

These slides are for use with

# Database Systems

## Concepts, Languages and Architectures

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Concepts,  
Languages  
and  
Architectures

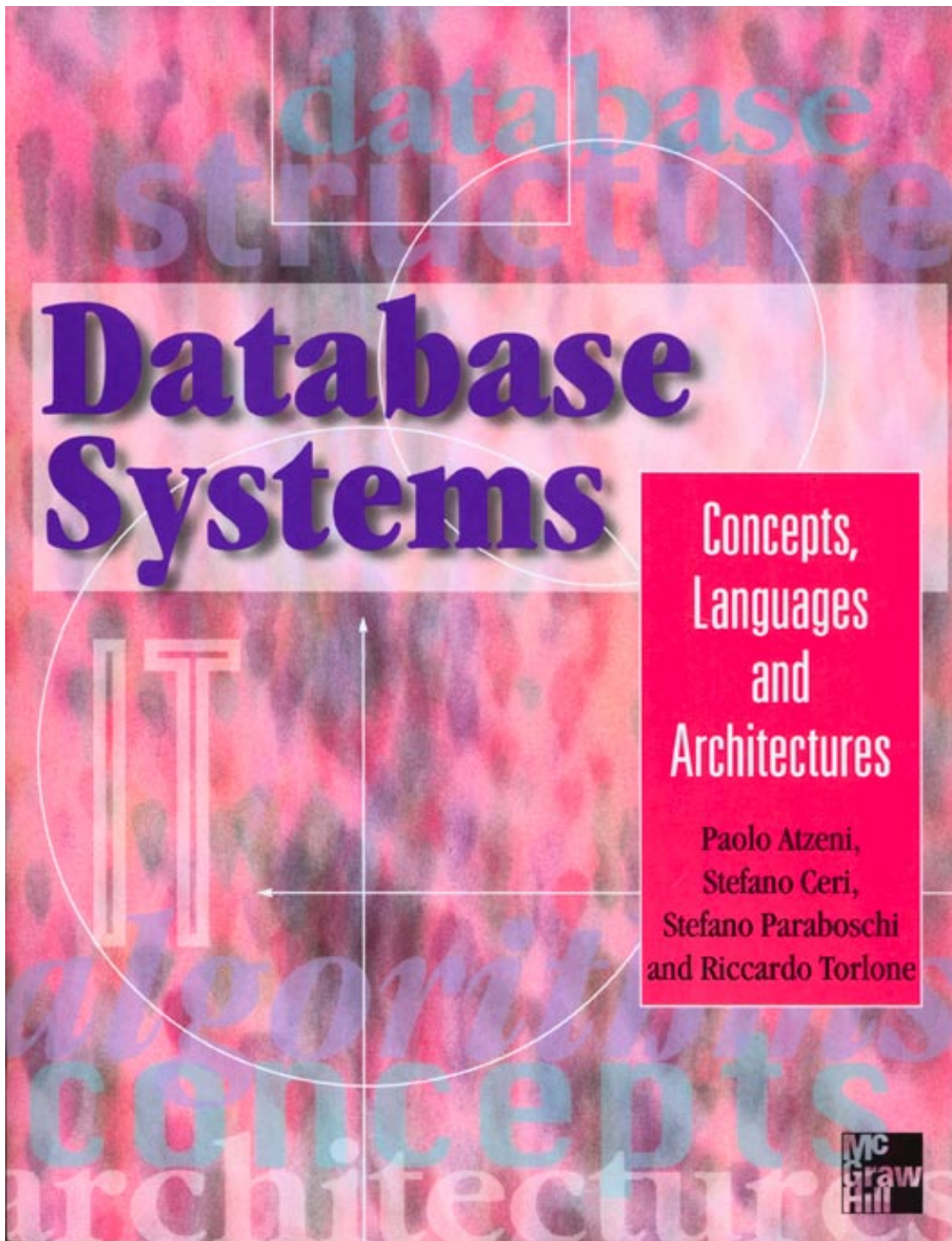
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Stefano Ceri,  
Stefano Paraboschi  
and Riccardo Torlone

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**To view** these slides on-screen or with a projector use the arrow keys to move to the next or previous slide. The return or enter key will also take you to the next slide. Note you can press the 'escape' key to reveal the menu bar and then use the standard Acrobat controls — including the magnifying glass to zoom in on details.

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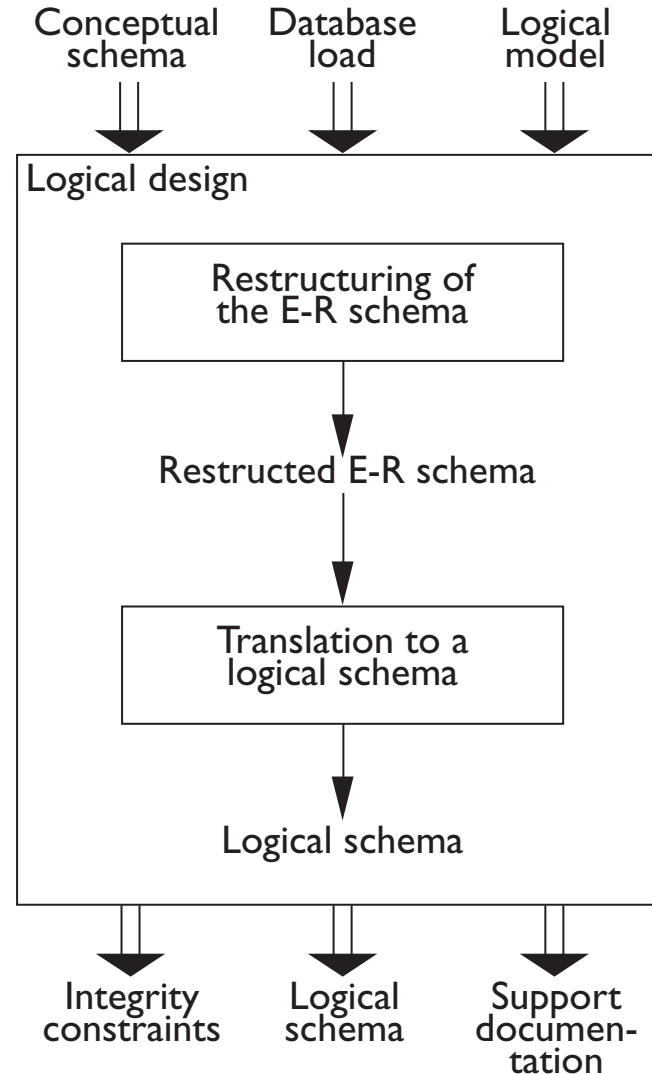
**Press the 'return' or 'enter' key to continue . . .**



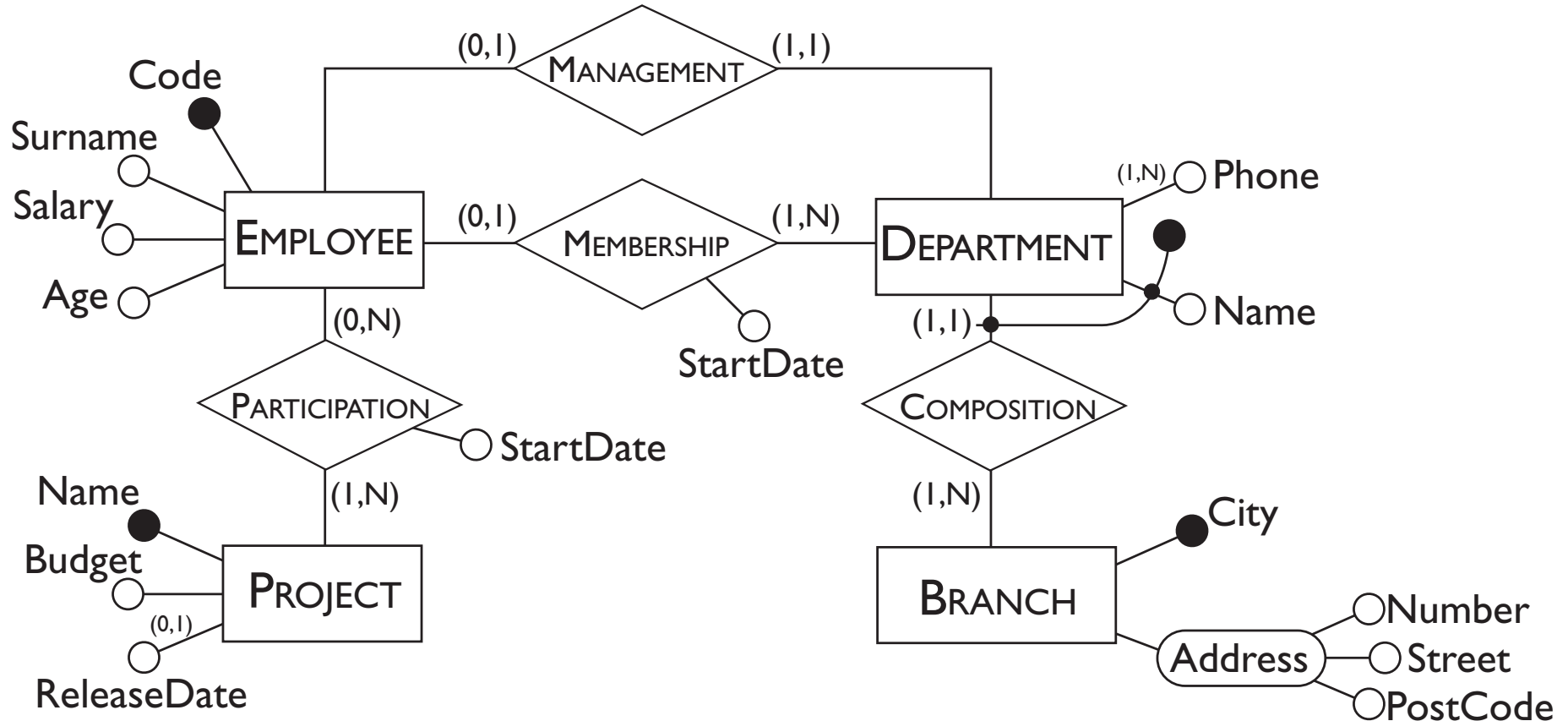
# Chapter 7

## Logical design

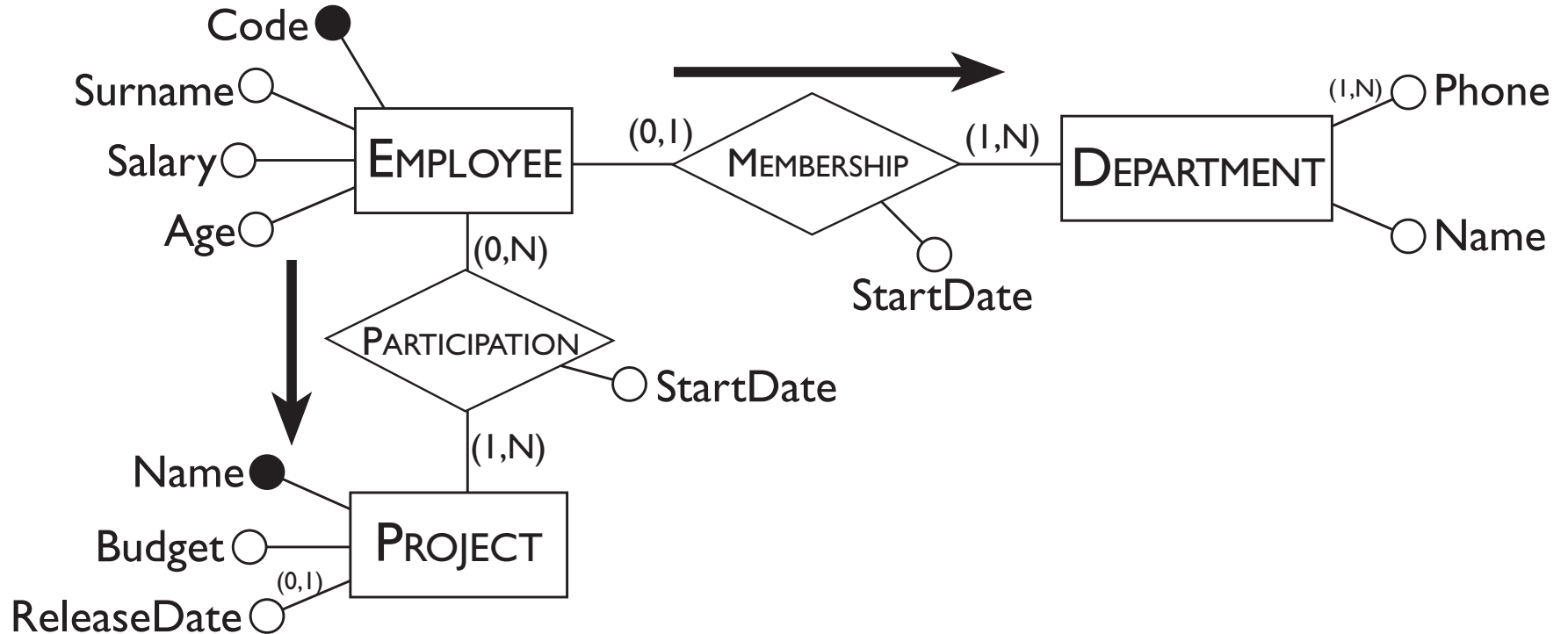
# Logical database design



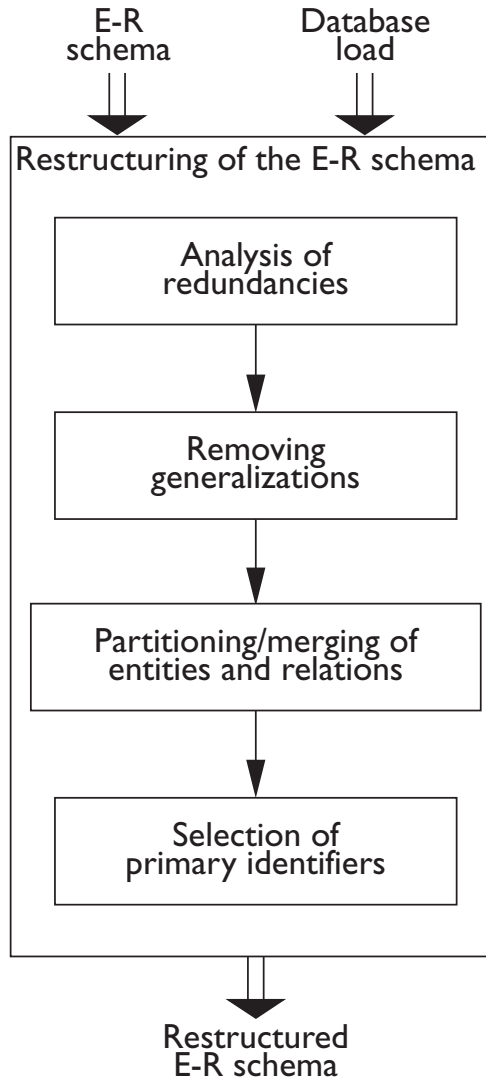
# An E-R schema on the personnel of a company



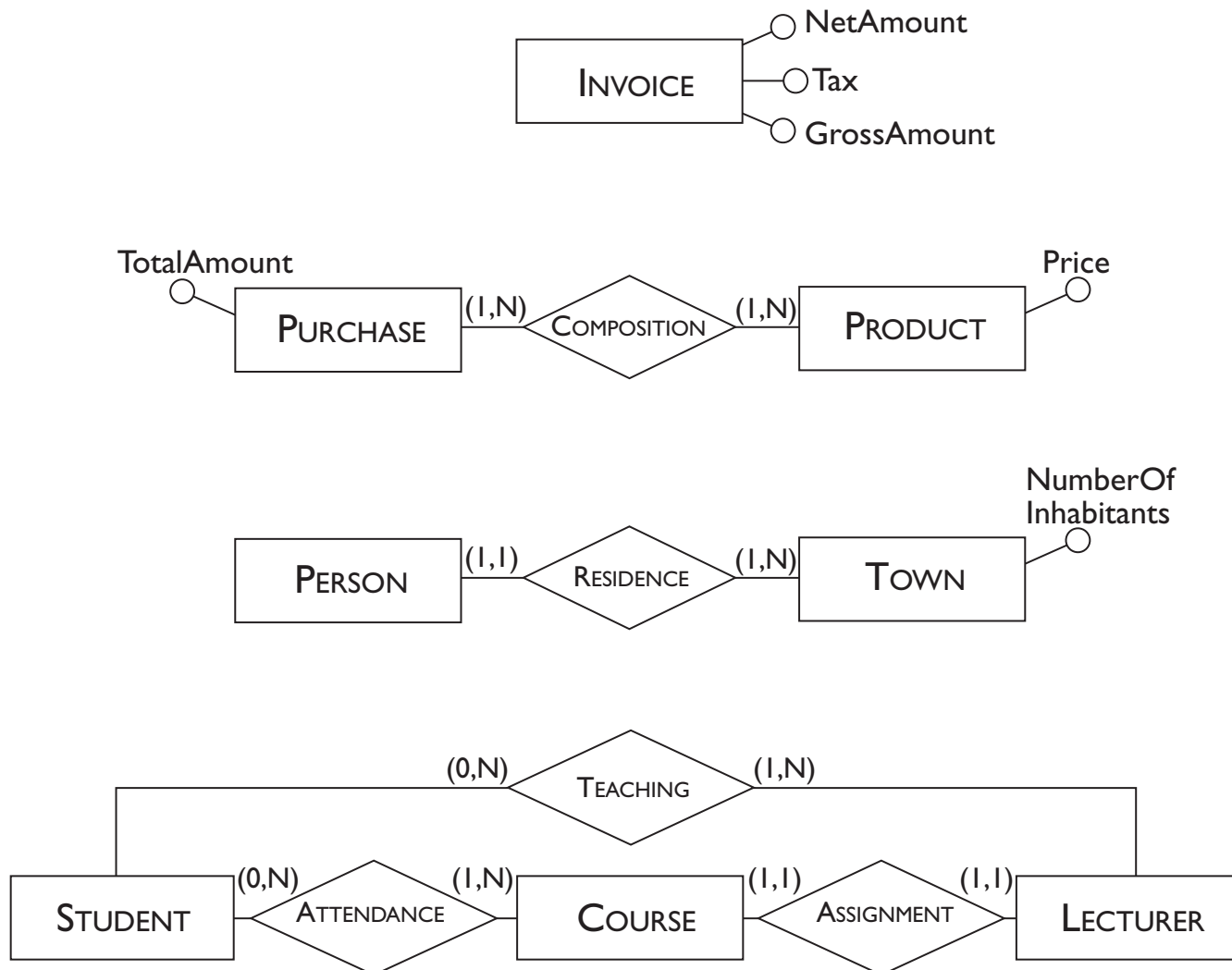
# Example of a navigation schema



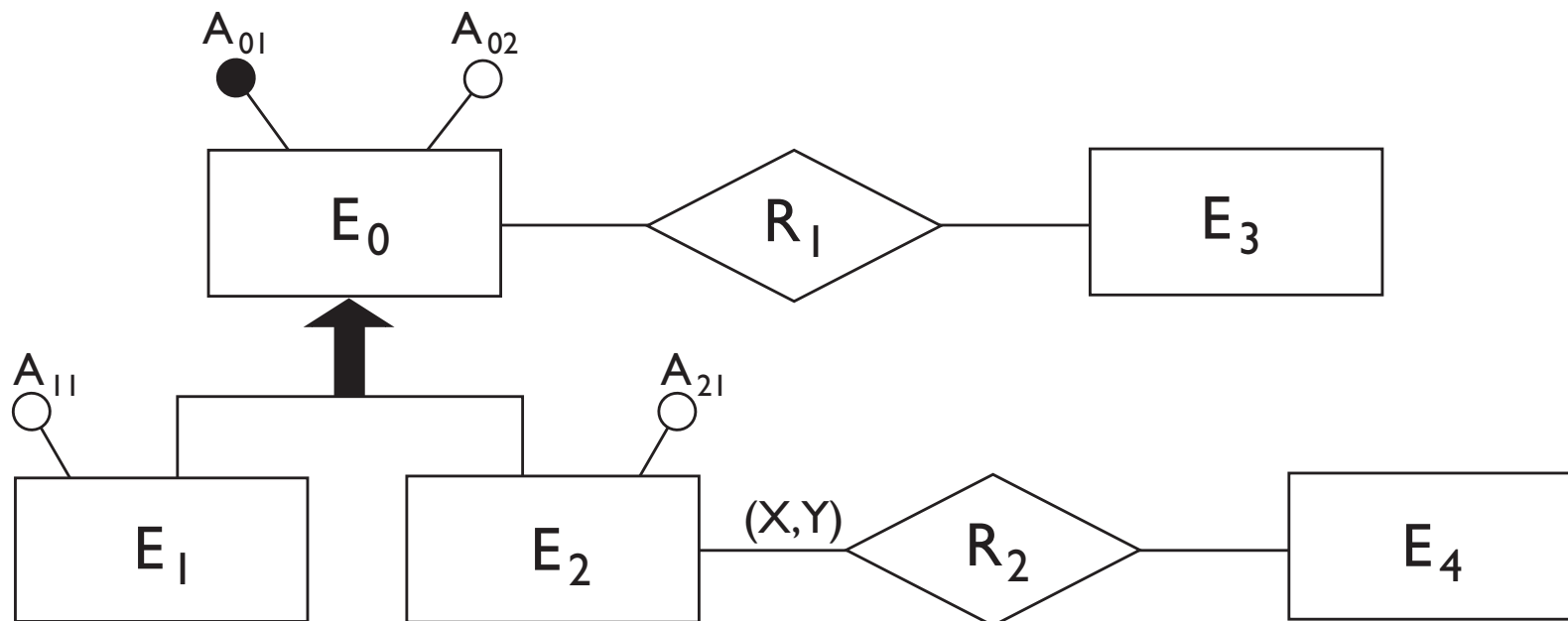
# Restructuring tasks of an E-R schema



# Examples of schemas with redundancies

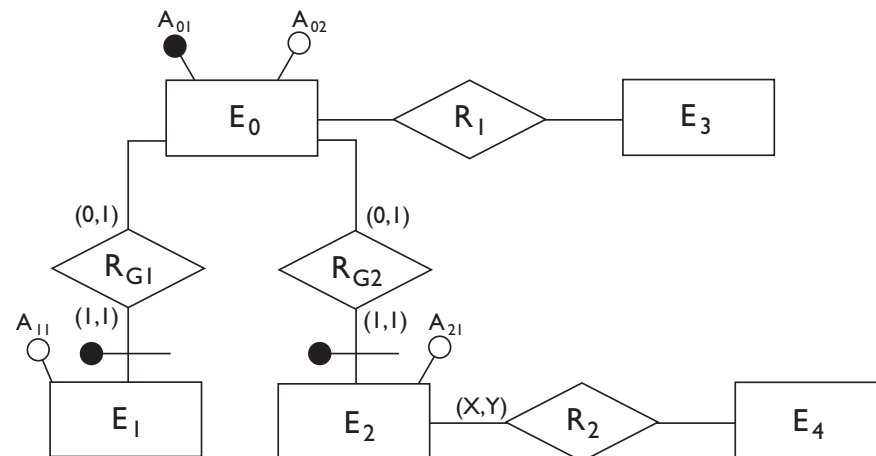
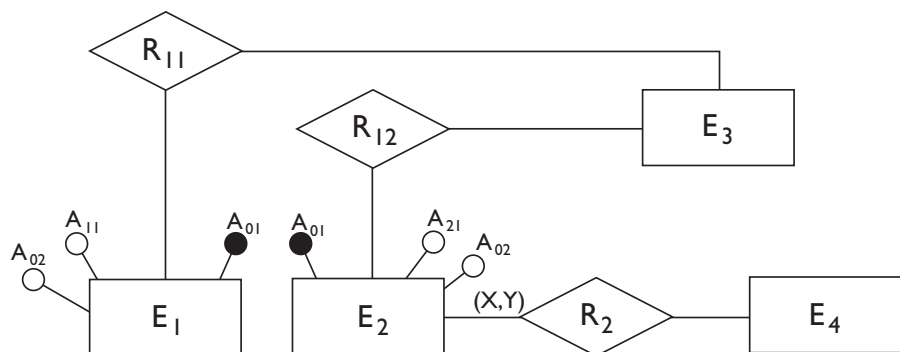
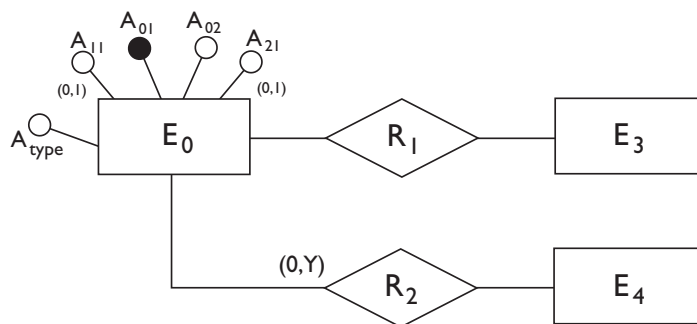


# Example of a schema with generalization

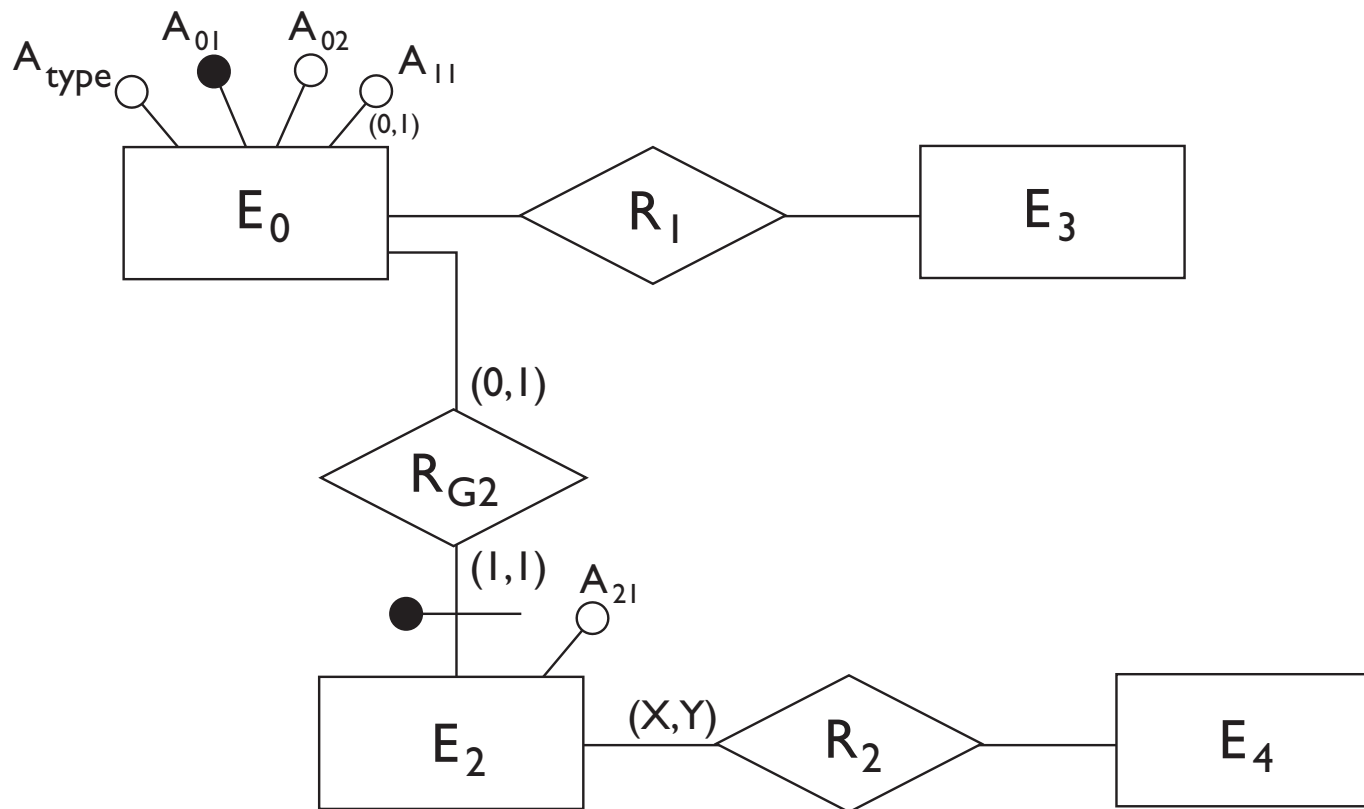




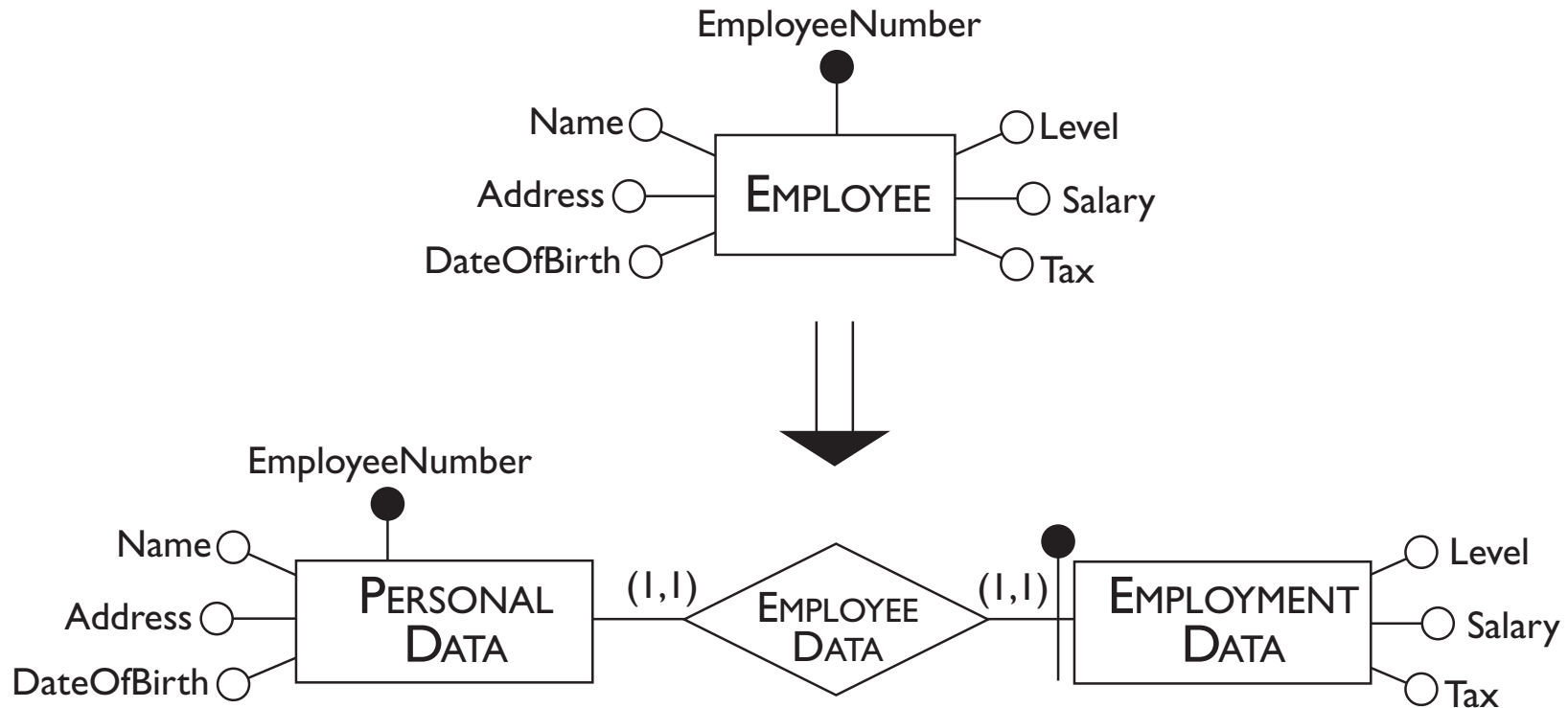
# Possible restructurings of the previous schema



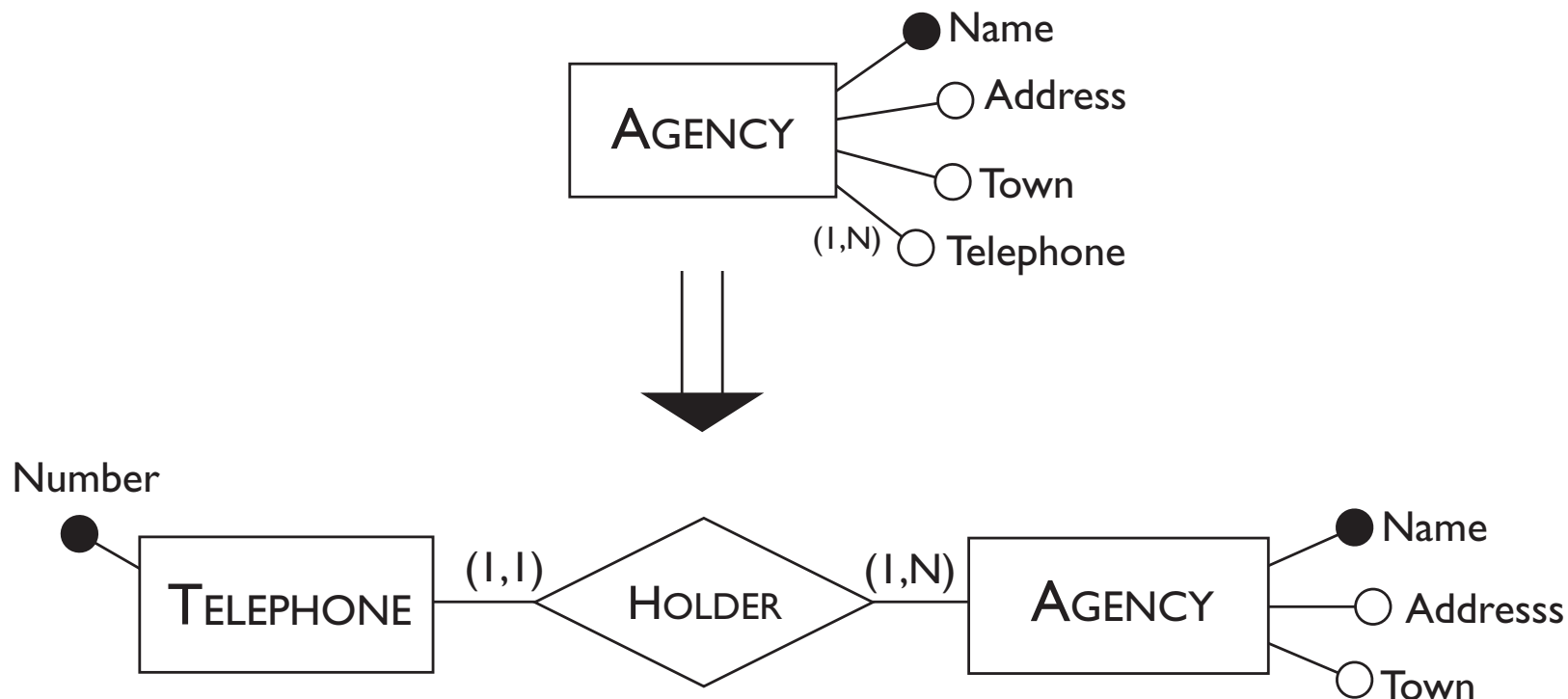
# Possible restructuring of the previous schema



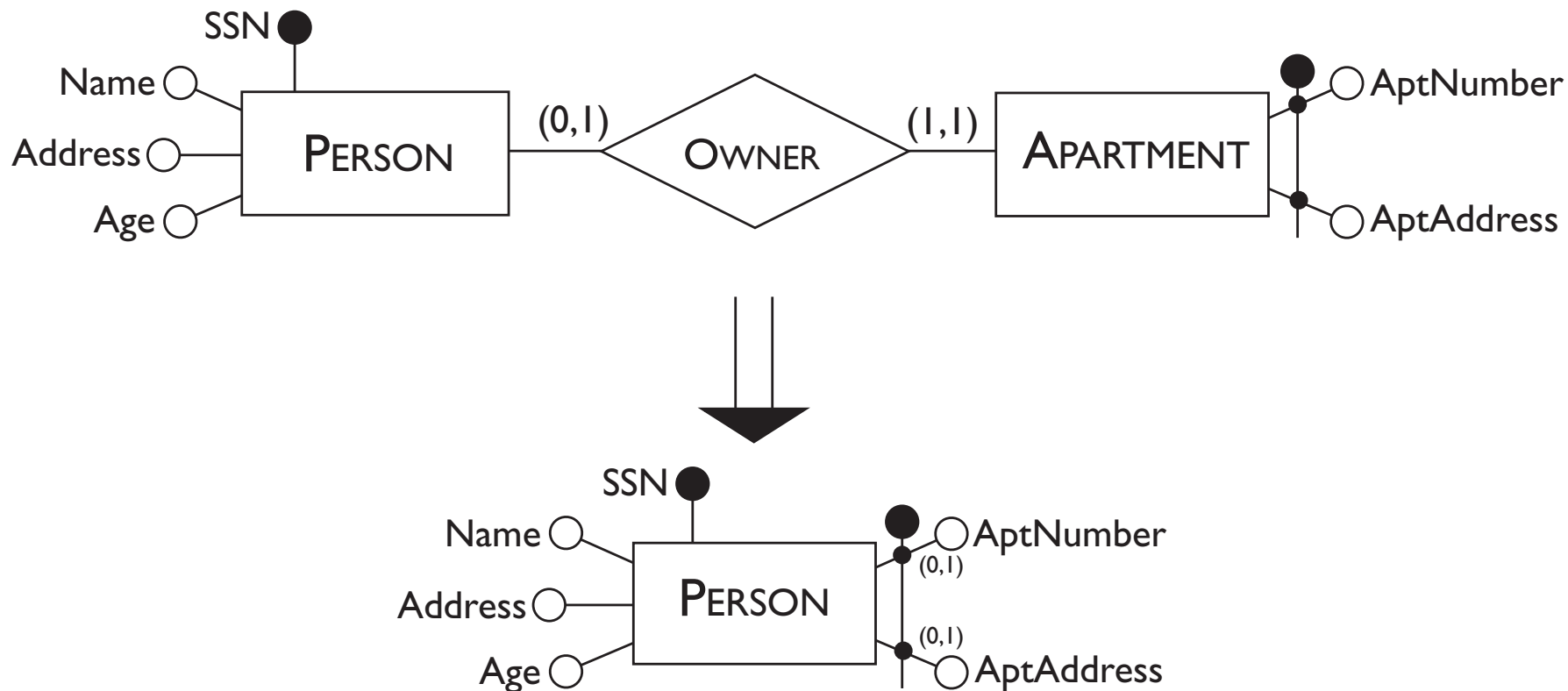
# Example of partitioning of entities



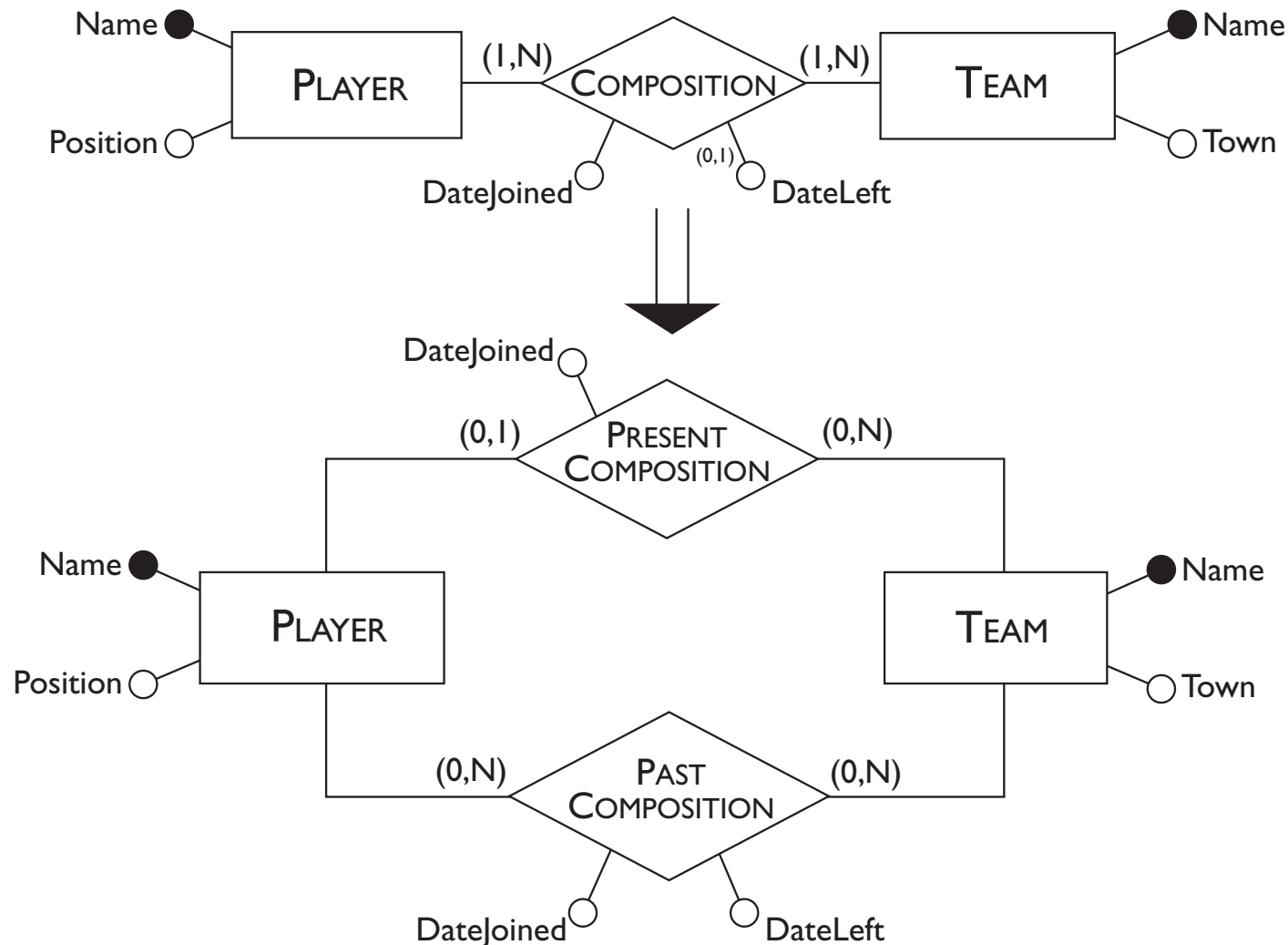
# Example of deletion of multi-value attributes



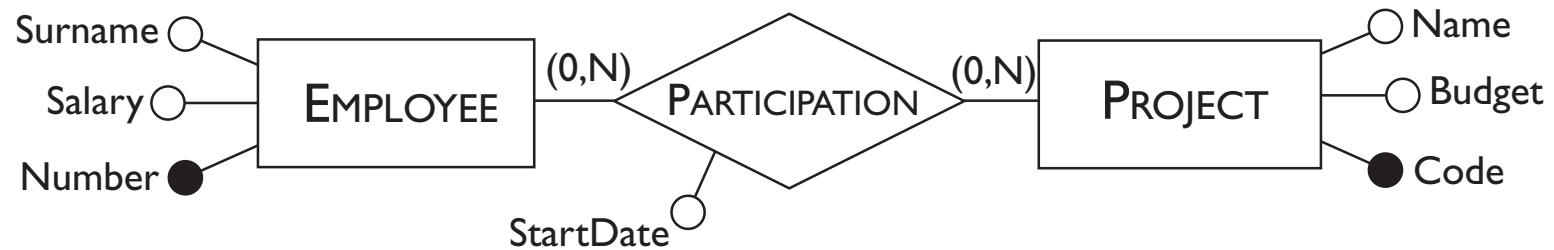
# Example of merging of entities



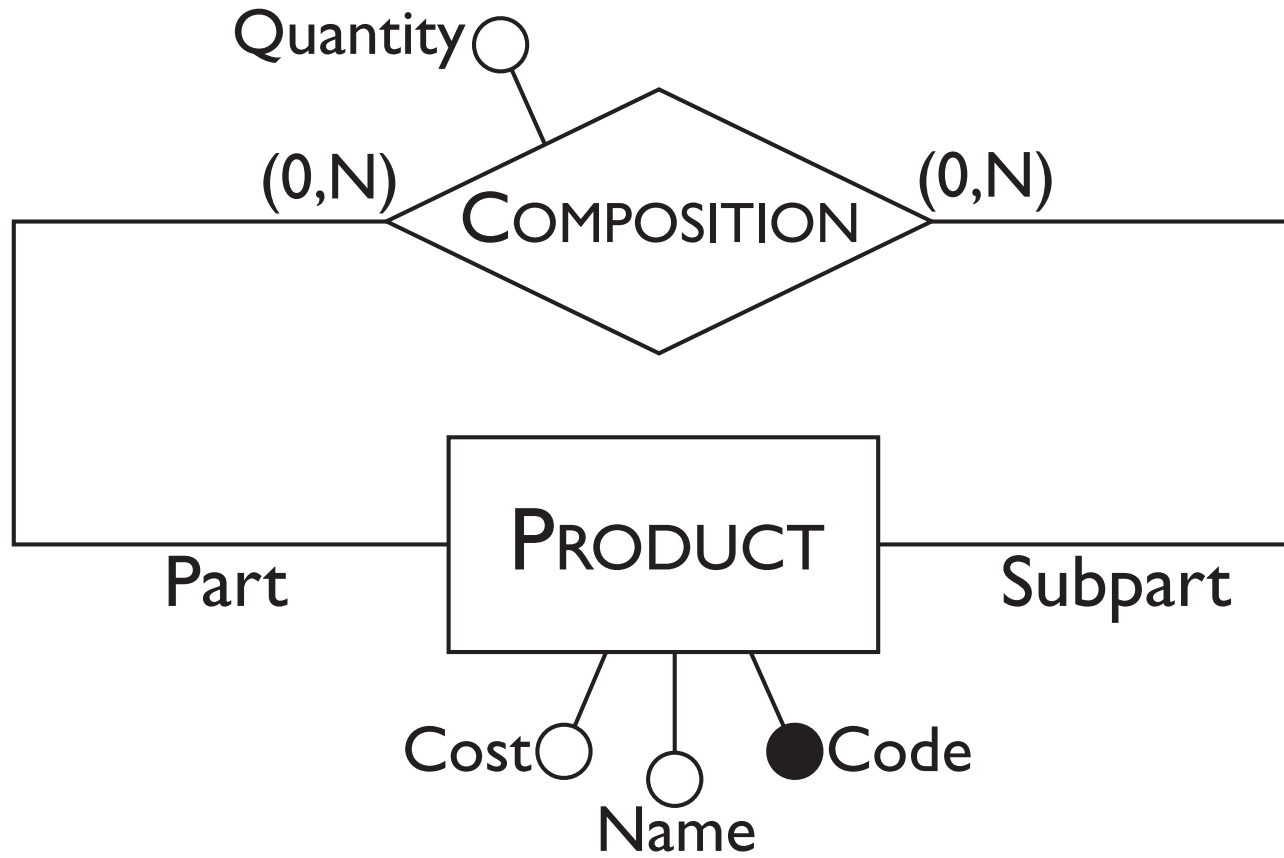
# Example of partitioning of a relationship



# An E-R schema with a many-to-many relationship

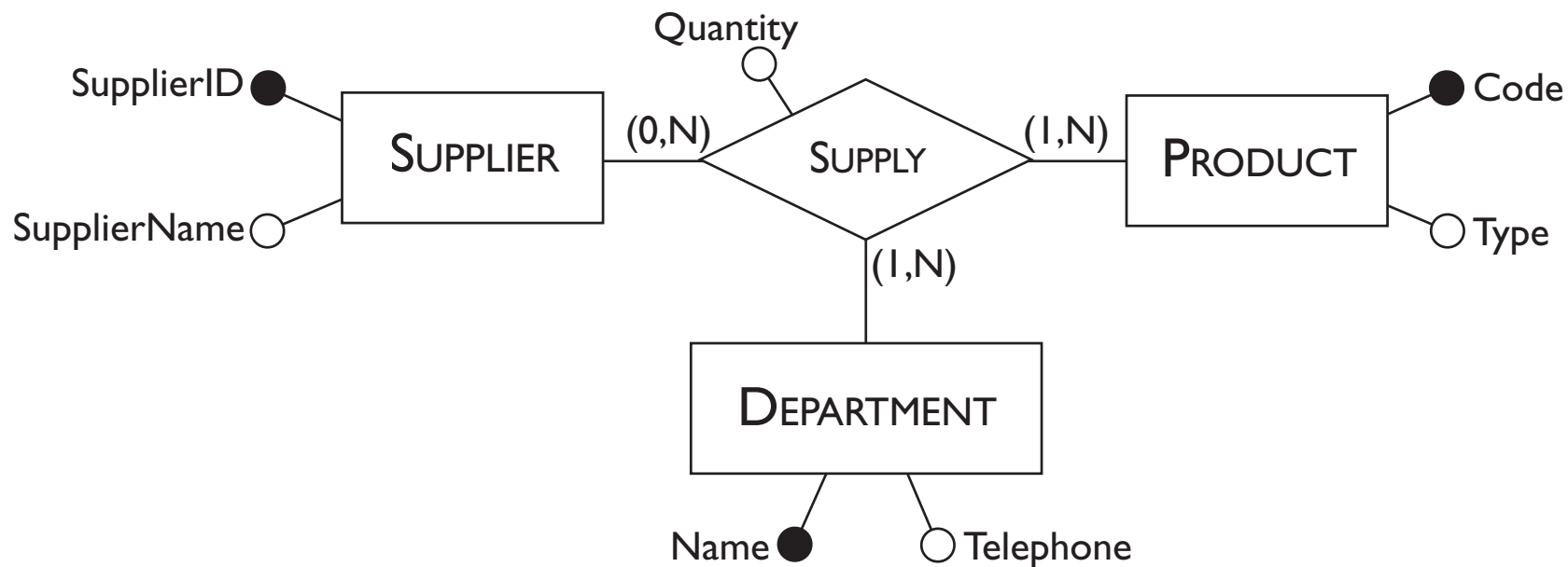


# E-R schema with recursive relationship

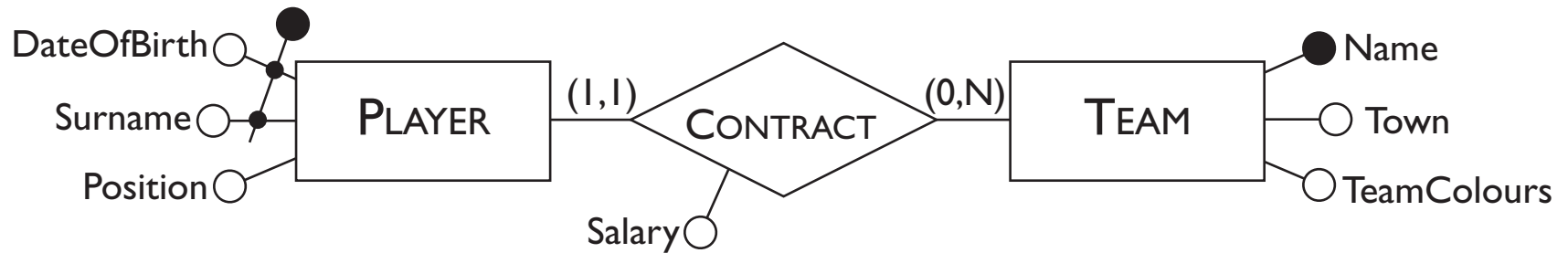




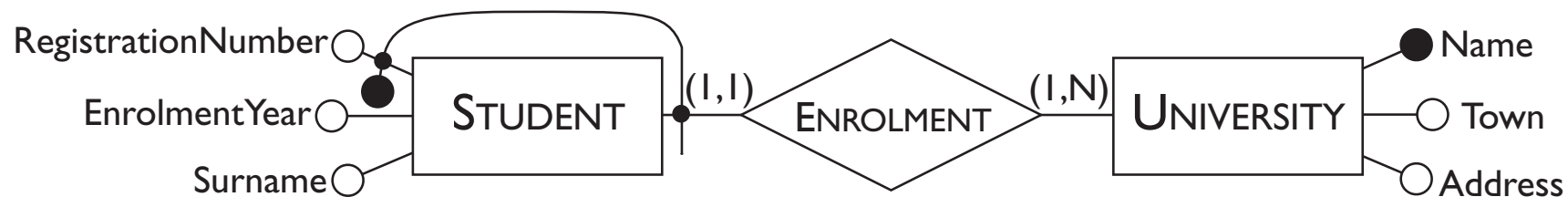
# E-R schema with ternary relationship



# E-R schema with one-to-many relationships



# E-R schema with external identifier



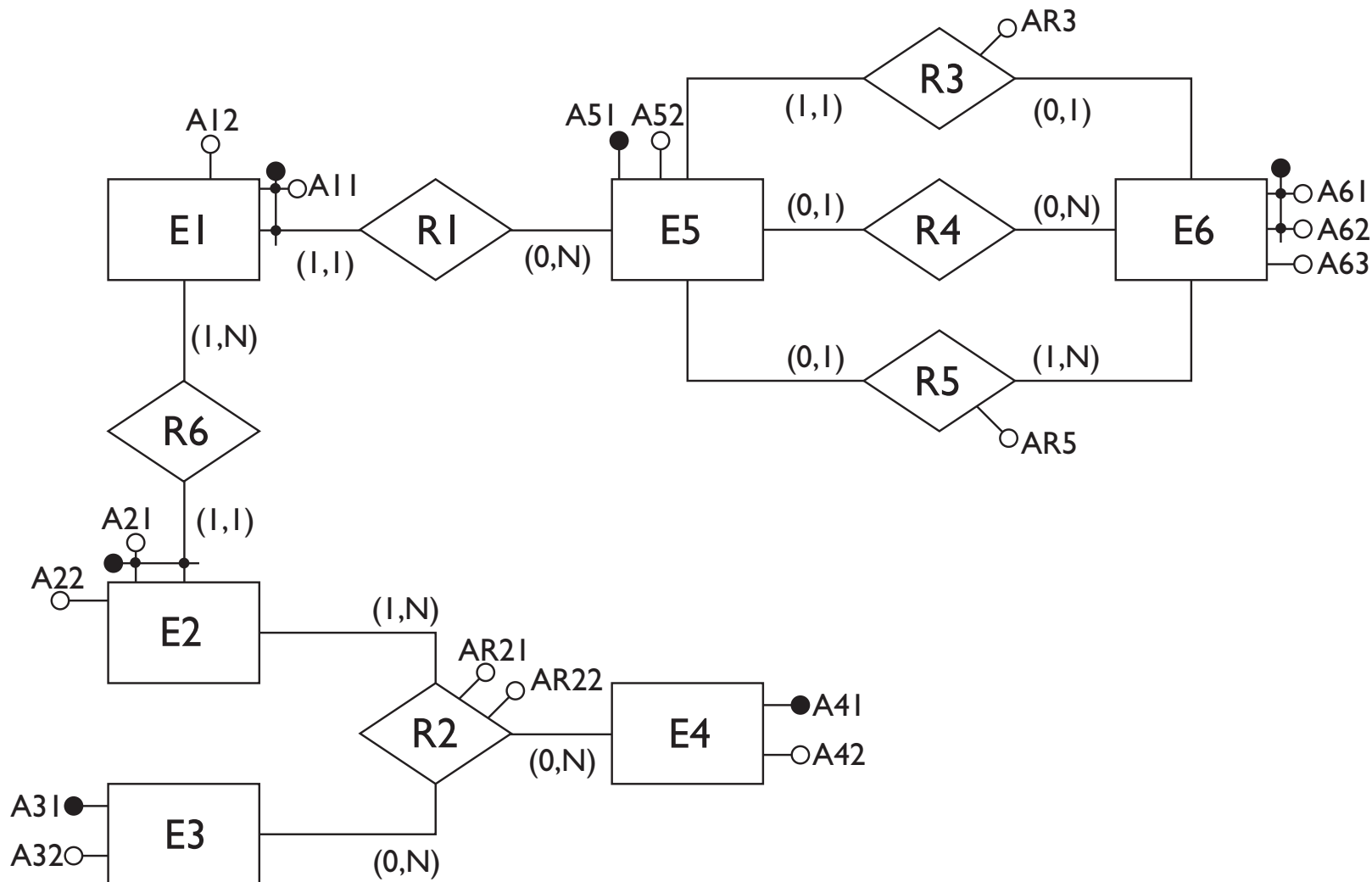
# E-R schema with one-to-one relationship



# E-R schema with one-to-one relationship



# An E-R schema for translation



# Translations from the E-R model to the relational (1)

Type	Initial schema	Possible translation
Binary many-to-many relationship		$E_1(\underline{A_{E11}}, A_{E12})$ $E_2(\underline{A_{E21}}, A_{E22})$ $R(\underline{A_{E11}}, \underline{A_{E21}}, A_R)$
Ternary many-to-many relationship		$E_1(\underline{A_{E11}}, A_{E12})$ $E_2(\underline{A_{E21}}, A_{E22})$ $E_3(\underline{A_{E31}}, A_{E32})$ $R(\underline{A_{E11}}, \underline{A_{E21}}, \underline{A_{E31}}, A_R)$
One-to-many relationship with mandatory participation		$E_1(\underline{A_{E11}}, A_{E12}, A_{E21}, A_R)$ $E_2(\underline{A_{E21}}, A_{E22})$

# Translations from the E-R model to the relational (2)

Type	Initial schema	Possible translation
One-to-many relationship with optional participation		$E_1(\underline{A_{E11}}, A_{E12})$ $E_2(\underline{A_{E21}}, A_{E22})$ $R(\underline{A_{E11}}, \underline{A_{E21}}, A_R)$ <p>Alternatively:</p> $E_1(\underline{A_{E11}}, A_{E21}, A_{E21}^*, A_R^*)$ $E_2(\underline{A_{E21}}, A_{E22})$
Relationship with external identifiers		$E_1(\underline{A_{E12}}, \underline{A_{E21}}, A_{E11}, A_R)$ $E_2(\underline{A_{E21}}, A_{E22})$



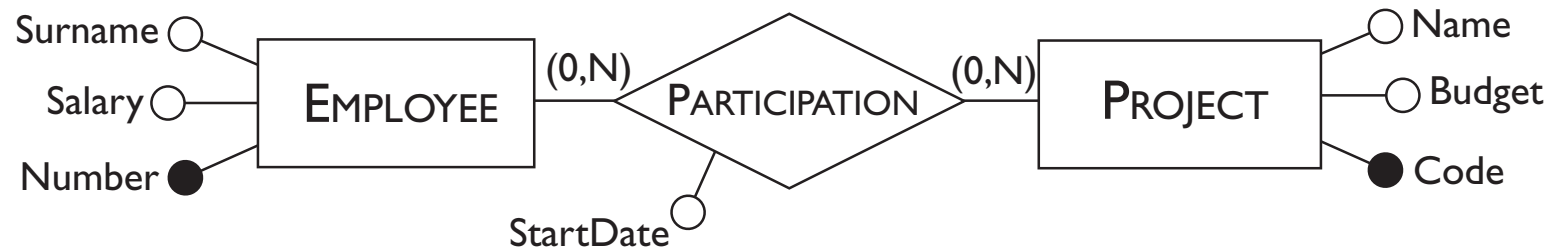
# Translations from the E-R model to the relational (3)

Type	Initial schema	Possible translation
One-to-one relationship with mandatory participation for both entities		$E_1(\underline{A_{E11}}, A_{E12}, \underline{A_{E21}}, A_R)$ $E_2(\underline{A_{E21}}, A_{E22})$ <p>Alternatively:</p> $E_2(\underline{A_{E21}}, A_{E22}, \underline{A_{E11}}, A_R)$ $E_1(\underline{A_{E11}}, A_{E12})$
One-to-one relationship with optional participation for one entity		$E_1(\underline{A_{E11}}, A_{E12}, \underline{A_{E21}}, A_R)$ $E_2(\underline{A_{E21}}, A_{E22})$

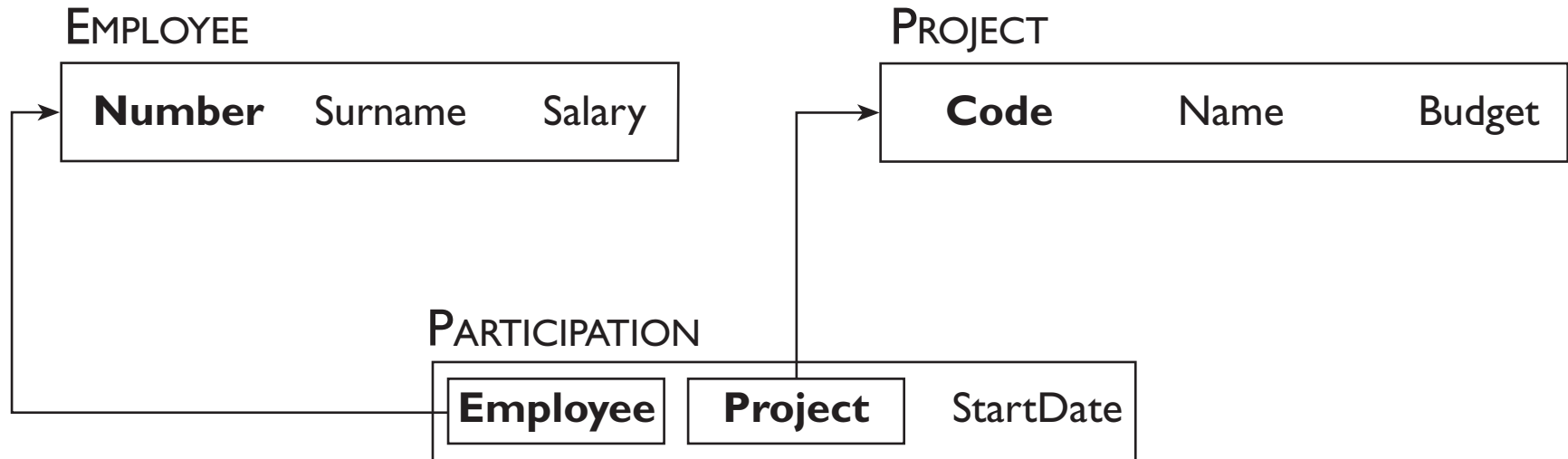
# Translations from the E-R model to the relational (4)

Type	Initial schema	Possible translation
One-to-one relationship with optional participation for both entities		$E_1(\underline{A_{E11}}, A_{E21})$ $E_2(\underline{A_{E21}}, A_{E22}, A_{E11}^*, A_R^*)$ <p>Alternatively:</p> $E_1(\underline{A_{E11}}, A_{E12}, A_{E21}^*, A_R^*)$ $E_2(\underline{A_{E21}}, A_{E22})$ <p>Alternatively:</p> $E_1(\underline{A_{E11}}, A_{E12})$ $E_2(\underline{A_{E21}}, A_{E22})$ $R(\underline{A_{E11}}, \underline{A_{E21}}, A_R)$

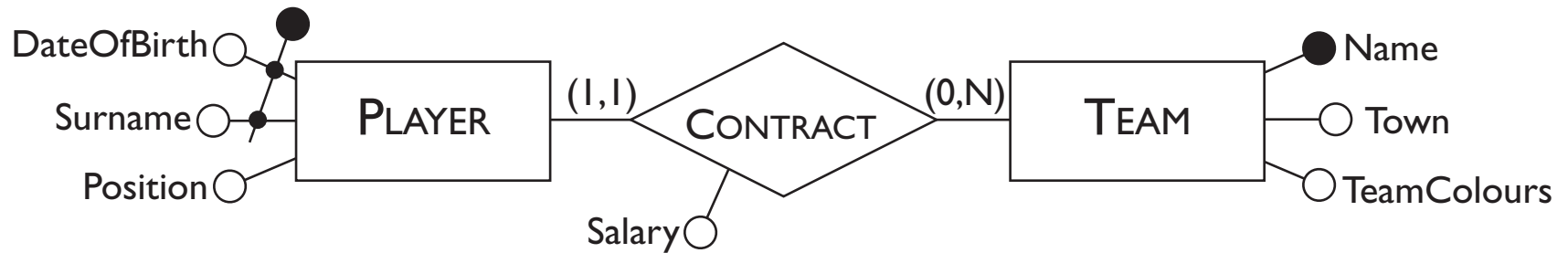
# An E-R schema with a many-to-many relationship



# Graphical representation of a translation of the previous schema



# E-R schema with one-to-many relationships



# Graphical representation of a translation of the previous schema

PLAYER

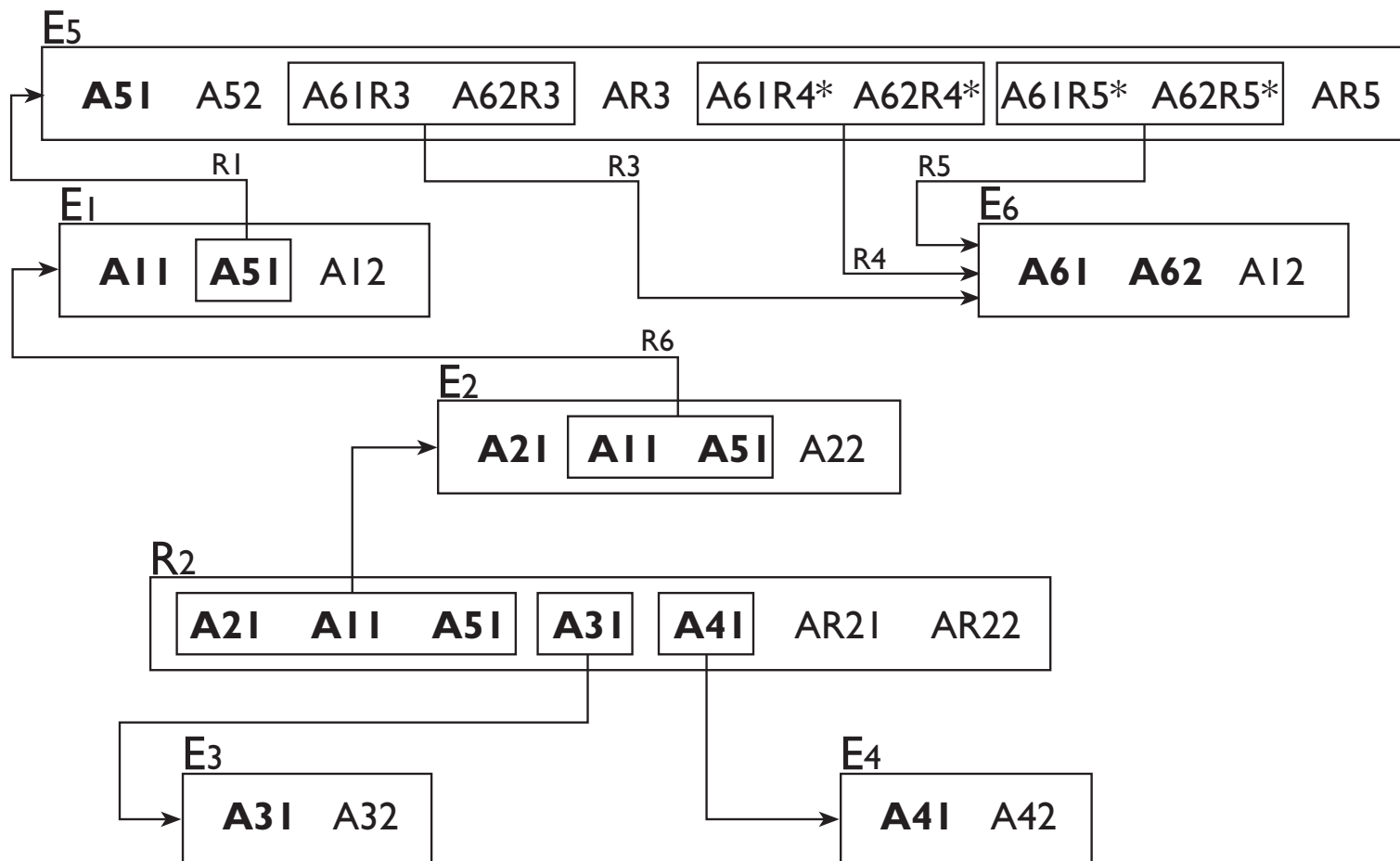


TEAM

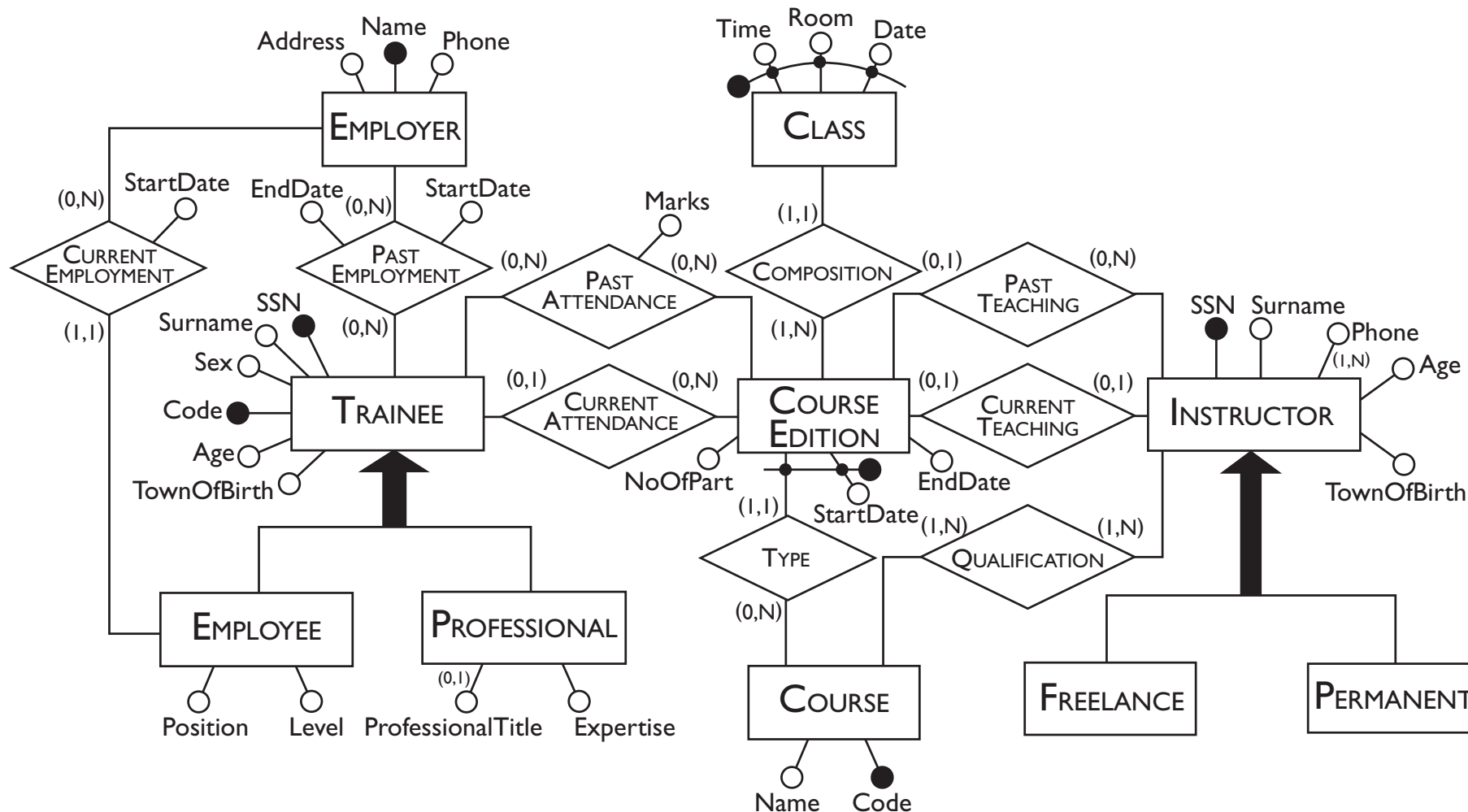


CONTRACT

# Graphical representation of a relational schema

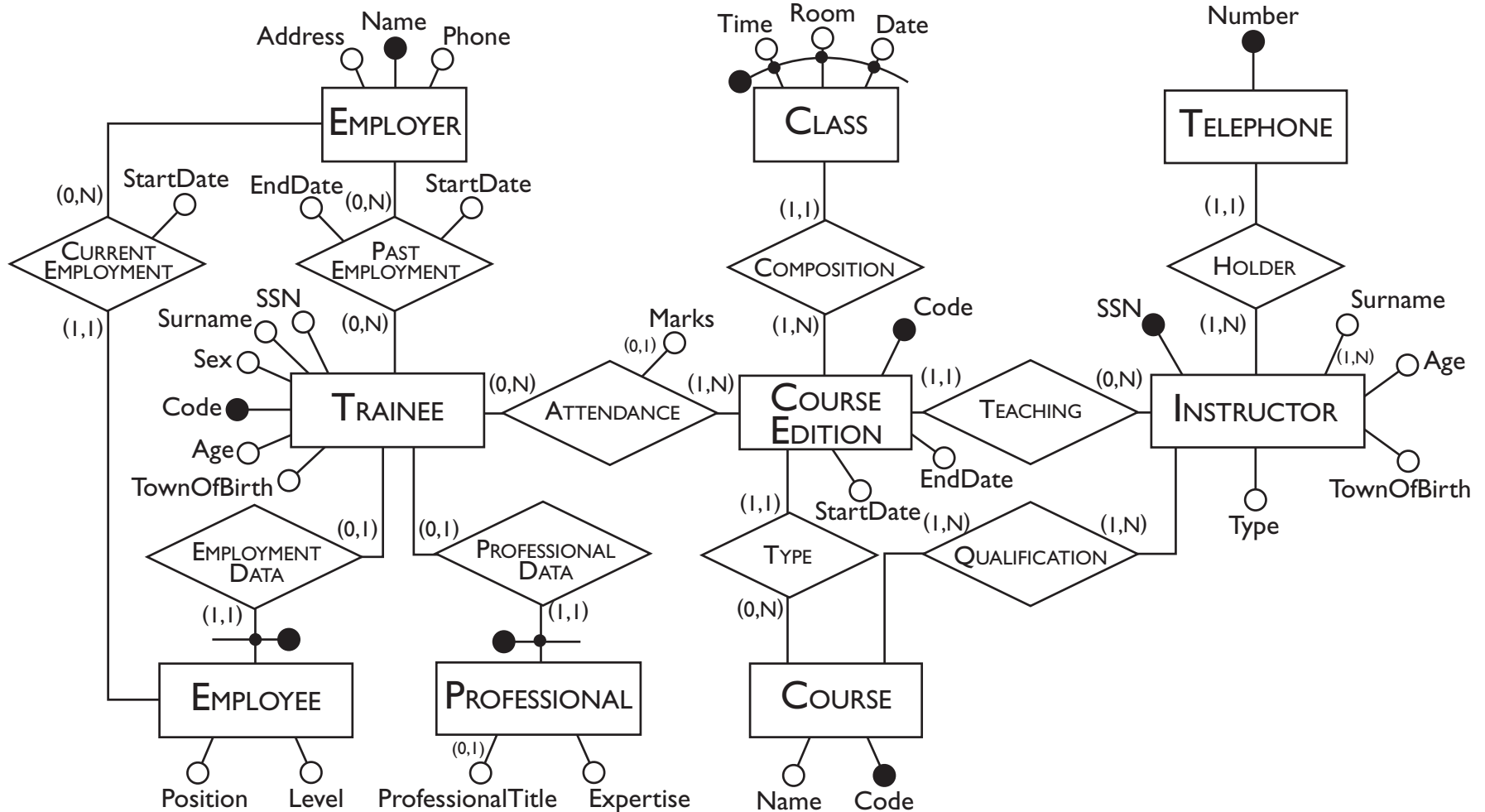


# The E-R schema of a training company





# The previous E-R schema after the restructuring phase



# Logical design with a CASE tool

The screenshot shows the Logic Works ERwin/ERX interface. The main window displays an Entity-Relationship (ER) diagram with the following entities and attributes:

- Employee Project**: Emp\_Id: NUMBER, Name: VARCHAR2(20)
- Employee**: Emp\_Id: NUMBER, Dept\_Id: NUMBER, Name: VARCHAR2(20), Salary: NUMBER, Age: NUMBER
- Department**: Dept\_Id: NUMBER, Name: VARCHAR2(20), Telephone: NUMBER
- Project**: Name: VARCHAR2(20), Budget: NUMBER, Deadline: DATE
- Manager**: Emp\_Id: NUMBER, Dept\_Id: NUMBER, Room: VARCHAR2(20), Name: VARCHAR2(20)
- Building**: Name: VARCHAR2(20), City: VARCHAR2(20), Address: VARCHAR2(20)

Relationships are indicated by lines connecting the entities. The Employee Project entity is connected to the Employee entity. The Employee entity is connected to the Department entity. The Project entity is connected to the Employee entity. The Manager entity is connected to the Employee entity and the Department entity. The Building entity is connected to the Department entity.

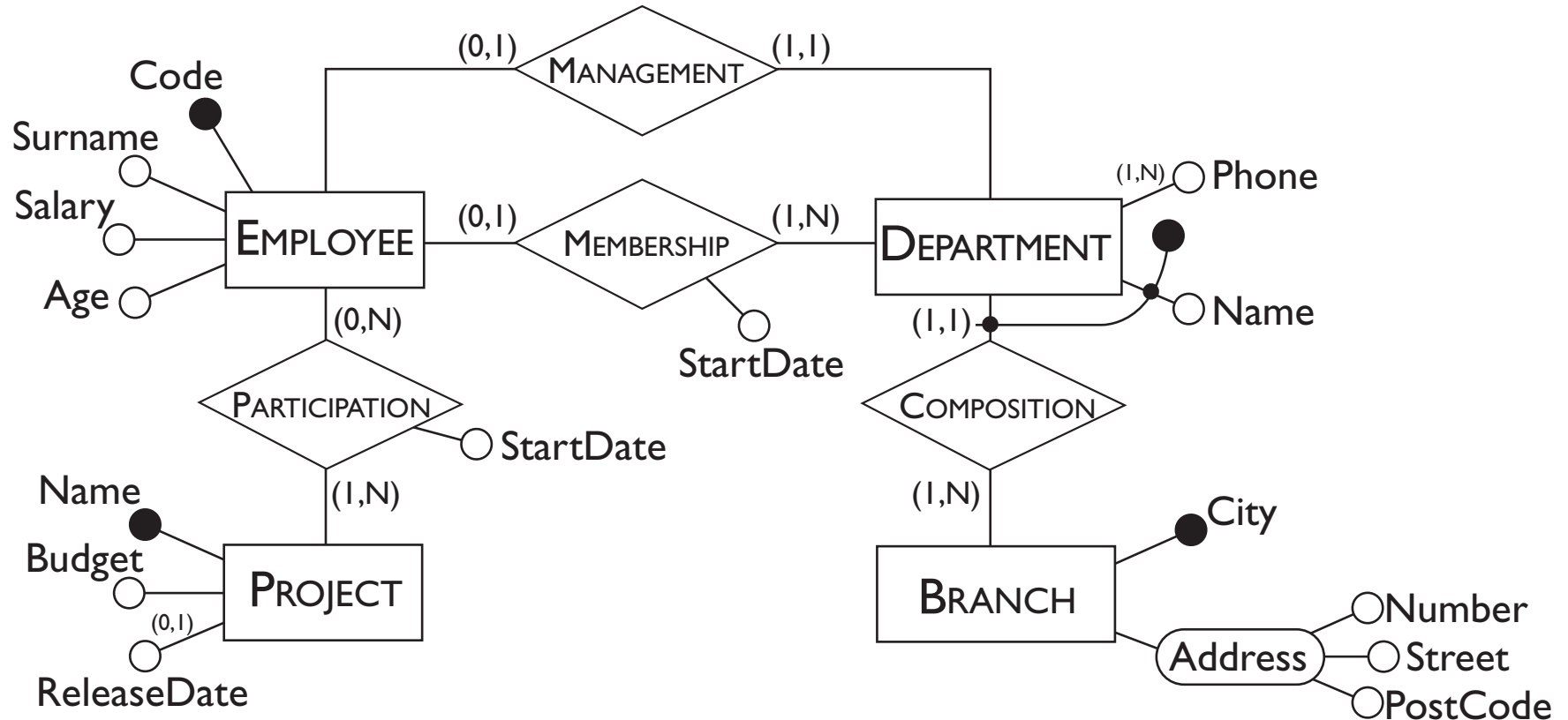
On the right side, the 'ORACLE Schema Generation Report' window is open, showing the following SQL code:

```
CREATE TABLE Employee (
  Emp_Id          NUMBER NOT NULL,
  Dept_Id         NUMBER NOT NULL,
  Name            VARCHAR2(20) NULL,
  Salary          NUMBER NULL,
  Age             NUMBER NULL,
  PRIMARY KEY (Emp_Id) );

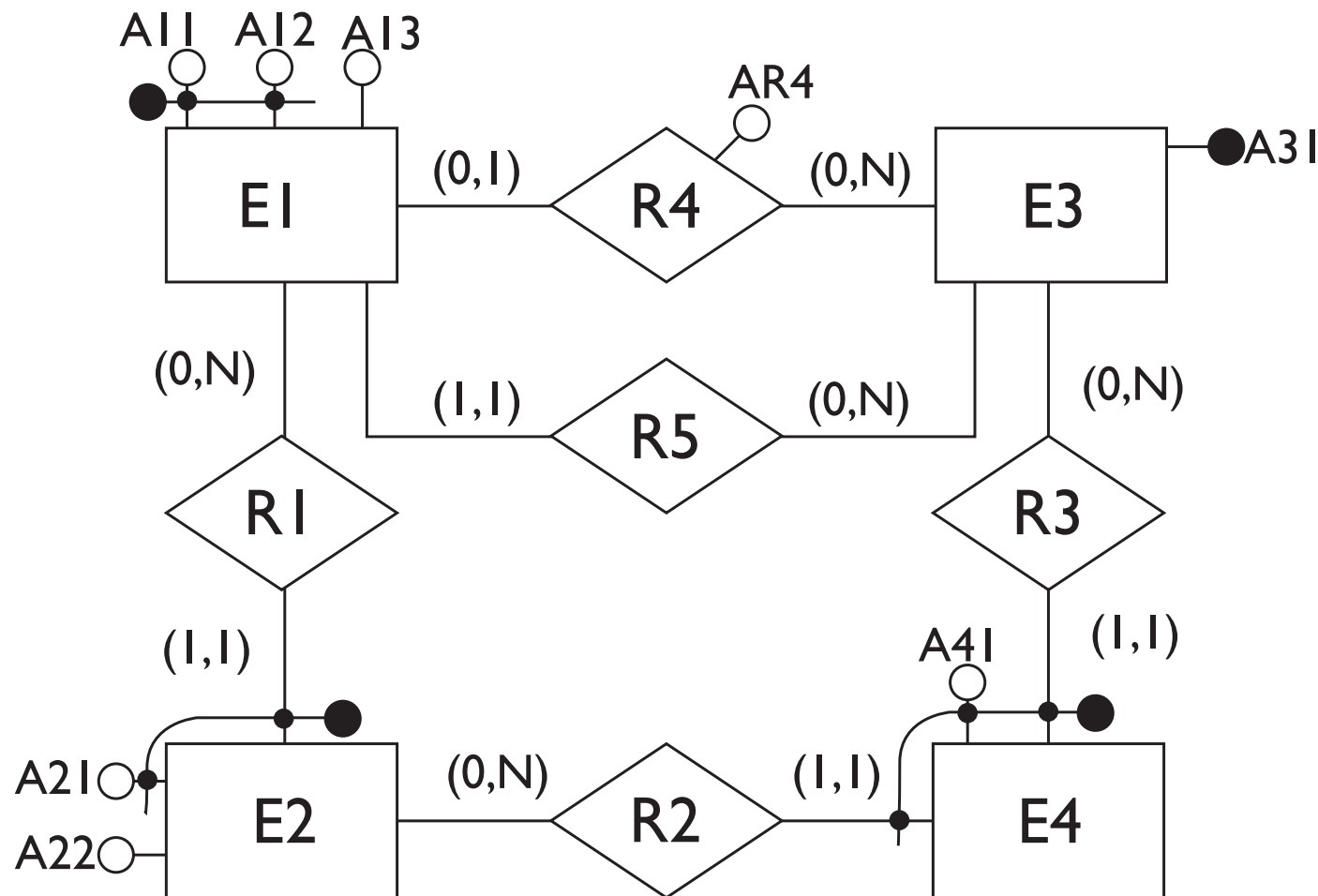
CREATE TABLE Project (
  Name            VARCHAR2(20) NOT NULL,
  Budget          NUMBER NULL,
  Deadline        DATE NULL,
  PRIMARY KEY (Name) );

CREATE TABLE Employee_Project (
  Emp_Id          NUMBER NOT NULL,
  Name            VARCHAR2(20) NOT NULL,
  PRIMARY KEY (Emp Id, Name) );
```

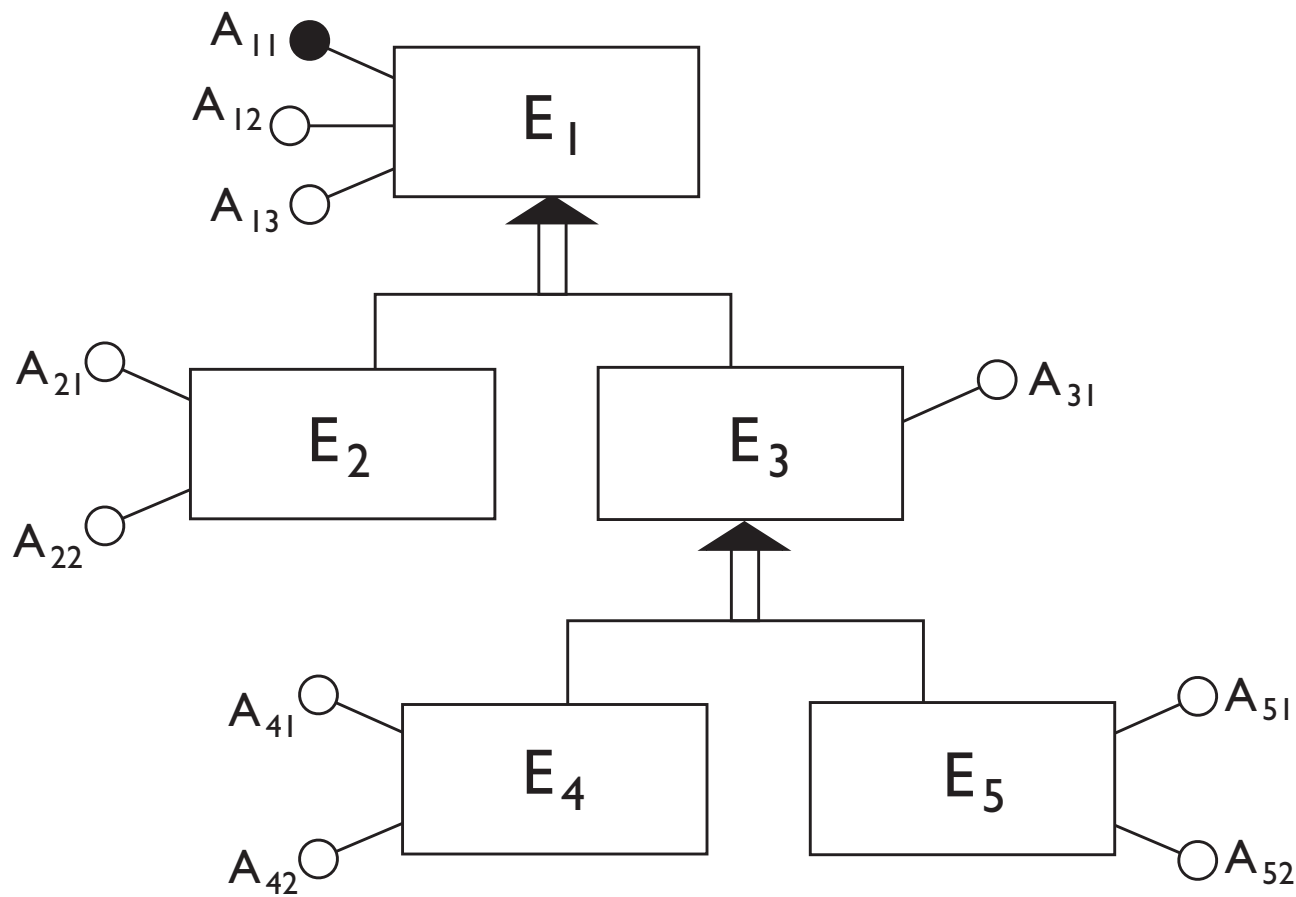
# An E-R schema on the personnel of a company



# An E-R schema with external identifiers



# An E-R schema with generalizations



# An E-R schema to translate

