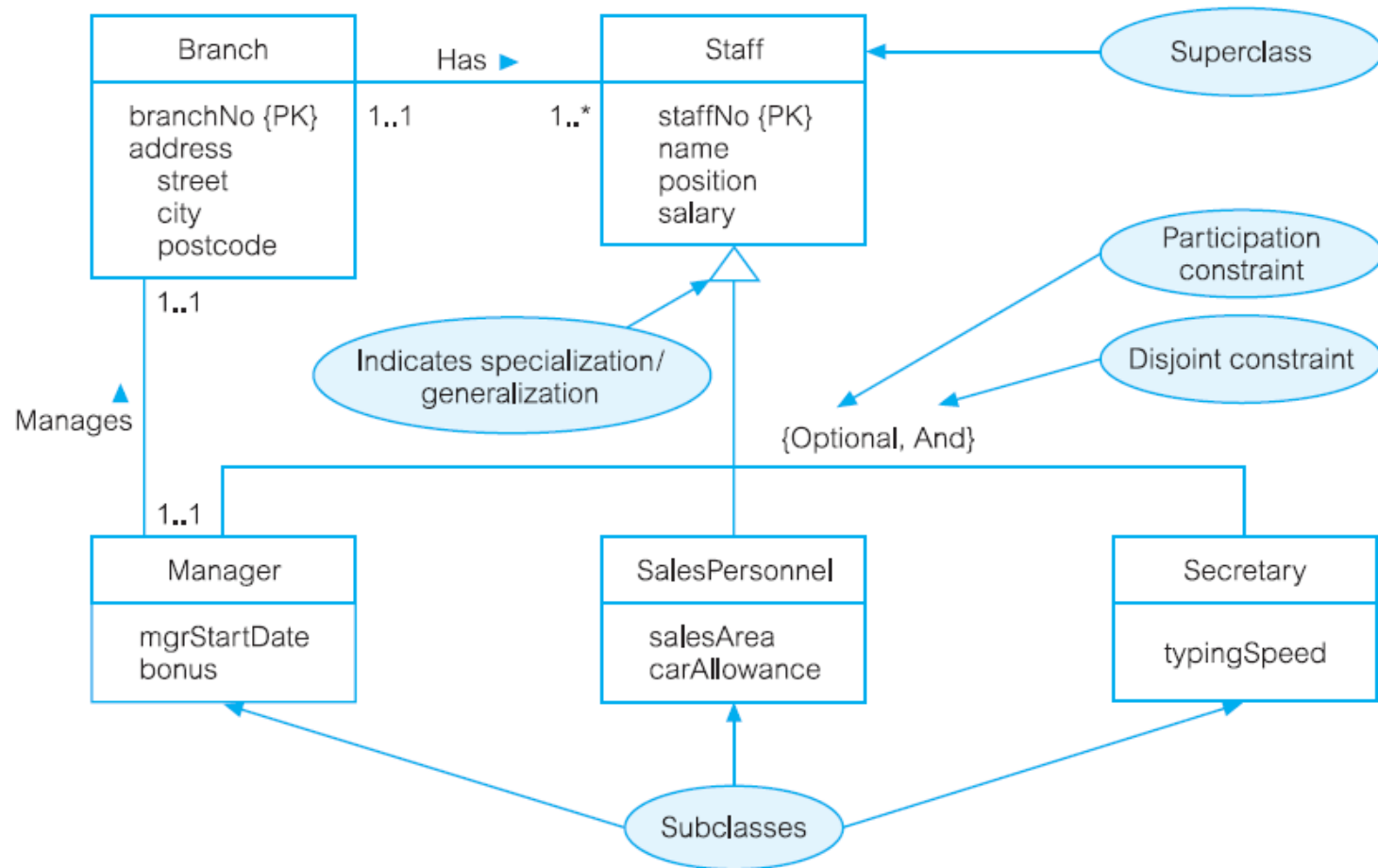
- **Generalization**
  - Process of minimizing differences between entities by identifying their common characteristics.

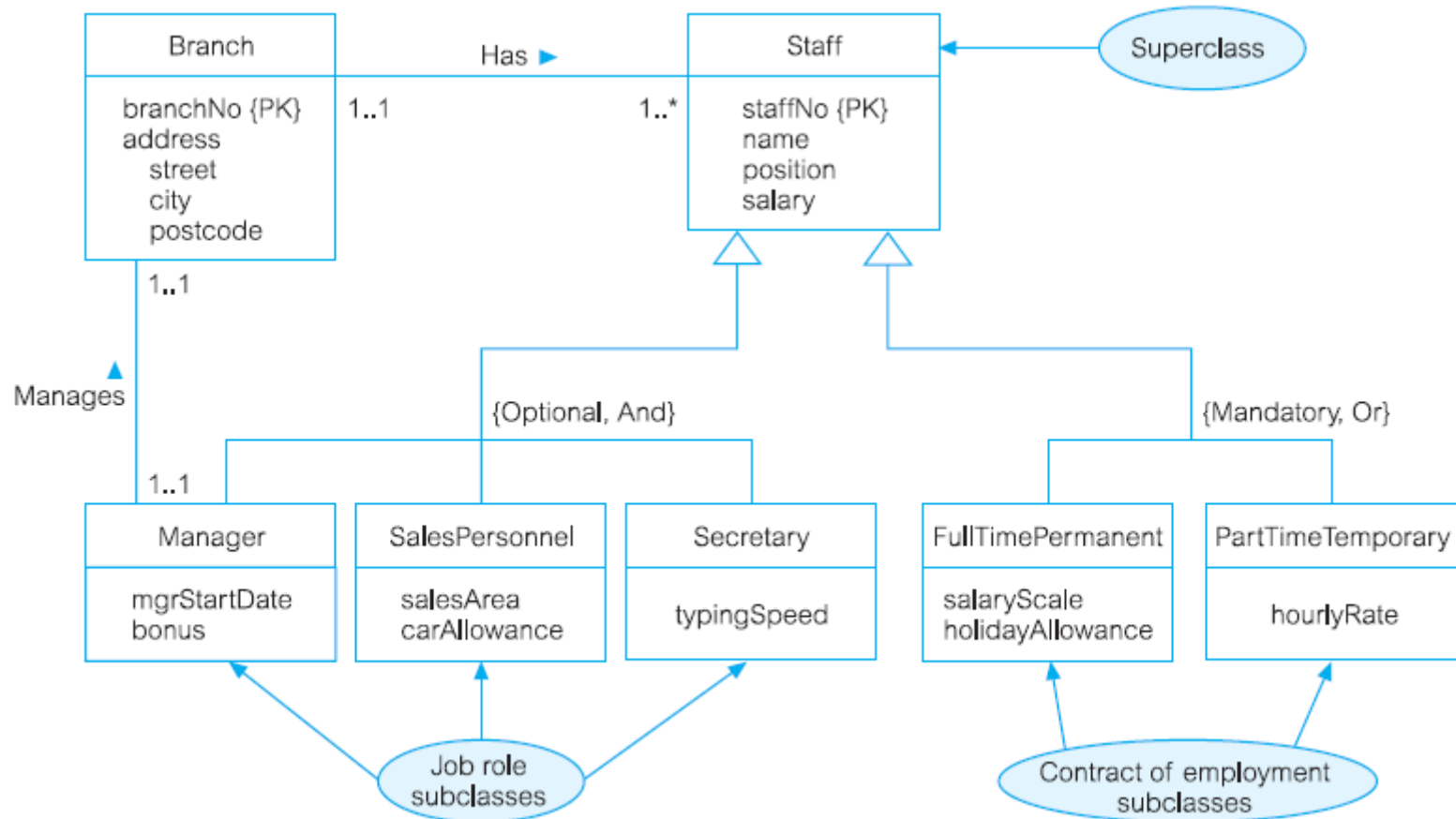# Example: AllStaff relation holding details of all staff

| | 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 | | | |

**Figure 13.1** The AllStaff relation holding details of all staff.

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# Specialization/generalization of Staff into subclasses representing job roles

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# Specialization/generalization of Staff into job roles and contracts of employment

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# EER diagram with shared subclass and subclass with its own subclass

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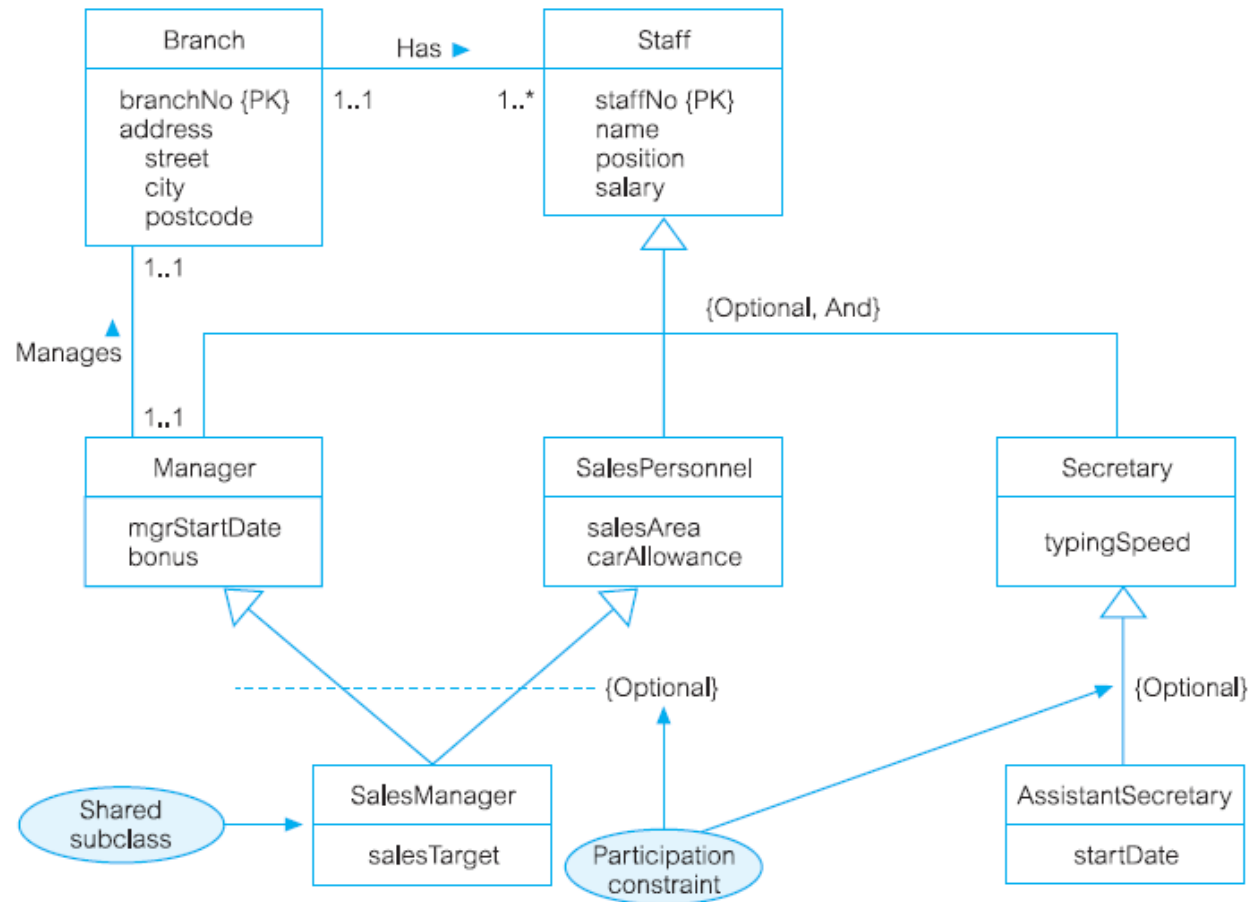
# Constraints on Specialization/Generalization

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

- **Participation constraint**
  - Determines whether every member in superclass must participate as a member of a subclass.
  - May be <u>mandatory</u> or <u>optional</u>.
  - **Mandatory**: Every member of superclass must be a member of a subclass
  - **Optional**: Every member of superclass need not belong to any of its subclasses

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# Constraints on Specialization/Generalization

- **Disjoint constraint**
    - Describes relationship between members of the subclasses and indicates whether member of a superclass can be a member of one, or more than one, subclass.
    - May be [disjoint](#) (OR) or [non-disjoint](#) (AND)
    - **Disjoint**: An entity occurrence can be a member of only one of the subclass
    - **Non-disjoint**: An entity occurrence can be a member of more than a subclass

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# Constraints on Specialization/Generalization

- There are four categories of constraints of specialization and generalization:
  - **mandatory and disjoint** {mandatory, or}
  - **optional and disjoint** {optional, or}
  - **mandatory and non-disjoint** {mandatory, and}
  - **optional and non-disjoint** {optional, and}

# Constraints on Specialization/Generalization

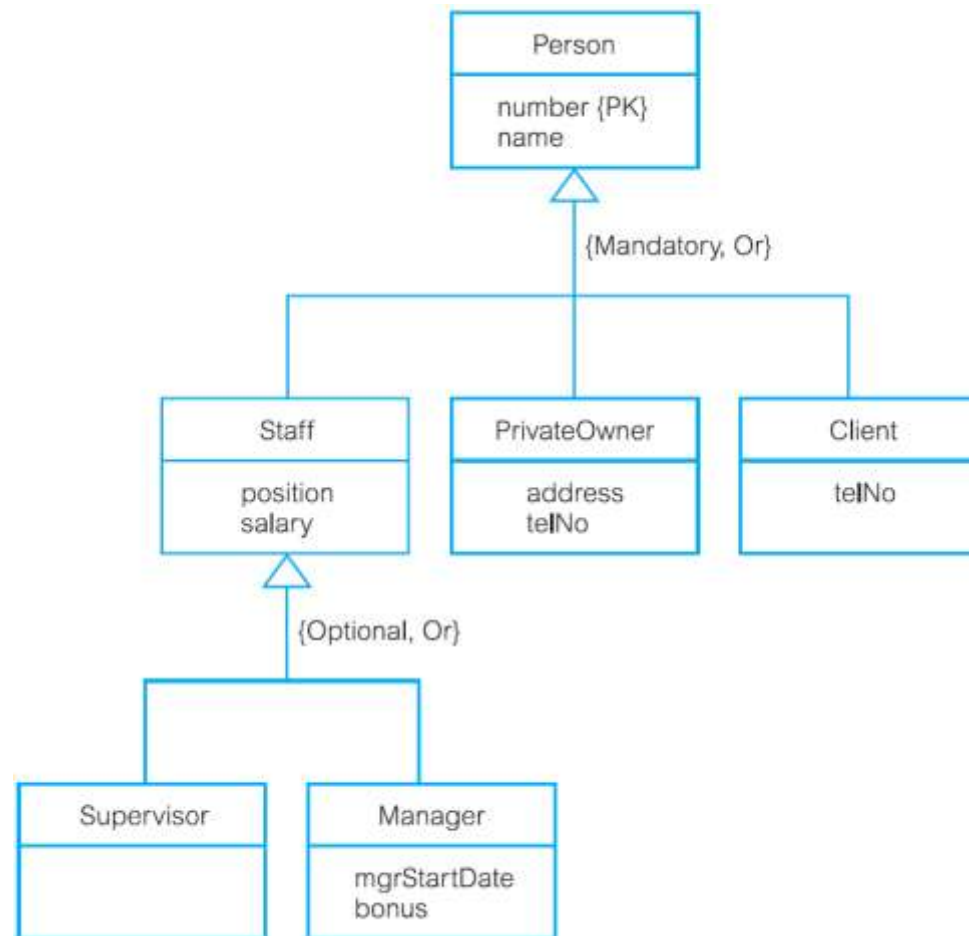| Participation constraint | Disjoint constraint | Tables required |
|---|---|---|
| Mandatory | Nondisjoint {And} | Single table |
| Optional | Nondisjoint {And} | Two tables: one table for superclass and one table for all subclasses |
| Mandatory | Disjoint {Or} | Many tables: one table for each combined superclass/subclass |
| Optional | Disjoint {Or} | Many tables: one table for superclass and one table for each subclass |

# DreamHome example - Staff **Superclass** with Supervisor and Manager **subclasses**
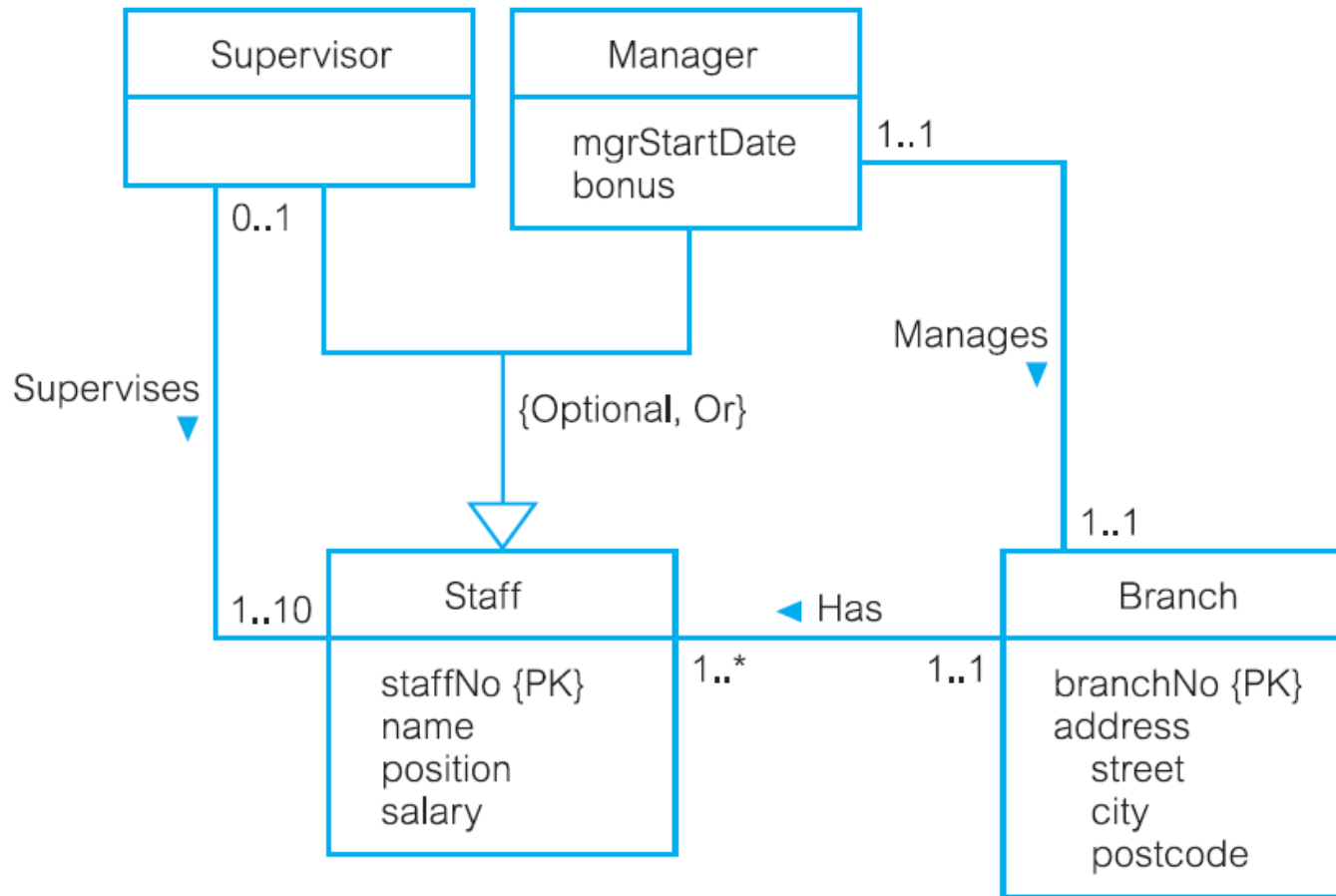
# DreamHome example - Owner Superclass with PrivateOwner and BusinessOwner subclasses

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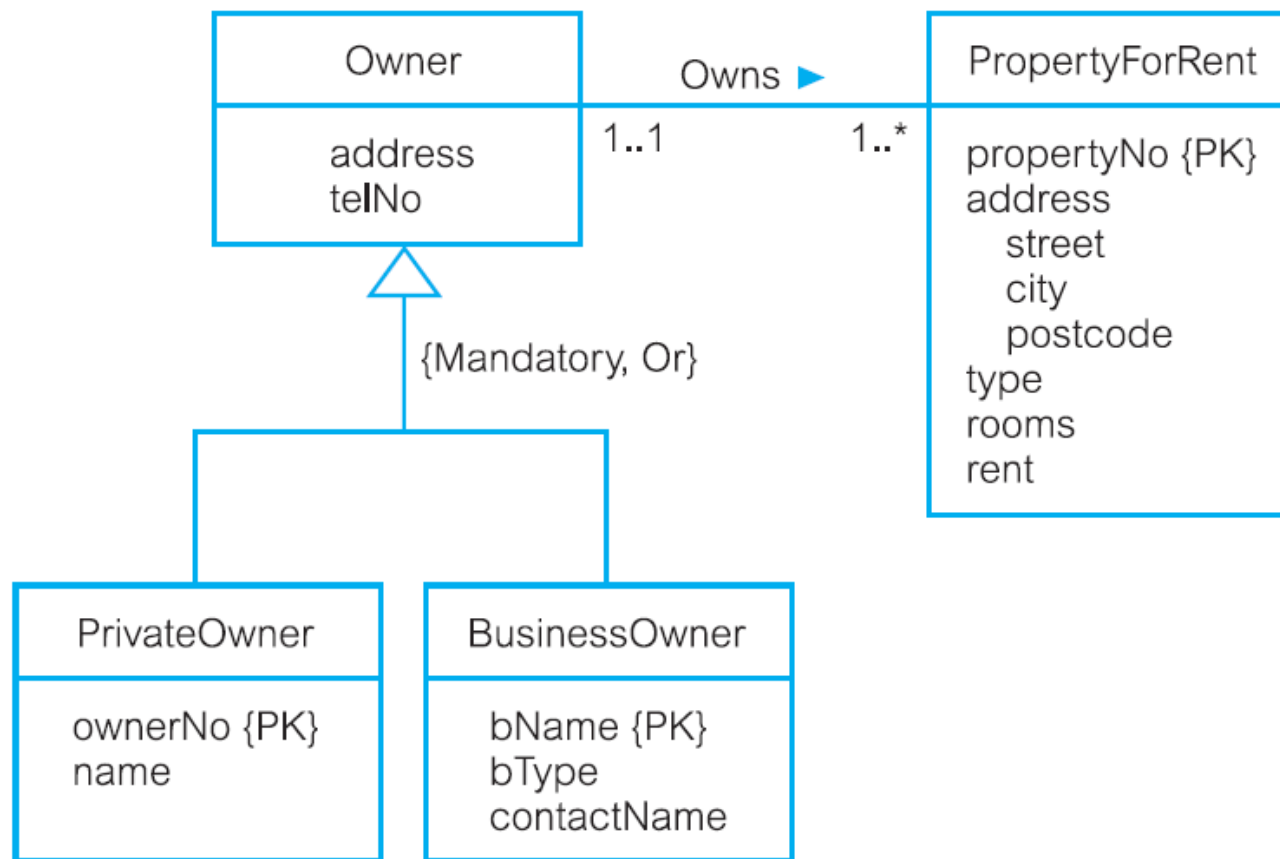
# DreamHome example - Person **superclass** with Staff, PrivateOwner, and Client **subclasses**

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# Problem 1:

- A car dealership wishes to maintain data about the customers who purchase a car. Each customer may purchase one or more vehicles and each vehicle can be purchased by many different customers over time (for example, a customer may purchase a new vehicle, trade that vehicle in and someone else can purchase the vehicle traded in.) Data that the dealership wishes to keep regarding customers includes customer identification number, name, address, home phone, work phone, cell phone and e-mail address.

- Information about vehicle includes vehicle identification number, make, model, year, transmission type, engine size and color. Vehicles can be a member of one of the following categories: cars, trucks, minivans or SUVS. A vehicle can be a member of only one category at a given time. Trucks, minivans and SUVS have unique attributes – cars does not. Trucks have the following unique attributes: Cab (example: regular, super or crew) and Driver (for example: 94X2 or (4X4); Minivans have Accessory package and SUVS have SUV style.

- The dealership is interested in the date of Purchase, amount of sale and Salesperson(s) completing each sale.

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# Problem 2

- Granite Sales Company keeps information on employees and the departments in which they work. For each department, the department name, internal mail box number, and office phone extension are kept. A department can have many assigned employees, and each employee is assigned to only one department. Employees can be salaried, hourly, or work on contract. All employees are assigned an employee number, which is kept along with the employee's name and address. For hourly employees, hourly wages and target weekly work hours are stored; for example, the company may target 40 hours/week for some employees, 32 for others, and 20 for others. Some salaried employees are salespeople who can earn a commission in addition to their base salary. For all salaried employees, the yearly salary amount is recorded in the system. For salespeople, their commission percentage on sales and commission percentage on profit are stored in the system. For example, John is a salesperson with a base salary of $50,000 per year plus a 2 percent commission on the sales price for all sales he makes, plus another 5 percent of the profit on each of those sales. For contract employees, the beginning date and end date of their contracts are stored along with the billing rate for their hours.

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