Database Theory

Assignment 1

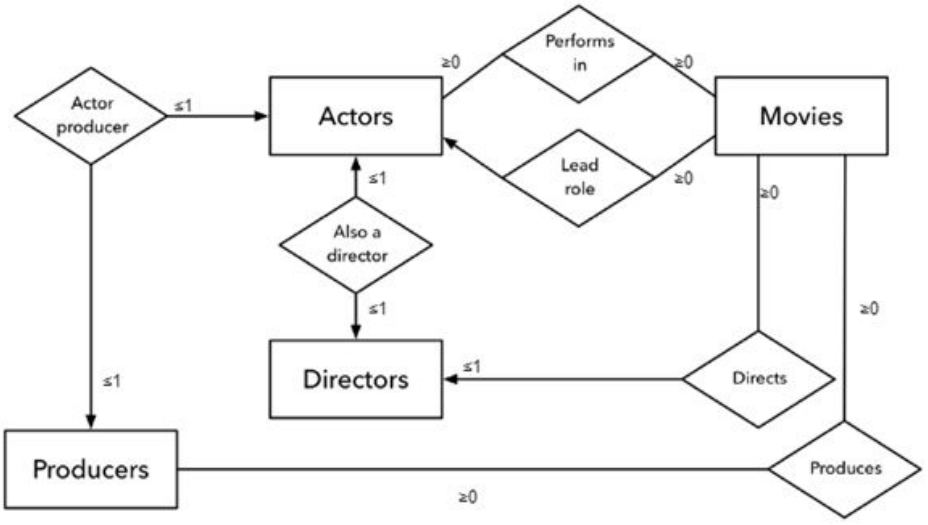
Students: Ruth Dirnfeld (rd222dv)
Helena Tevar (ht222fd)
Semester: 18HT

Table of Content

Task 1

Given the constraints shown in the E/R diagram, we are responding to the following statements with True, False, or Maybe. (Maybe: statements that are, although not explicitly shown to be True, cannot be proven False based on the schema as shown)

Assumptions:
MoviesDB is a populated database
For us:
'Some": interpreted as true if there is a possible case according to our E/R diagram
'Every': would have to be fulfilled for every case
- means: 0…n
➔ means: 0…1



Statements and Responses

1. There are no actors in this database that have been in no movies.
False
The "performs in" is a many-many relationship, which means that there can be 0 or many. Therefore, there can be an actor which has been in no movie.

2. There are some actors who have acted in more than ten movies.
True
The "performs in" is a many-many relationship, which means that some actors may have acted in more than 10 movies.

3. Some actors have done a lead role in multiple movies.
True
Many – one relationship: Our E/R diagram only specifies the maximum Actor entities per Movie, which is one. So, an Actor can have a lead role in many movies.

4. A movie can have only a maximum of two lead actors.

False

The maximum of lead roles per movie is 0 or 1. Because the multiplicity of the arrow is 0…1

5. Every director has been an actor in some movie.

False

According to the E/R diagram, the “also a director” is a one-one relationship (an Actor that is “also a director” is connected to one Director entity). An Actor happens to be a Director only if there is an “Also a director” relationship, which means that it is possible that an Actor is not a Director.

6. No producer has ever been an actor.

False

Similar as before (it could happen that an Actor is a Director), now it can happen that a Producer is an Actor.

7. A producer cannot be an actor in some other movie.

False

Since we know already that a Producer can be an Actor, we can also see in the E/R diagram that he can “perform in” many movies.

8. There are movies with more than a dozen actors.

Maybe

The relationship is many-many, so it is allowed and there might be movies with more than a dozen actors, but we don’t know for sure, so we can’t say that this statement is true.

9. Some producers have been a director as well.

True

We know from previous cases, that a Producer can be an Actor, and an Actor can be a Director, so it is possible that a Producer is an Actor, which happens to be a Director as well.

10. Most movies have one director and one producer.

Maybe

Might be true, but we can’t say based on the E/R diagram what “most” movies have. Therefore, the statement might be true.

11. Some movies have one director but several producers.

True

In this case, it says “some movies”, so it happens to be true since it is possible that some movies have one director but several producers. We know this because we know that a movie has a many-one relationship with Directors and a many-many relationship with the Producers.

12. There are some actors who have done a lead role, directed a movie, and produced a movie.

True

From the previous conclusions, we know that an Actor can be a Director, a Producer and be the lead role.

13. No movie has a director who also acted in that movie.
False
Since the Director is also an Actor, it is possible that he also “performs in” that movie.

Task 2

Considering a model where an entity set Births is related to Babies, Mothers, Doctors, and Nurses by four binary relationships.

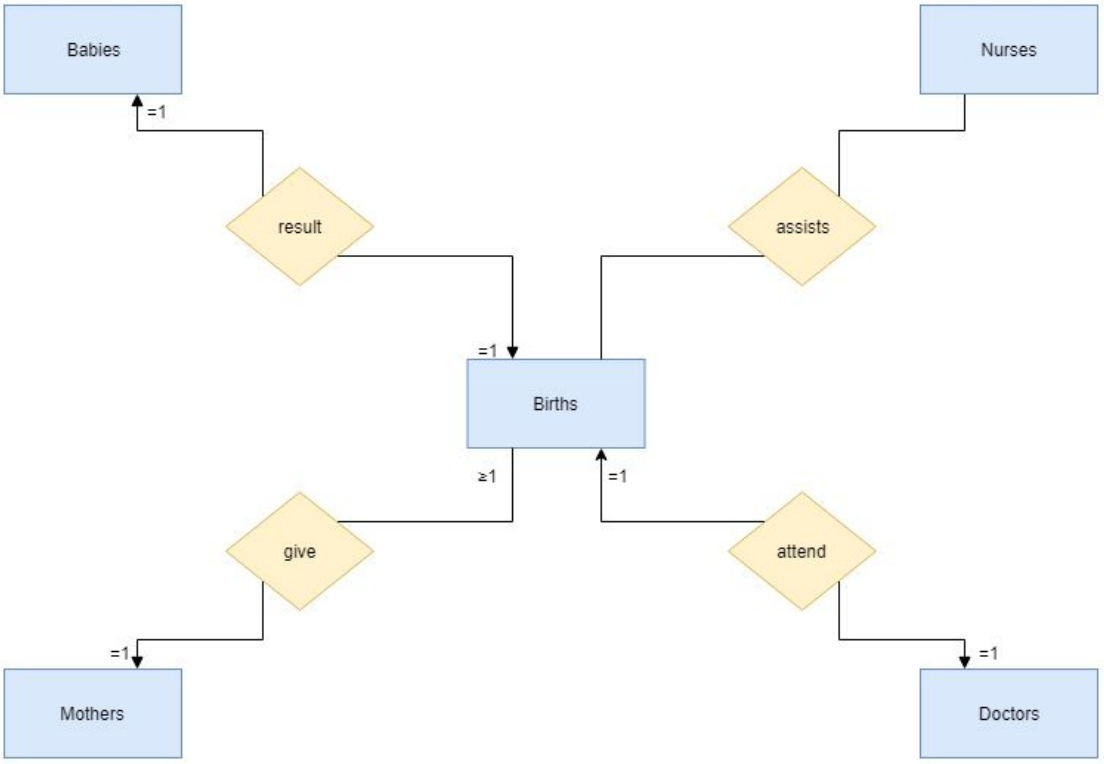
2.1 Multiplicity to represent the following conditions

1. Every baby is the result of a unique birth, and every birth is of a unique baby.
   - ➢ exactly one - exactly one unique relationship between Baby and Birth

2. In addition to (1), every baby has a unique mother.
   - ➢ exactly one - exactly one relationship between Baby and Mother (since a Birth does not involve more than one Baby born to one Mother, and therefore also at least one - exactly one relation between Birth and Mother)

3. In addition to (1) and (2), for every birth, there is a unique doctor.
   - ➢ exactly one - exactly one unique relationship between Birth and Doctor

- means: 0…n (if not other written in the diagram)



2.2 Design Flaws

There are many design flaws in the given model. There is no option for twin siblings, there is only one unique doctor attending each birth and there is no information about the nurses. The following are the main design flaws we noticed:

- Babies - Births ⇒ one-to-one (exactly one - exactly one).
    - This relationship does not represent the real world. Twins, triplets, etc, may come from the same birth.

- Doctors - Births ⇒ one-to-one (exactly one - exactly one).
    - Each birth will have a unique doctor, so one doctor cannot attend more than one birth. But a doctor may have many births in one shift in the real world. Many doctors may assist the same birth. In addition, different doctors of different specialities may participate in the birth, for instance, the anesthesiologist is also a doctor.

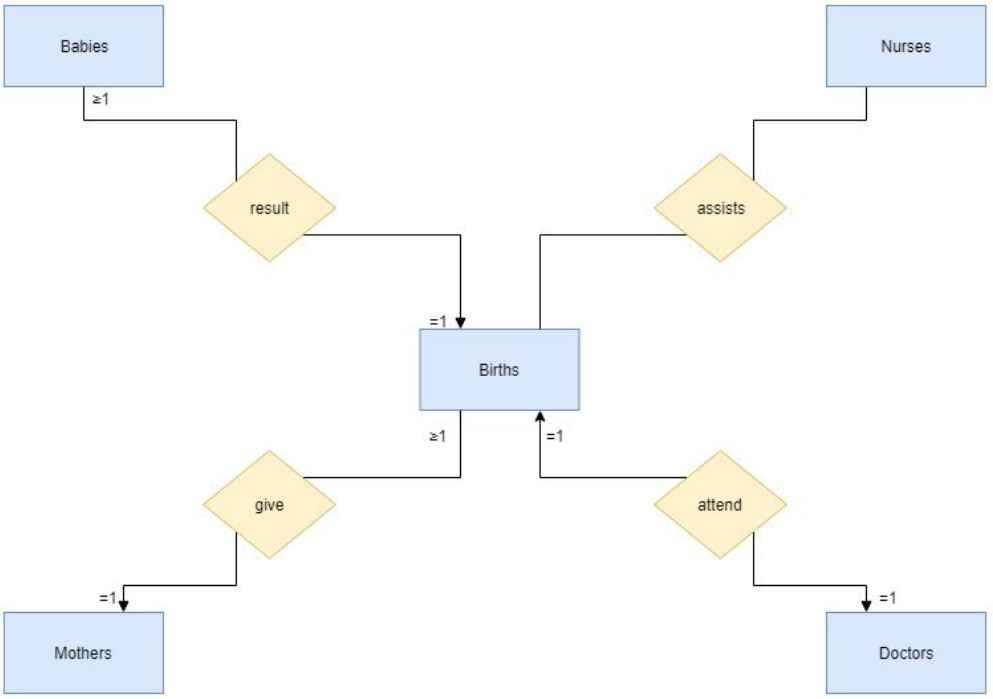
- Nurses - Births ⇒ many-to-many
    - There is no information about the relationship of this two entities. We can, therefore, assume that many nurses assist at many births, as they do in real-world situations.

2.3 Change of viewpoint on babies

Suppose we change our viewpoint to allow a birth to involve more than one baby born to one mother. How would you represent the fact that every baby still has a unique mother?

Since we need to change only the viewpoint of allowing to have more than one baby to be born to one mother, then the only change noticeable would be the relationship Babies-Births with a many - one (at least one - exactly one) relationship. The relation Births-Mothers remains as many - one (at least one - exactly one), so no matter how many babies come from a birth, each birth only has a single mother.

- means: 0…n (if not other written in the diagram)



Task 3

A university registrar's office maintains data about the following entities:
(a) courses include number, title, credits, syllabus, and prerequisites;
(b) course offerings include course number, year, semester, section number, instructor(s), timings, and classroom;
(c) students, including student-id, name, and program; and
(d) instructors, including an identification number, name, department, and title.
Further, the enrollment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modelled.
Construct an E/R diagram for the registrar's office.

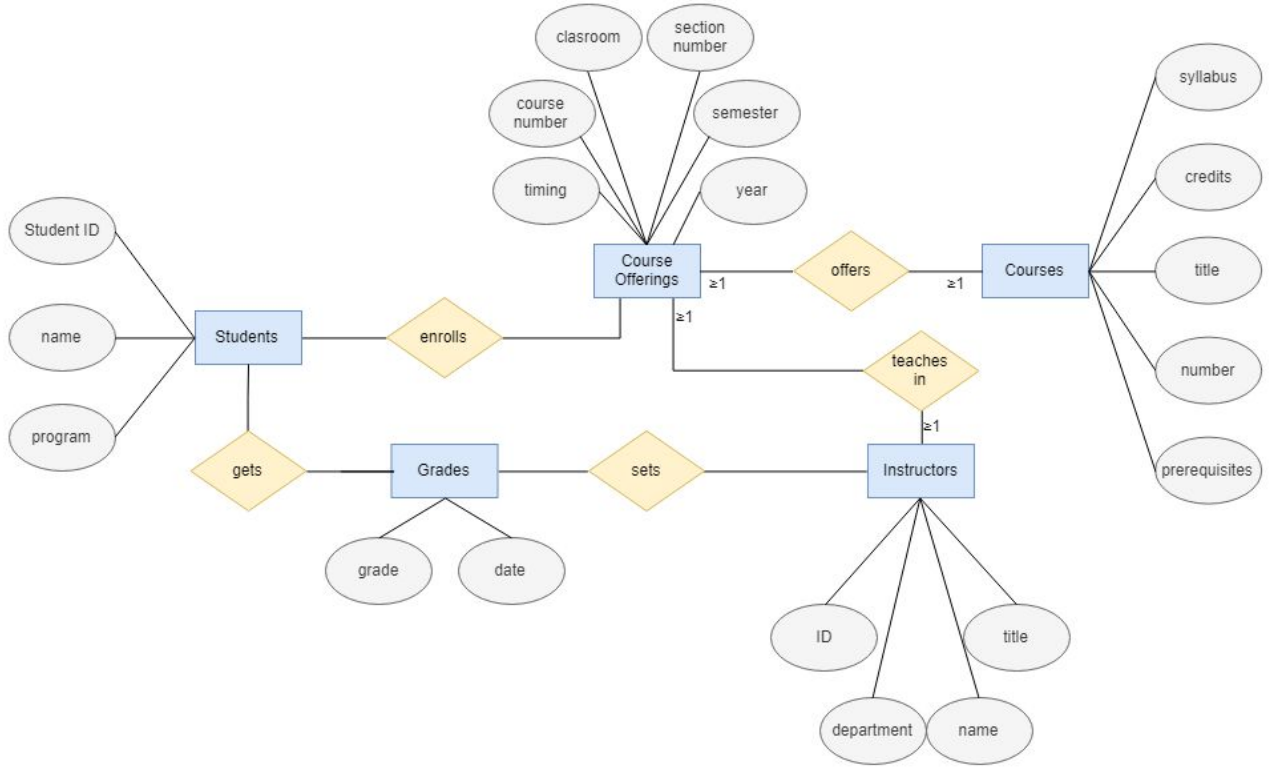
E/R diagram for the registrar's office

In our E/R diagram, some of the given attributes are replaced by an entity set.

Relationship	Description
Students-Course Offerings *Many-Many*	Each Student may enrol in many different courses.
Students-Grades *Many-Many*	Each student gets multiple grades.

Grades-Instructors *Many-Many*	Grades are set by the instructors.
Instructors-Course Offerings *Many-Many*	Each course offering may need at least one or more instructors, so it is a at least one to at least one relation
Course Offerings - Courses *Many-Many*	There can be at least one-course offering per course, so it is an at least one to at least one relation.

 means: 0…n (if not other written in the diagram)



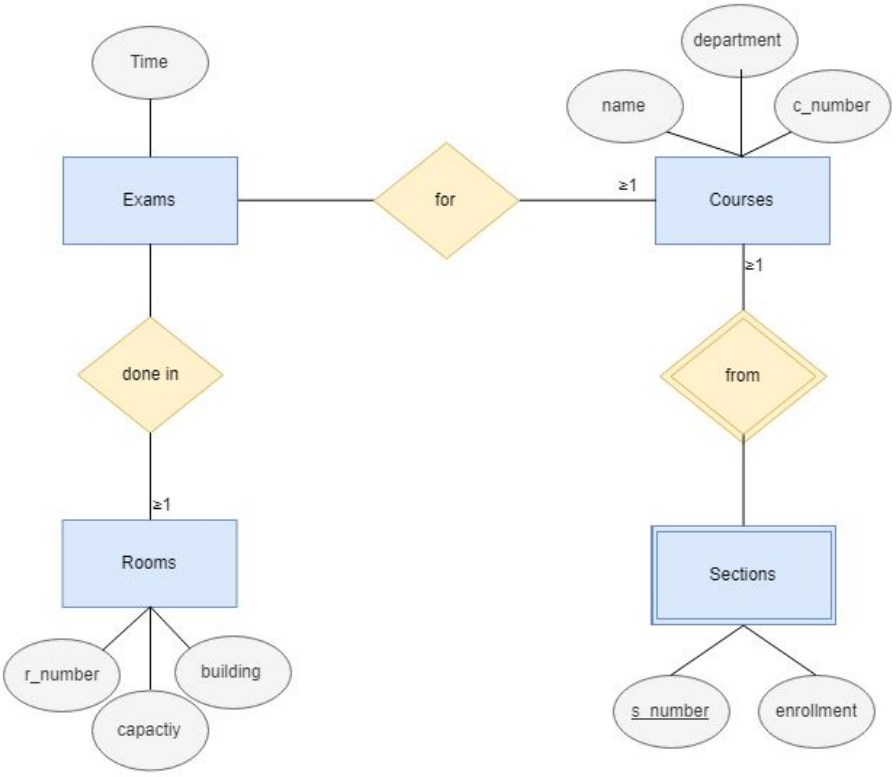
Task 4

Classroom scheduling:
Consider a university database for the scheduling of classrooms for the final exams. This database could be modeled as a single entity set exam with attributes course_name, section_number, room_number, and time. Alternatively, one or more additional entity sets could be defined, along with relationship sets to replace some of the attributes of the exam entity set, as:

- course with attributes name, department, and c_number
- section with attributes s_number and enrollment, and dependent as a weak entity set on course.
- room with attributes r_number, capacity, and building

4.1 The E/R diagram illustrating the use of all three additional entity sets listed

- means: 0…n (if not other written in the diagram)



In this exercise, we assumed that sections are different types of course, for instance, morning and evening groups. A course may not need to use sections, so their relationship would be that each course may have zero to many sections, but if there is a section, this section needs at least one course (because it is dependent on the course as a weak entity set). Furthermore, each course is related to the exams set in a many-many relationship, because a course may have different exams, for instance, different retakes. In the same way, the set courses are related to the set rooms in a many-many relation because the number of students can be larger than the capacity of the room, so the exam may need different rooms.
Because a university room may be used for different courses or programs, it would be more efficient to have rooms as its own entity. The set Rooms represent a real-life object more accurately than being part of Exams attributes.

4.2 Application characteristics that would influence a decision to include or not include each of the additional entity sets

Our decision would be to have the attributes of the single entity as: **additional entity sets**. This is beneficial, since smaller modules are easier to maintain and are more flexible when it comes to changes, than one big module which would hold the whole responsibility.