



**SAPIENZA**  
UNIVERSITÀ DI ROMA

# Data Management and Analysis

## Unit 2

**DESIGN ER MODEL**

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# DESIGN ER MODEL

## General

The **conceptual design of a database consists of the construction of an Entity-Relationship schema**, providing an optimal description of the user requirements

Even for simple applications, the schema can contain many concepts, correlated in a quite complex way. It follows that the construction of the final schema is, often, an incremental process

The conceptual schema is refined and enriched during a series of transformations and possibly corrections



# DESIGN ER MODEL

## Scenario

Training Company

We wish to create a database for a **company that runs training courses**.

For this, we must store data about the **trainees** and the **instructors**.

For each course participant (about 5000), identified by a code, we want to store the social security number, surname, age, sex, place of birth, employer's name, address and telephone number, previous employers (and period employed), the courses attended (there are about 200 courses) and the final assessment of each course.

We need also to represent the **seminars** that each participant is attending at present and, for each day, the **places** and times the **classes** are held.

Each **course** has a code and a title and any course can be given any number of times.

Each time a particular course is given, we will call it an '**edition**' of the **course**. For each edition, we represent the start date, the end date, and the number of participants.

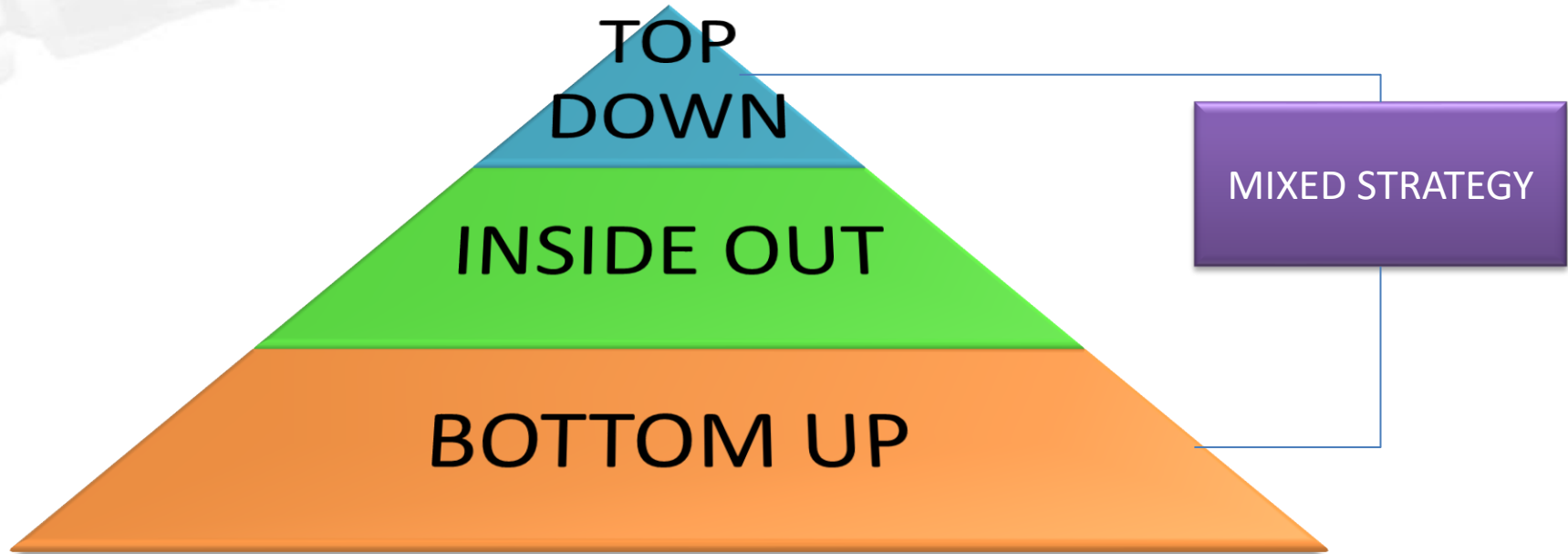
If a trainee is a **self-employed professional**, we need to know his or her area of expertise, and, if appropriate, his or her title. For somebody who works for a company (**worker**), we store the level and position held.

For each instructor (about 300), we will show the surname, age, place of birth, the edition of the course taught, those taught in the past and the courses that the tutor is qualified to teach. All the instructors' telephone numbers are also stored.

An **instructor** can be permanently employed by the **training company** or can be **freelance**

# DESIGN ER MODEL

## Strategies





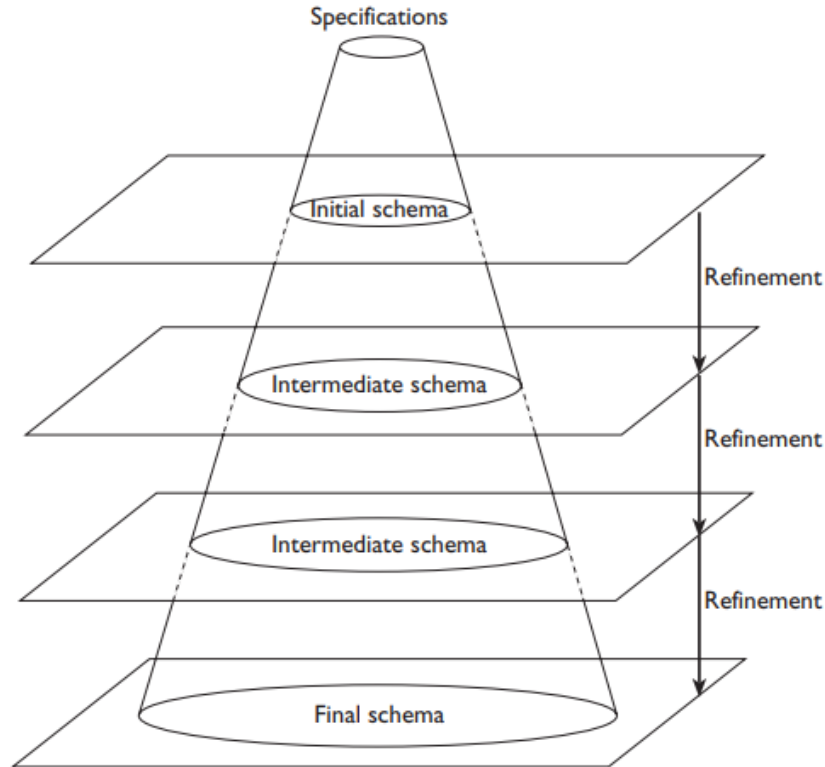
# DESIGN ER MODEL

## Strategies: TOP-DOWN

In TOP-DOWN strategy, the conceptual schema is produced by means of a series of successive refinements, starting from an initial schema that describes all the requirements by means of a few highly abstract concepts


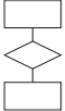

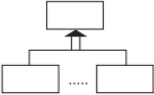

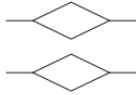

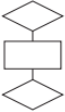




# DESIGN ER MODEL

## Strategies: TOP-DOWN




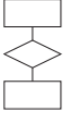

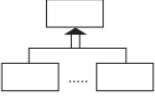

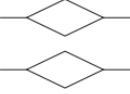

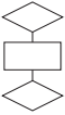




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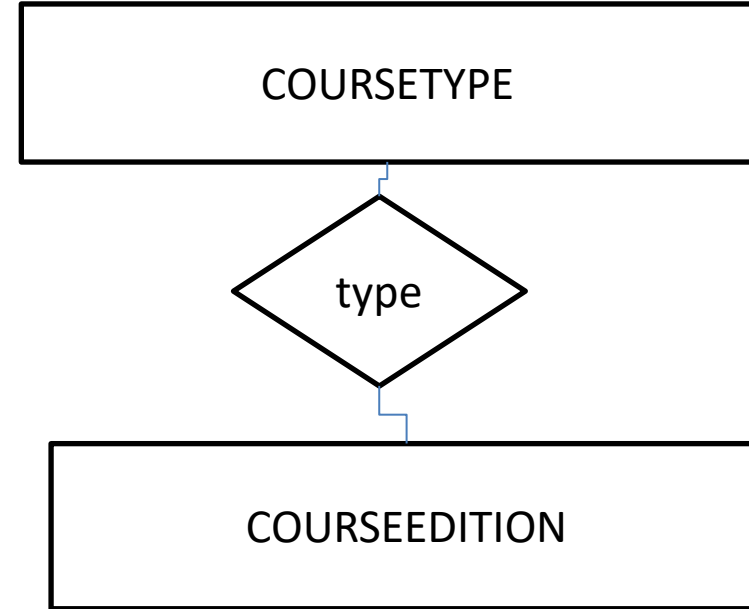
## Strategies: TOP-DOWN

Transformation	Initial concept	Result
$T_1$ From one entity to two entities and a relationship between them		
$T_2$ From one entity to a generalization		
$T_3$ From one relationship to multiple relationships		
$T_4$ From one relationship to an entity with relationships		
$T_5$ Adding attributes to an entity		
$T_6$ Adding attributes to a relationship		

# DESIGN ER MODEL

## Strategies: TOP-DOWN




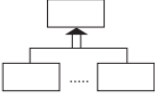








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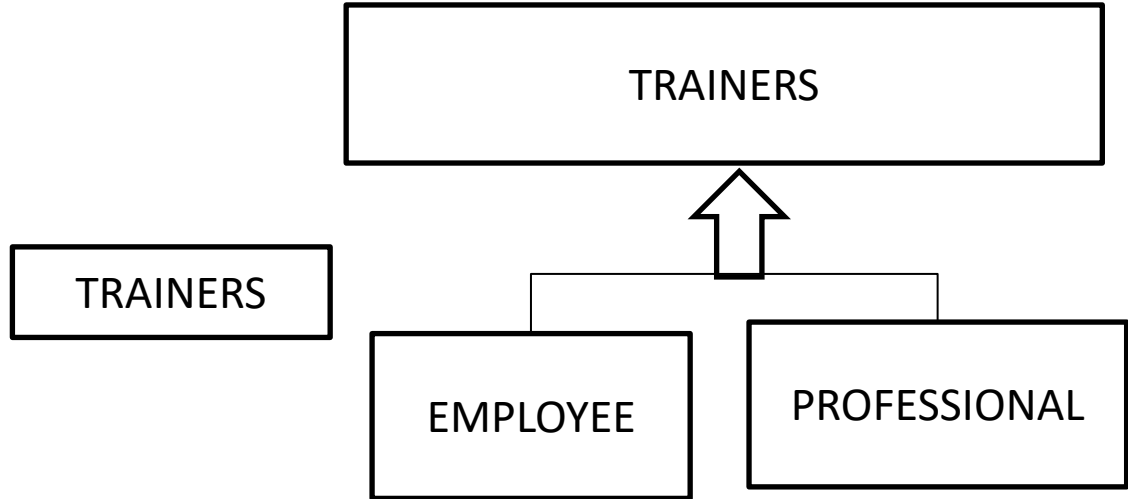




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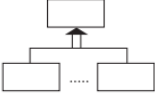



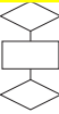




## Strategies: TOP-DOWN

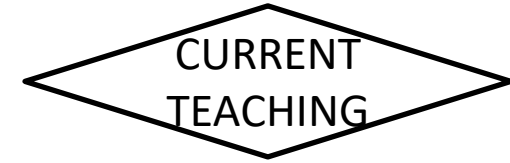
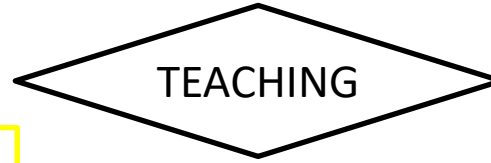
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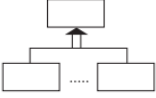








## Strategies: TOP-DOWN

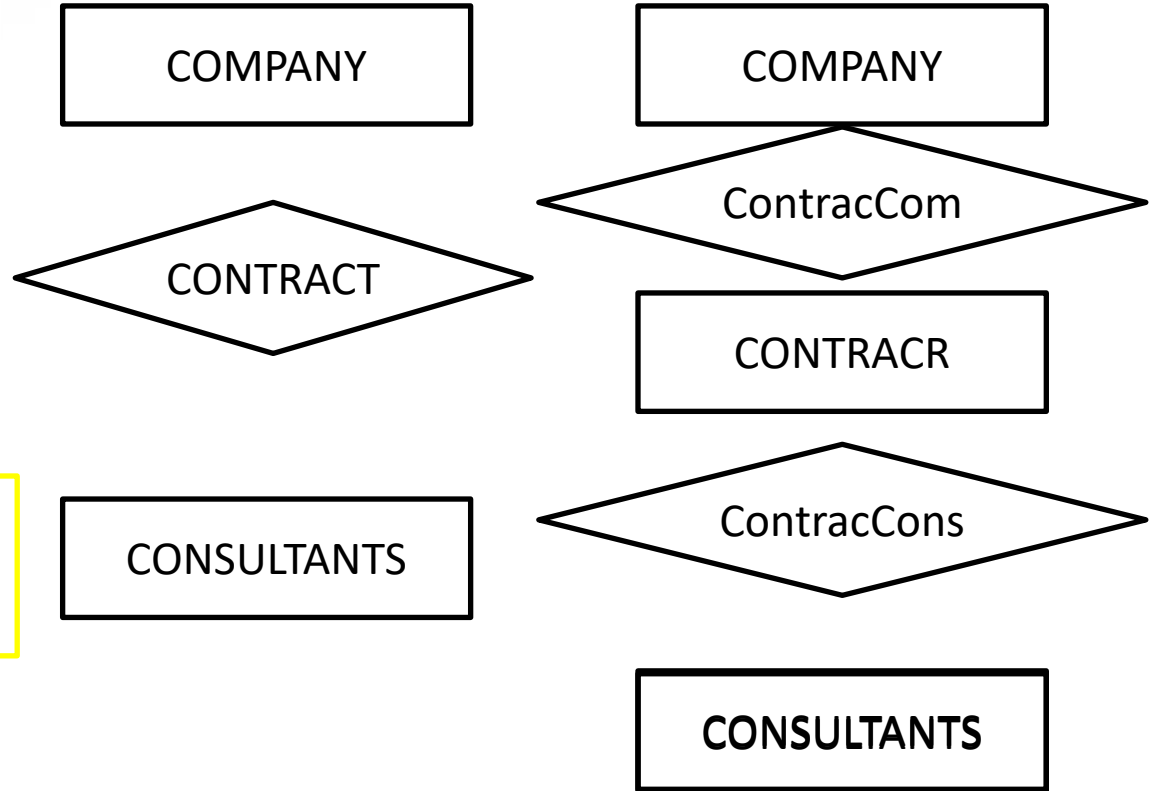
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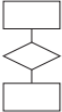

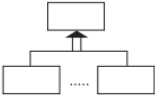

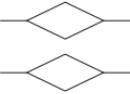

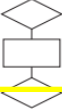




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TRAINER

TRAINER

SocialSecurityNumber,

Surname,


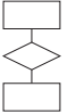

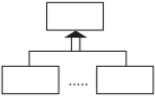

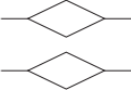






Age,

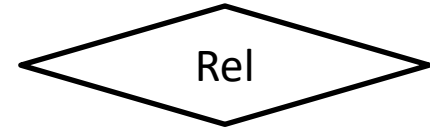
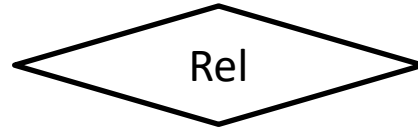
Sex

TownOfBirth

# DESIGN ER MODEL

## Strategies: TOP-DOWN

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A  
B  
C  
D



# DESIGN ER MODEL

## Strategies: BOTTOM-UP

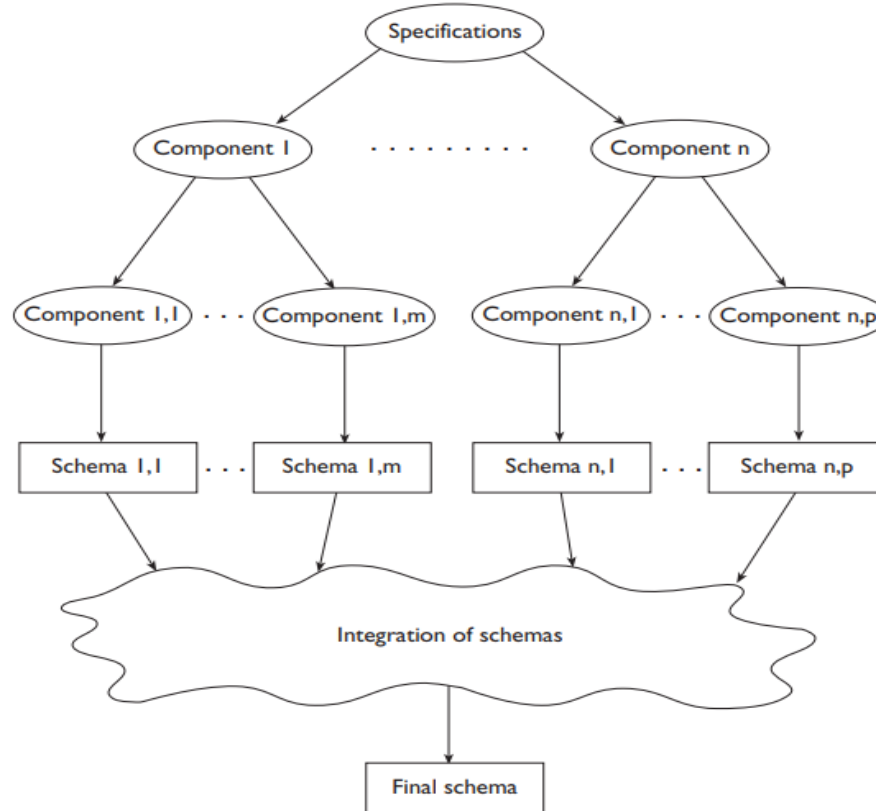
In this strategy, the initial specifications are decomposed into smaller and smaller components, until each component describes an elementary fragment of the specifications

At this point, the various components are represented by simple conceptual schemas that can also consist of single concepts

The various schemas thus obtained are then amalgamated until a final conceptual schema is reached.








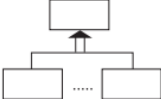








# DESIGN ER MODEL

## Strategies: BOTTOM-UP



# DESIGN ER MODEL

## Strategies: BOTTOM-UP

Transformation	Initial concept	Result
$T_1$ Generation of an entity		
$T_2$ Generation of a relationship	 	
$T_3$ Generation of a generalization	  ..... 	
$T_4$ Aggregation of attributes on an entity	  	
$T_5$ Aggregation of attributes on a relationship	  	





# DESIGN ER MODEL

## Strategies: INSIDE-OUT

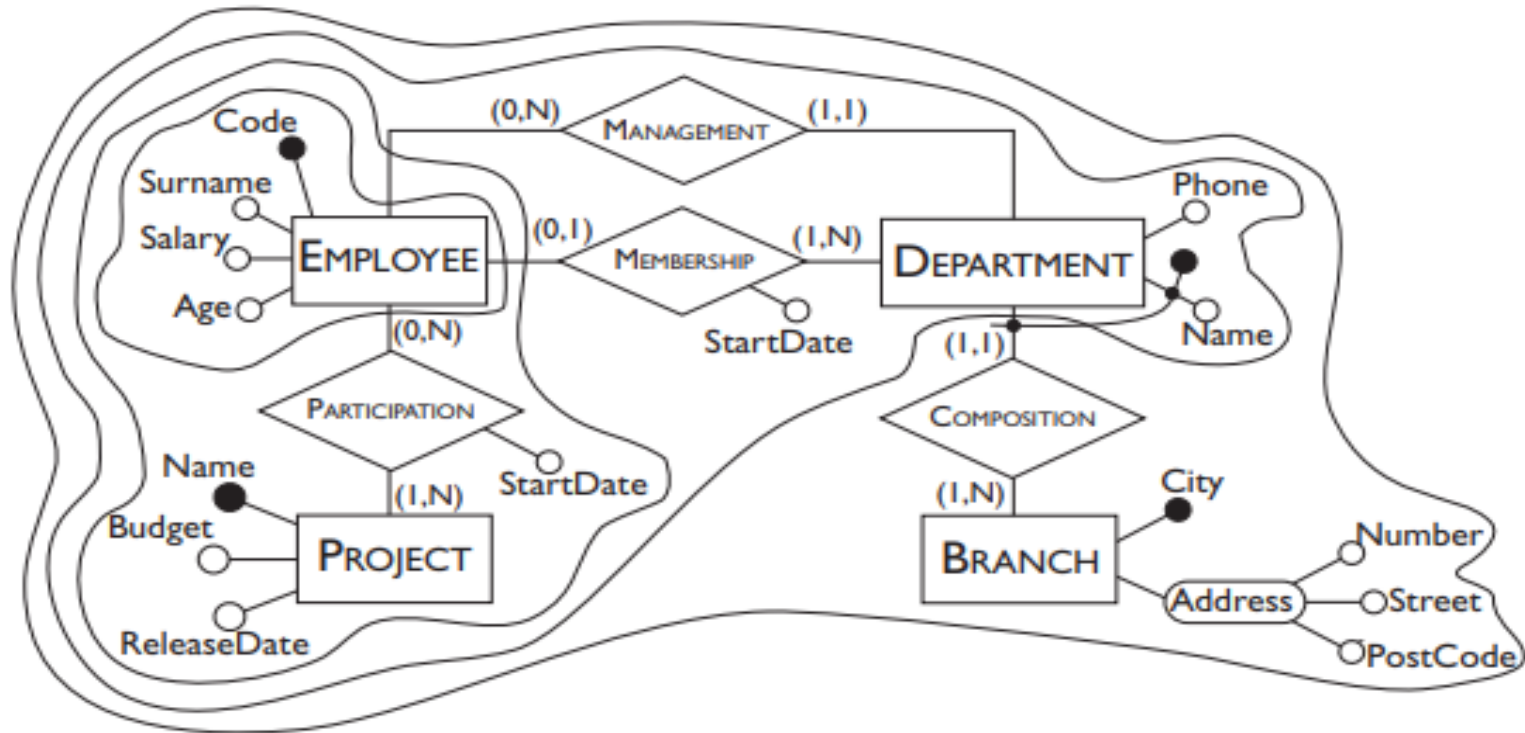
**INSIDE-OUT strategy** can be regarded as a particular type of bottom-up strategy

It begins with the identification of only a few important concepts and, based on these, the design proceeds, spreading outward 'radially'

That is, first the concepts nearest to the initial concepts are represented, and we then move towards those further away by means of 'navigation' through the specification

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Strategies: INSIDE-OUT





# DESIGN ER MODEL

## Strategies: MIXED STRATEGY

The mixed strategy seeks to combine the top-down and bottom-up advantages:

The designer divides the requirements into separate components (as in the bottom-up) but, at the same time, defines a skeleton scheme, containing, at the abstract level, the main concepts of the application

This provides a unified, albeit abstract, view of the entire project and can guide the integration phases of the subschemes

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## Strategies: MIXED STRATEGY

Considering Training Accademy

It is immediate to identify three main concepts (entities): PARTICIPANT, COURSE, TEACHER.

There are PARTICIP. and TEACHING relationships between them.

The following skeleton schema is obtained





**A complete example of conceptual  
design  
TRAINING COMPANY**



# DESIGN ER MODEL

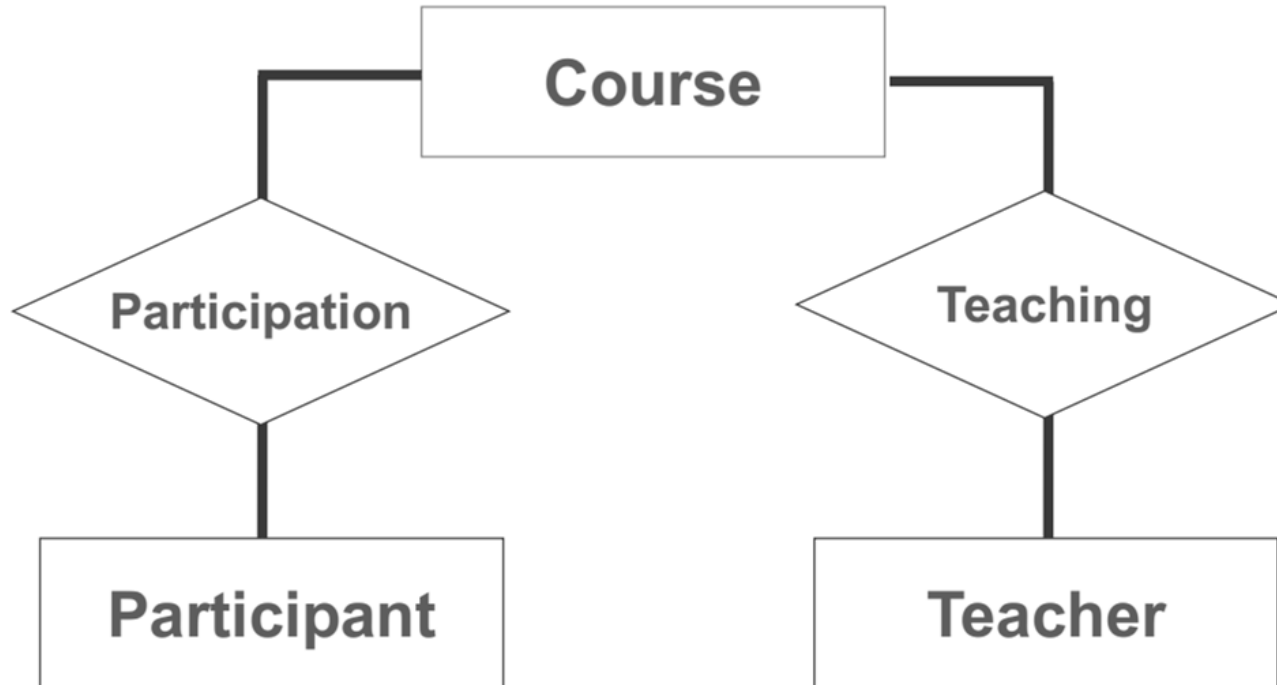
## Structuring requirements - part I

General phrases

*We want to create a database for a company that provides courses, of which we want to represent the data of course participants and teachers*

# DESIGN ER MODEL

## Skeleton schema





# DESIGN ER MODEL

## Structuring requirements – part II

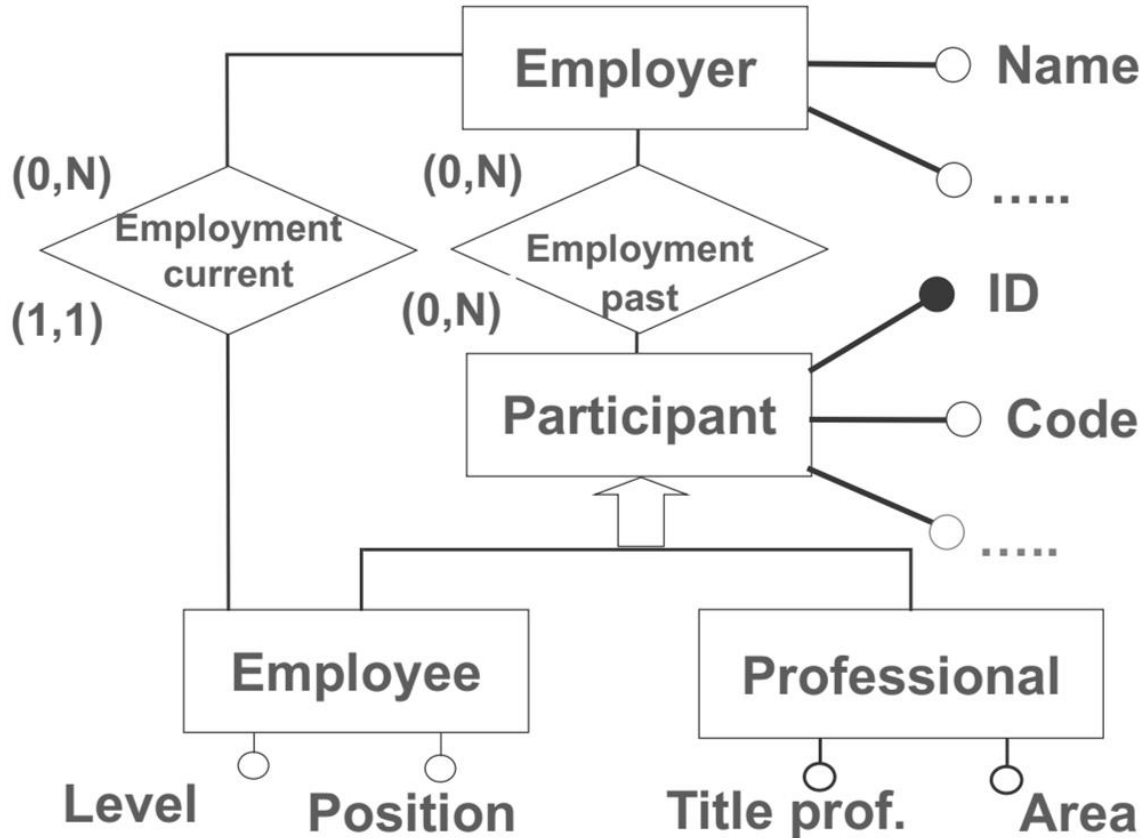
Phrases about participant

*We represent the name, address and telephone number of the present and past employers of the participants*



# DESIGN ER MODEL

## Skeleton schema





# DESIGN ER MODEL

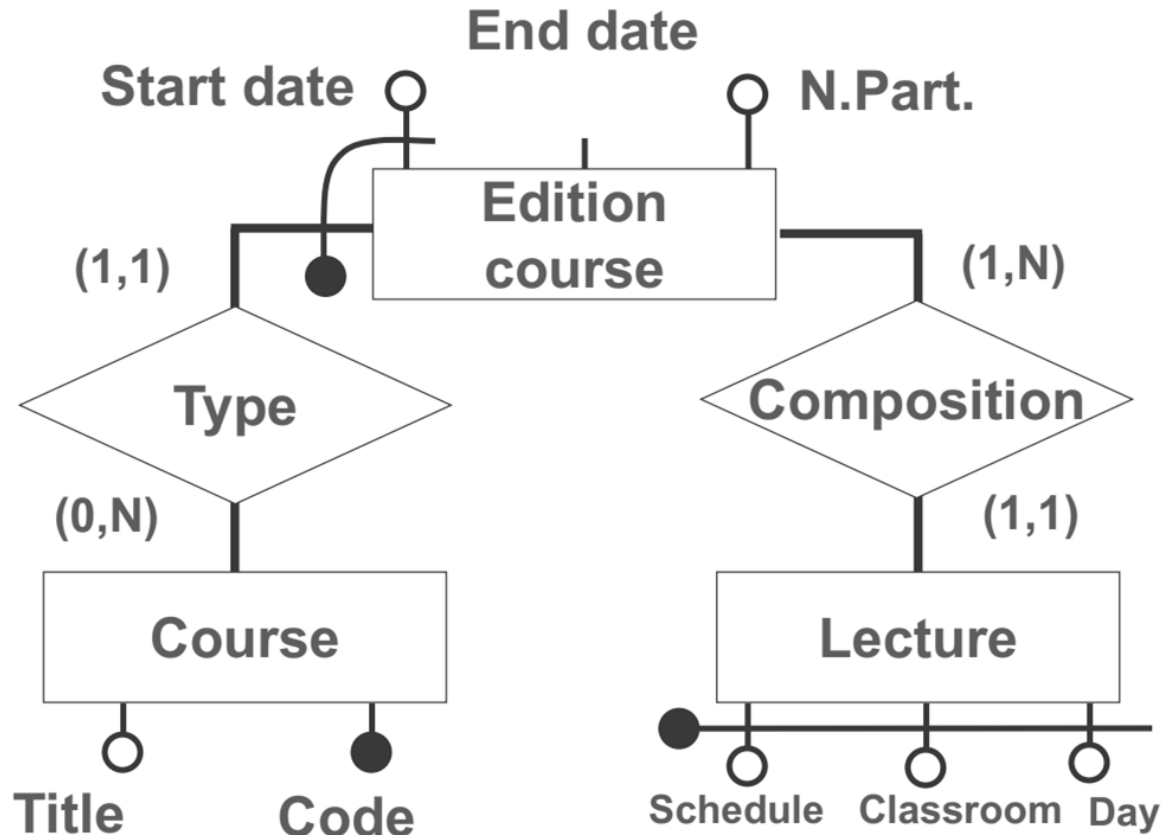
## Structuring requirements – part III

Phrases related to courses

*For the courses (about 200), we represent the title and the code, the various editions with start and end dates and, for each edition, we represent the number of participants and the day of the week, the classrooms and the hours where the lessons are held.*

# DESIGN ER MODEL

## Skeleton schema





# DESIGN ER MODEL

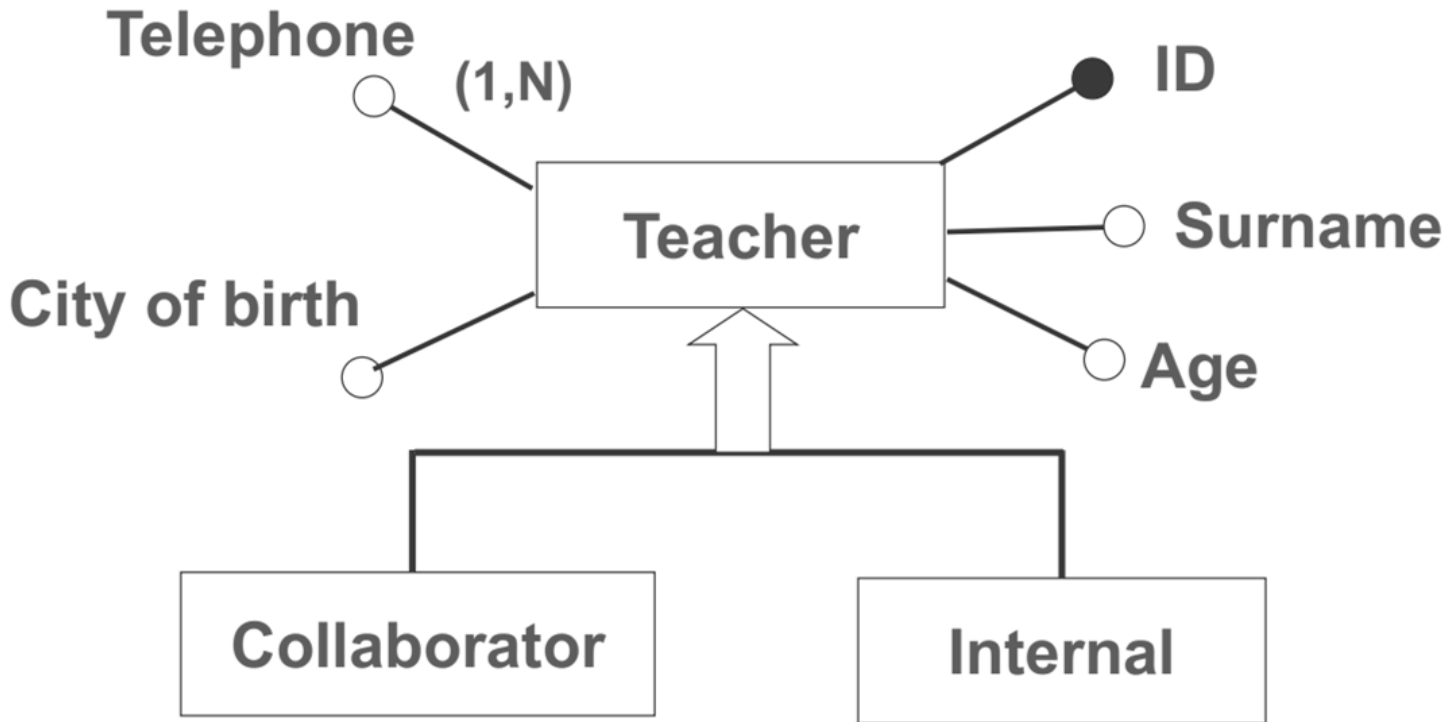
## Structuring requirements – part III

Phrases related to teachers

*For teachers (about 300), we represent the surname, age, city of birth, all telephone numbers, the title of the course they teach, those who have taught in the past and those who can teach. Teachers can be internal employees of the training company or external collaborators*

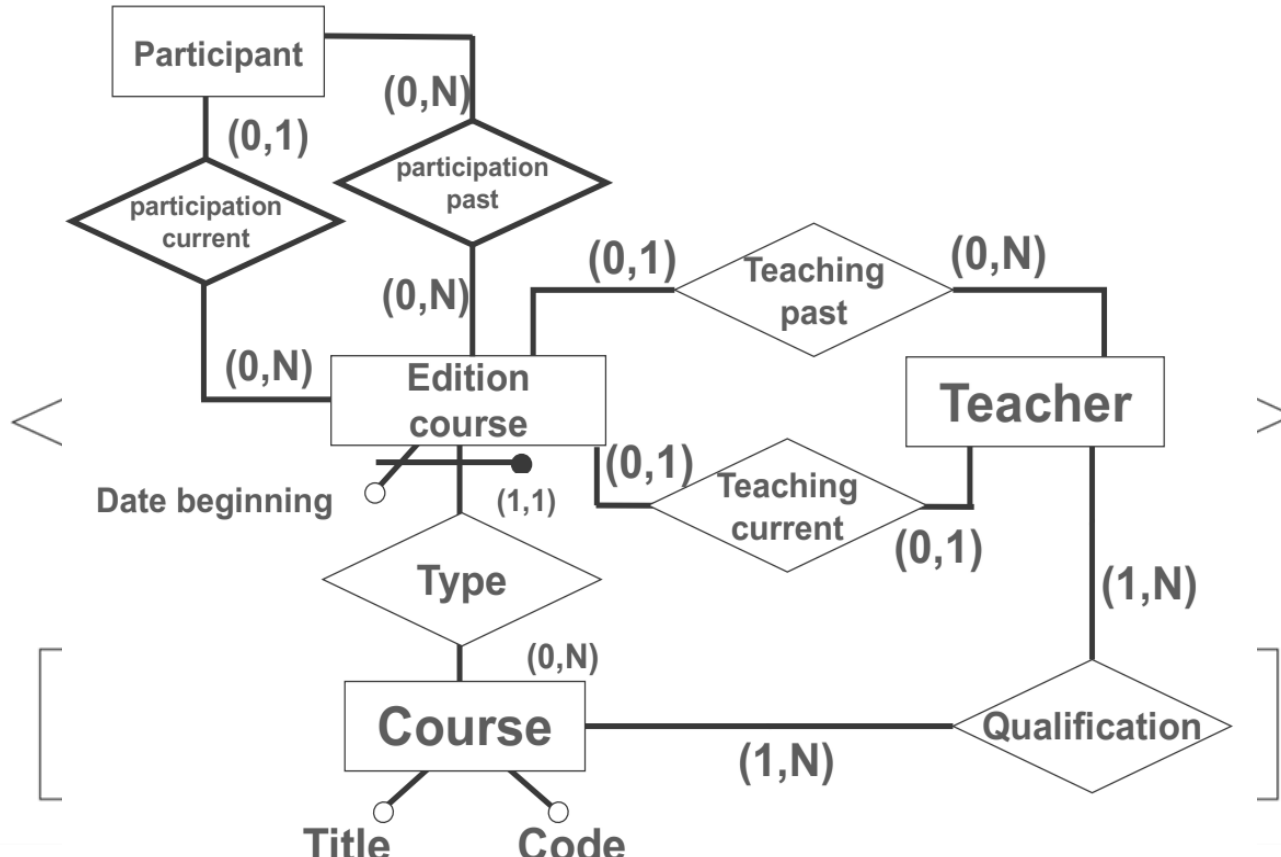
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## Skeleton schema



# DESIGN ER MODEL

## Integration schemas





**End**