

Chapter 7

DB Design Example

[From Atzeni, et al, *Database Systems: Concepts, Languages and Architectures*, 2000]

The requirement

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, 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.

Glossary of terms

Term	Description	Synonym	Links
Trainee	Participant in a course. Can be an employee or self-employed.	Participant	Course, Employer
Instructor	Course tutor. Can be freelance.	Tutor	Course
Course	Course offered. Can have various editions.	Seminar	Instructor, Trainee
Employer	Company by which a trainee is employed or has been employed.		Trainee

Rewriting & structuring of requirements

Phrases of a general nature
We wish to create a database for a company that runs training courses. We wish to hold the data for the trainees and the instructors.
Phrases relating to the trainees
For each trainee (about 5000), identified by a code, we will hold the social security number, surname, age, sex, town of birth, current employer, previous employers (along with the start date and the end date of the period employed), the editions of the courses the trainee is attending at present and those he or she has attended in the past, with the final marks out of ten.
Phrases relating to the employers of the trainees
For each employer of a trainee we will hold the name, address and telephone number.

Rewriting & structuring of requirements

Phrases relating to the courses
For each course (about 200), we will hold the name and code. Each time a particular course is given, we will call it an 'edition' of the course. For each edition, we will hold the start date, the end date, and the number of participants. For the editions currently in progress, we will hold the dates, the classrooms and the times in which the classes are held.
Phrases relating to specific types of trainee
For a trainee who is a self-employed professional, we will hold the area of expertise and, if appropriate, the professional title. For a trainee who is an employee, we will hold the level and position held.
Phrases relating to the instructors
For each instructor (about 300), we will hold surname, age, town of birth, all telephone numbers, the edition of courses taught, those taught in the past and the courses the instructor is qualified to teach. The instructors can be permanently employed by the training company or can be freelance.

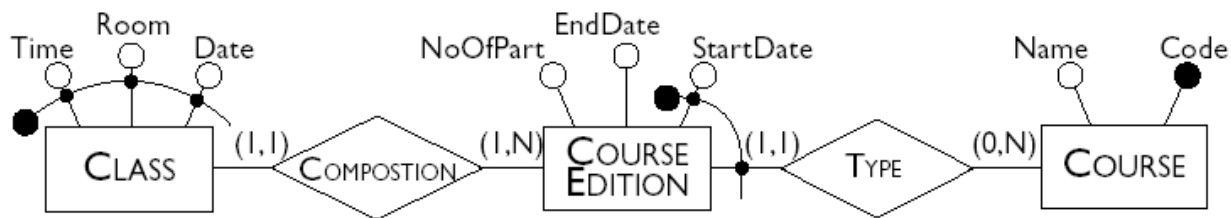
Example of operational requirements

- ❑ **operation 1:** insert a new trainee including all his or her data (to be carried out approximately 40 times a day);
- ❑ **operation 2:** assign a trainee to an edition of a course (50 times a day);
- ❑ **operation 3:** insert a new instructor, including all his or her data and the courses he or she is qualified to teach (twice a day);
- ❑ **operation 4:** assign a qualified instructor to an edition of a course (15 times a day);
- ❑ **operation 5:** display all the information on the past editions of a course with title, class timetables and number of trainees (10 times a day);
- ❑ **operation 6:** display all the courses offered, with information on the instructors who are qualified to teach them (20 times a day);
- ❑ **operation 7:** for each instructor, find the trainees all the courses he or she is teaching or has taught (5 times a week);
- ❑ **operation 8:** carry out a statistical analysis of all the trainees with all the information about them, about the editions of courses they have attended and the marks obtained (10 times a month).

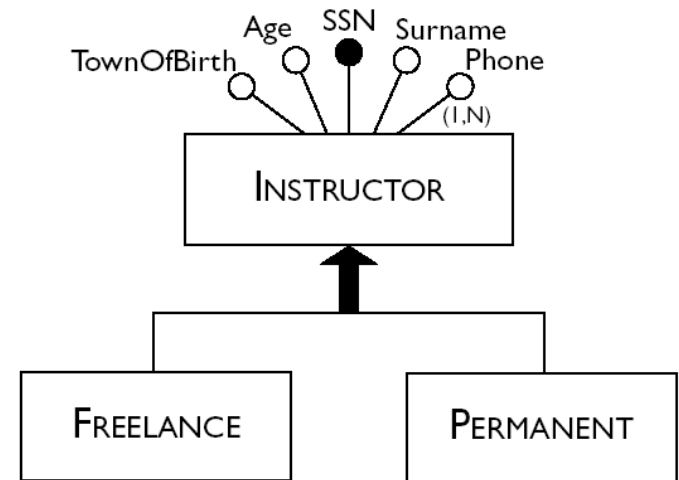
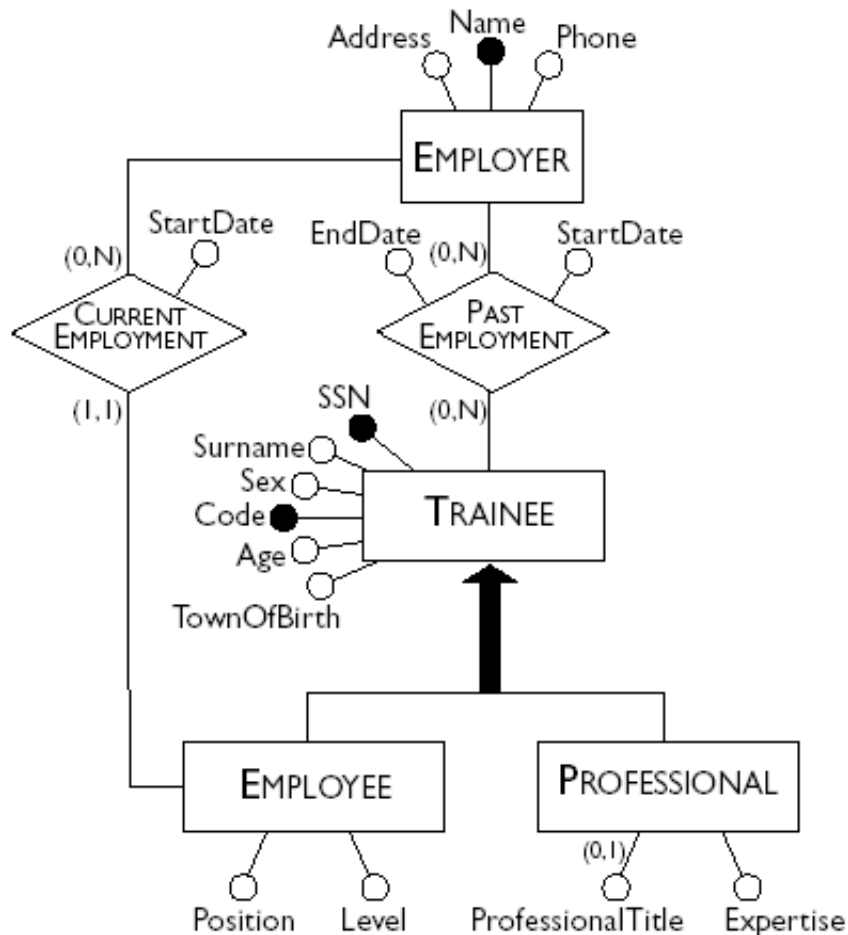
Skeleton Schema



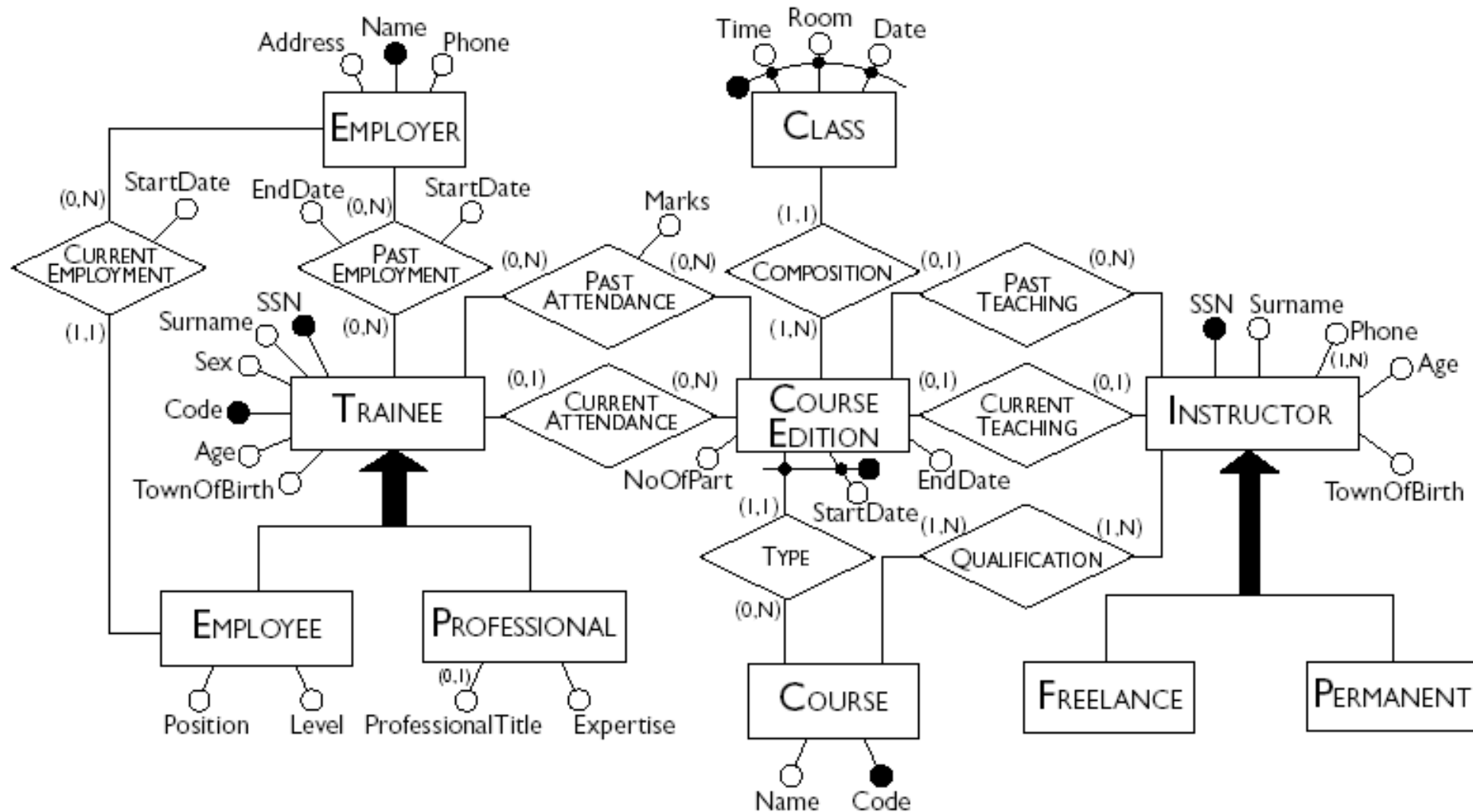
Refinement of Course



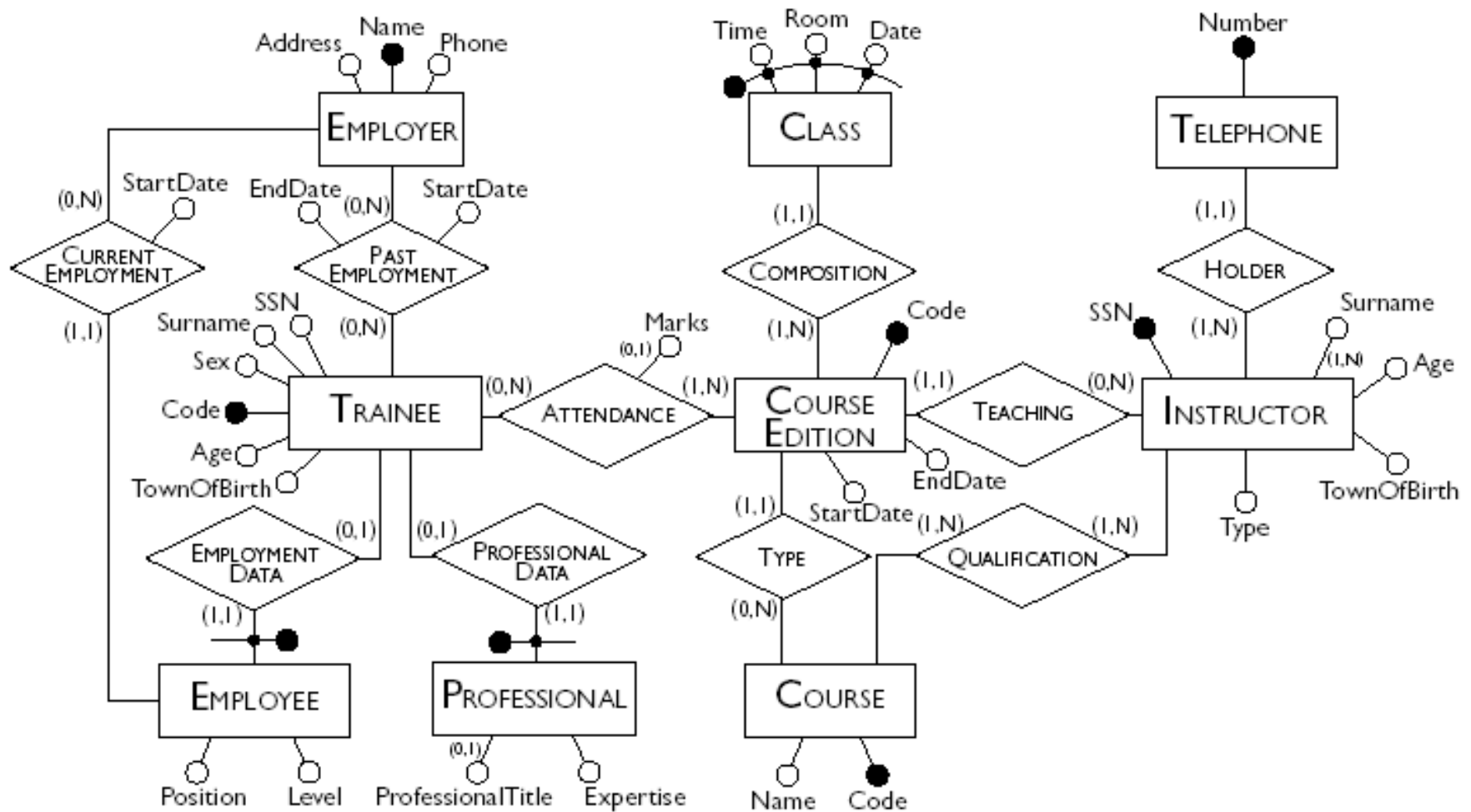
Refinement of Trainee & Instructor



Integration



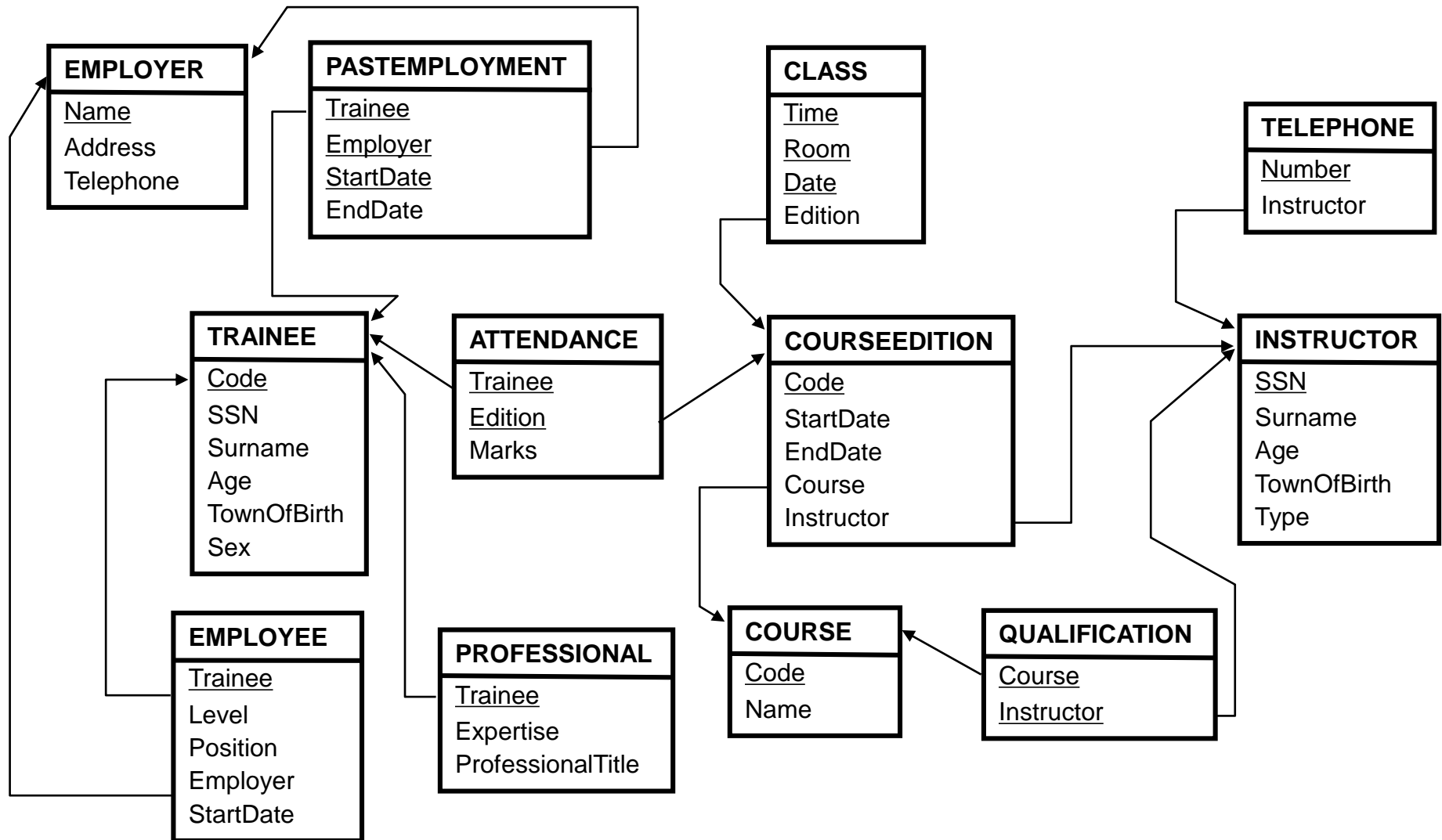
Removing Generalizations



Translation into the relational model

- ❑ COURSEEDITION(Code, StartDate, EndDate, Course, Instructor)
- ❑ CLASS(Time, Room, Date, Edition)
- ❑ INSTRUCTOR(SSN, Surname, Age, TownOfBirth, Type)
- ❑ TELEPHONE(Number, Instructor)
- ❑ COURSE(Code, Name)
- ❑ QUALIFICATION(Course, Instructor)
- ❑ TRAINEE(Code, SSN, Surname, Age, TownOfBirth, Sex)
- ❑ ATTENDANCE(Trainee, Edition, Marks*)
- ❑ EMPLOYER(Name, Address, Telephone)
- ❑ PASTEMPLOYMENT(Trainee, Employer, StartDate, EndDate)
- ❑ PROFESSIONAL(Trainee, Expertise, ProfessionalTitle*)
- ❑ EMPLOYEE(Trainee, Level, Position, Employer, StartDate)

Schema Diagram



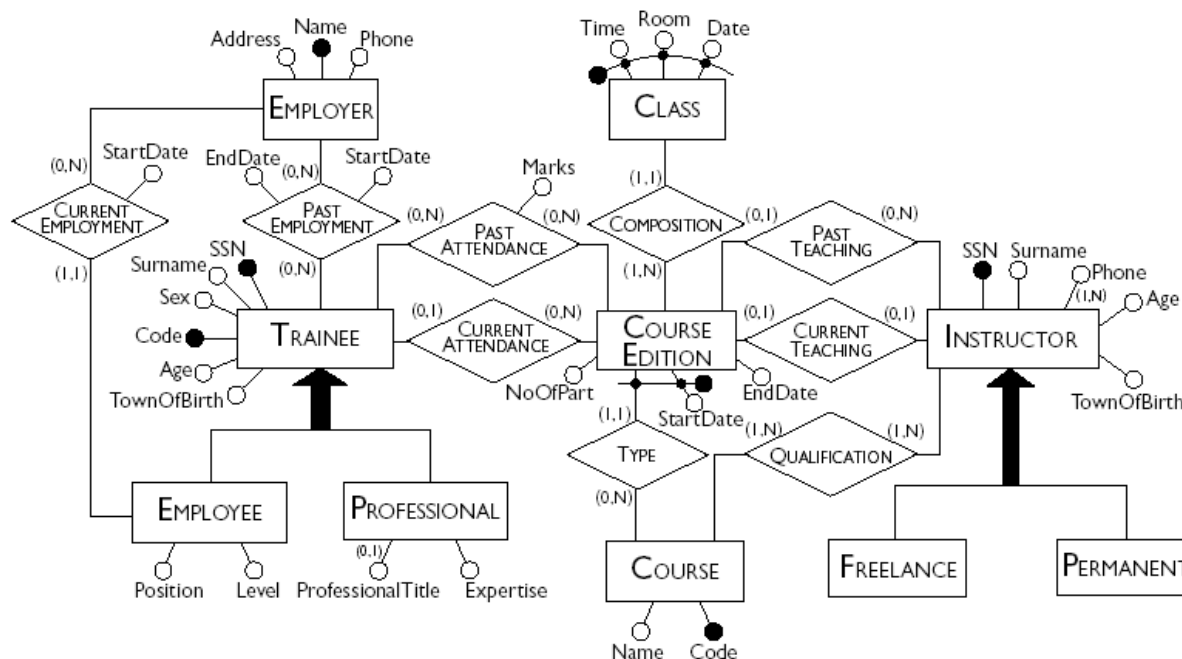
Qualities of a Database Schema

1. Completeness

- A schema represents all relevant features of the application domain.

2. Correctness

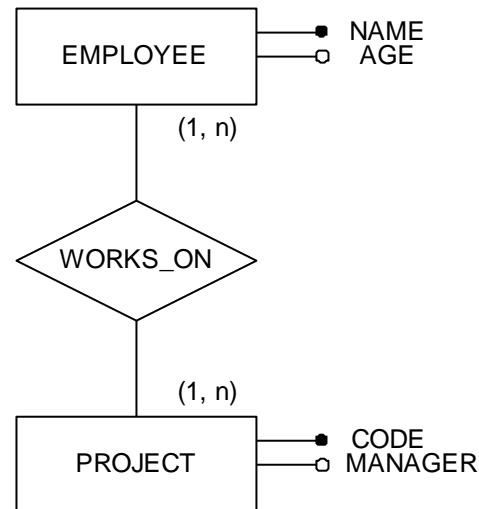
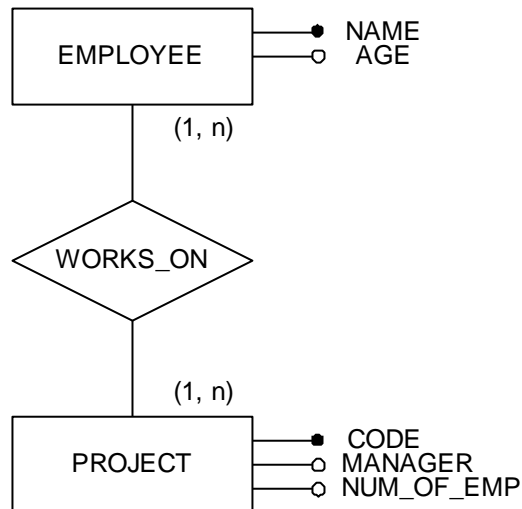
- A schema properly uses the concepts of the ER model.



Qualities of a Database Schema (cont.)

3. Minimality

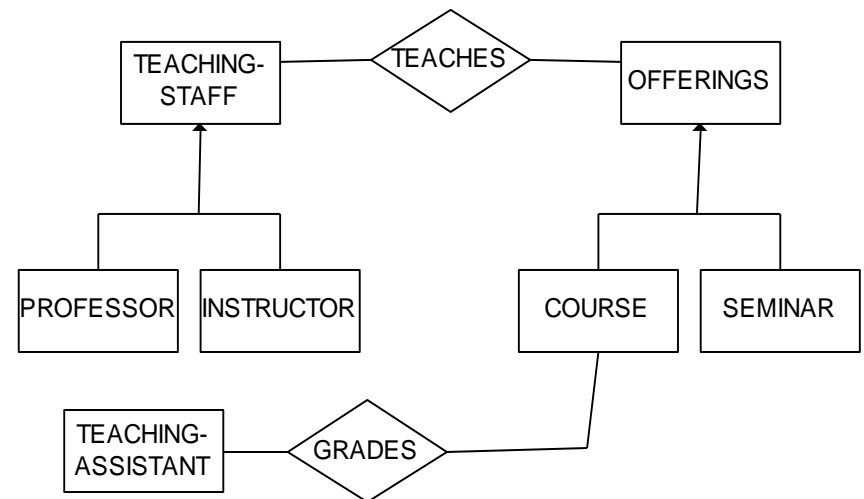
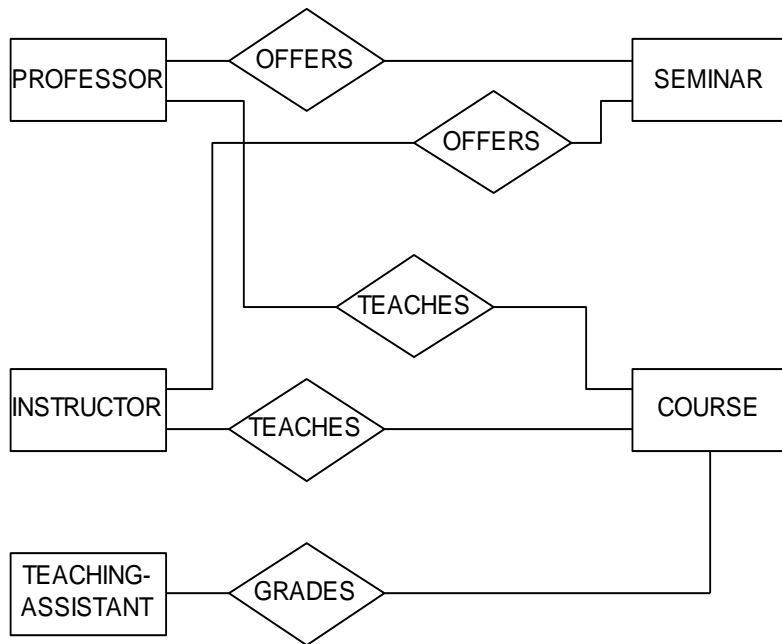
- Every aspect of the requirements appears *only once* in the schema.
- No concept can be deleted from the schema without losing some information.



Qualities of a Database Schema (cont.)

4. Expressiveness

- A schema represents requirements in a natural way and can be easily understood through the meaning of ER, without the need for further explanation.



Qualities of a Database Schema (cont.)

5. Readability

- A schema respects certain aesthetic criteria that make the diagram graceful

