TDA357/ DIT620 Databases

ER exercises

13.02.2019

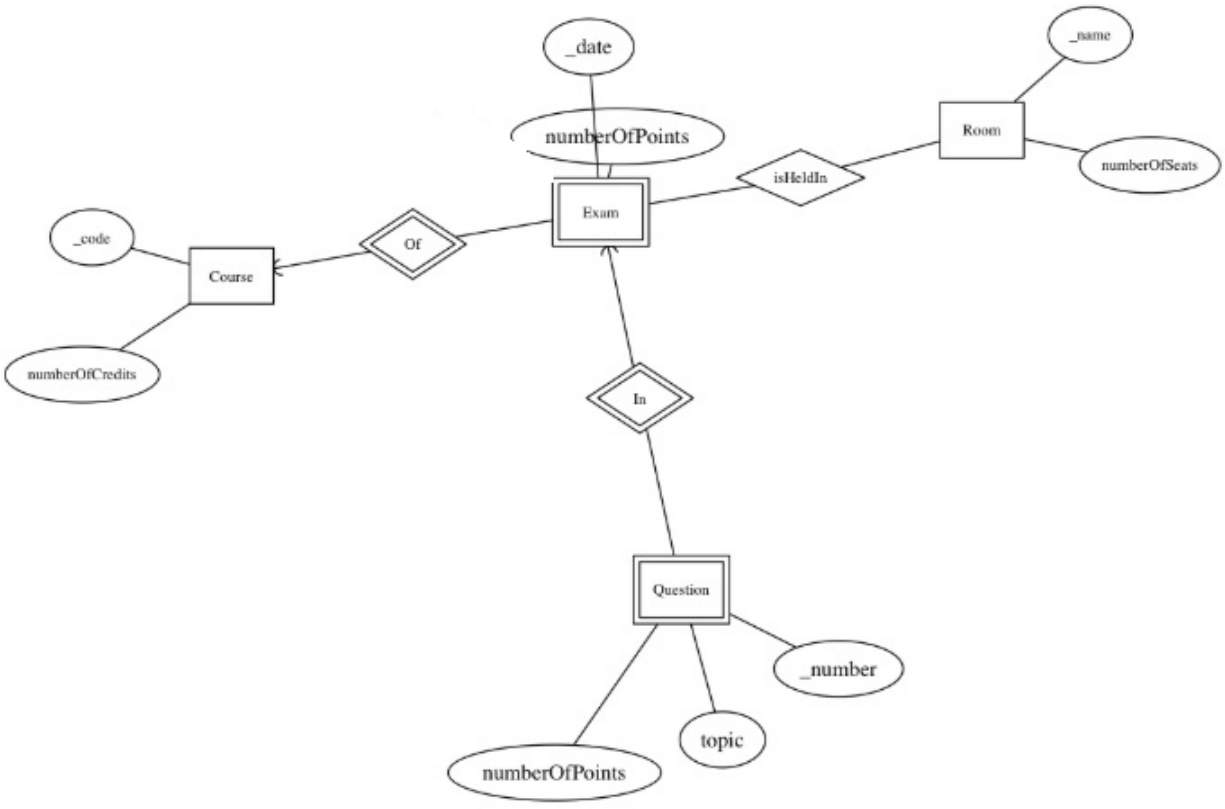
1. Modelling (from exam 2017)

   The domain to model is courses, exams, and exam questions:

   - A course has a code and a number of credits. The code identifies the course uniquely.
   - A course can have many exams, on different dates. Each exam has a total number of points.
   - Each exam has a set of questions, identified by a question number. Each question has a topic and a maximum number of points.
   - Each exam is held in one or more rooms.
   - Rooms have unique names. Each room has a number of seats.

   (a) Draw an Entity-Relationship diagram for this domain. Do not use multivalued attributes.

   Solution:



(b) Write a database schema, carefully marking keys and referential constraints. The schema can be a direct translation of your diagram, which is an easy way to get it. However, if you are unsure about your diagram, you can write the schema separately.

Solution:

Course(_code, numberOfCredits)

Exam(_date, numberOfPoints, numberOfParticipants, _courseCode)

courseCode → Course.code

Question(_number, topic, numberOfPoints, _examDate, _examCourseCode)

examDate → Exam.date

examCourseCode → Exam.courseCode

Room(_name,numberOfSeats)

isHeldIn(_examDate,_examCourseCode,_roomName)

examDate → Exam.date

examCourseCode → Exam.courseCode

roomName → Room.name

2. A local authority manages several nurseries which provide daycare for children. They want to use a database to record information about their nurseries. Each nursery is identifies by its name. Each nursery is organised into several sections, each with around 15 children. The sections within each nursery have unique names, but there might be sections with the same name in different nurseries. The local authority employs several teachers and each teacher is assigned to one of the sections. Each teacher's name and person number should be stored in the database. The name and person number of each child should be also stored. Initially, an application is made for a nursery place for a child. The application contains information about the child, the child's starting date at nursery, and a list of nursery choices (e.g. choice 1 is nursery 'A', choice 2 is nursery '2', etc.). After an application is processed, the child is allocated an available place in one of the sections of one of the nurseries. Information about the application and child's placement should be stored in the database. For each child, the person number, name and telephone number of each parent should be stored in the database.

(a) Draw an E-R diagram that correctly models this domain.

Solution: (below)

(b) Translate this E-R diagram into a set of relations, clearly making all references and keys. If any attributes can contain null values, state which ones.

Solution:

Nursery(_name)

Section(_name, _nursery)

nursery → Nursery.name

Teacher(_personNr, name, section, nursery)

(section,nursery) → Section.(name,nursery)

Application(_child, _startingDate)

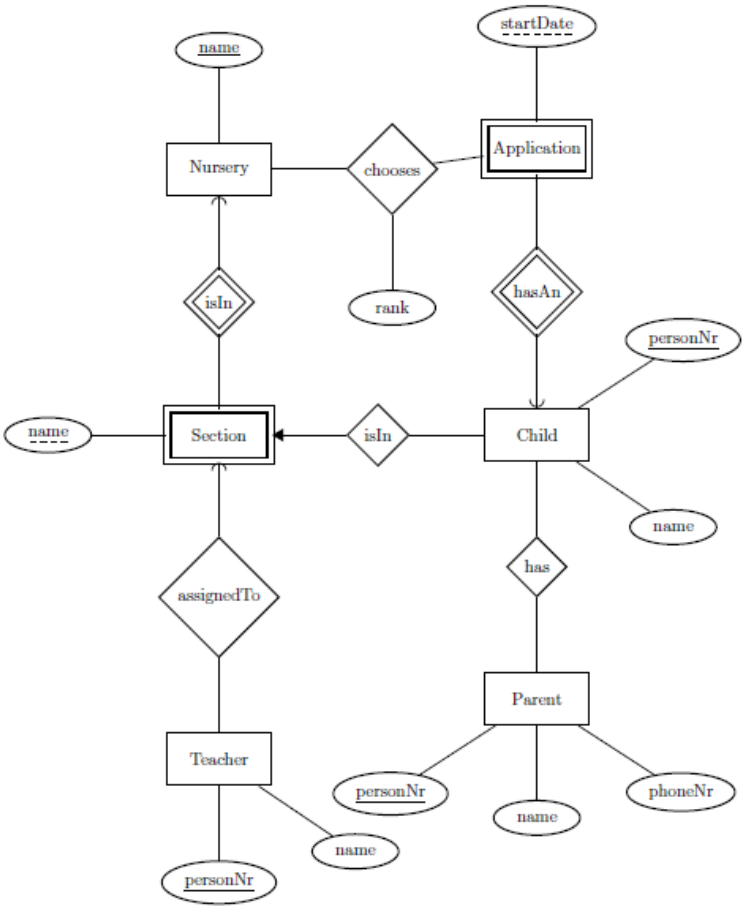
child → Child.personNr

Chooses(_child, _startDate, _nursery, rank)

child → Application.personNr

startDate → Application.startingDate

nursery → Nursery.name



Parent(_personNr, name, telephone)

hasParent(_parent, _child)

parent → Parent.personNr

child → Child.personNr

Two options for Child:

ER approach:

Child(_personNr, name)

ChildIsIn(_child, section, nursery)

child → Child.personNr

(section,nursery) → Section.(name,nursery)

Nullable approach:

Child(_personNr,name,section or NULL, nursery or NULL)

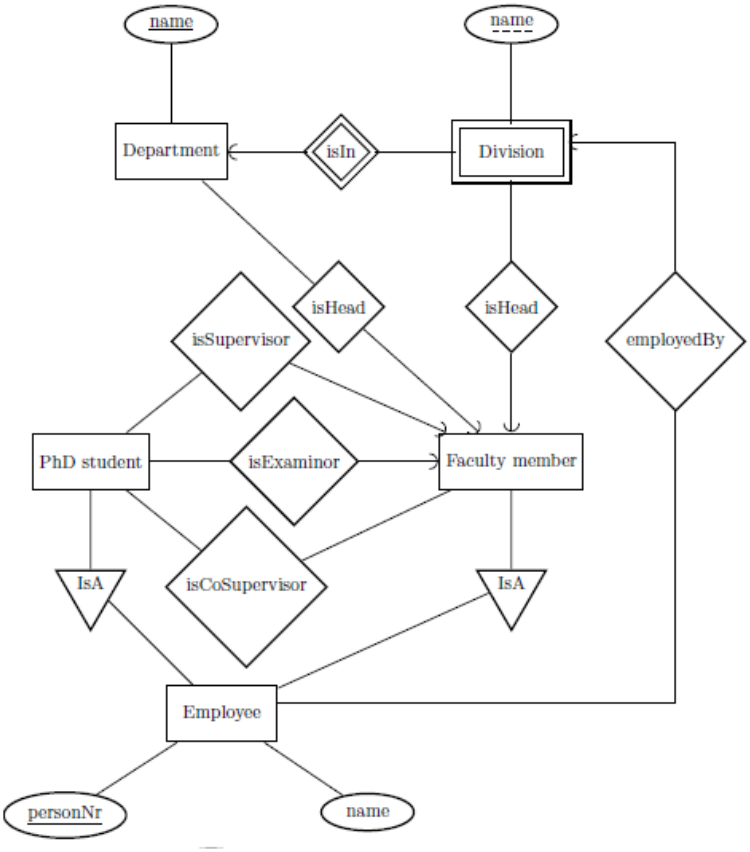
(section,nursery) → Section.(name,nursery)

3. A university wants to use a database to store information about its departments, divisions and employees. Each department at the university has a unique name. Each department contains several divisions. Divisions in different departments can have the same name, but the division names within each department are unique. There can be many employees in each division, but each employee is employed at only one division. For each employee, their name and their unique personNumber should be stored. There are two kinds of employee at the university: faculty members and PhD students.

For each PhD student, one faculty member is appointed to be their examiner. Each PhD student also has one main supervisor, but they can have zero or more co-supervisors. One faculty member at each department is appointed to be the head of that department. Similarly, one faculty member at each division is appointed to be the head of that division.

(a) Draw an E-R diagram that correctly models this domain.

Solution:



(b) Translate this E-R diagram into a set of relations, clearly marking all references and keys.

Solution: Department(_name, head)

head → Faculty.personNr

Division(_name, _department, head)

head → Faculty.personNr

department → Department.name

Cosupervisor(_student, _supervisor)

student → Student.personNr

supervisor → Faculty.personNr

Employee(_personNr, name, division, department)

division → Division.name

department → Department.name

Faculty(_personNr)

personNr → Employee.personNr

Phd(_personNr, supervisor, examinor)

personNr → Employee.personNr

supervisor → Faculty.personNr

examinor → Faculty.personNr

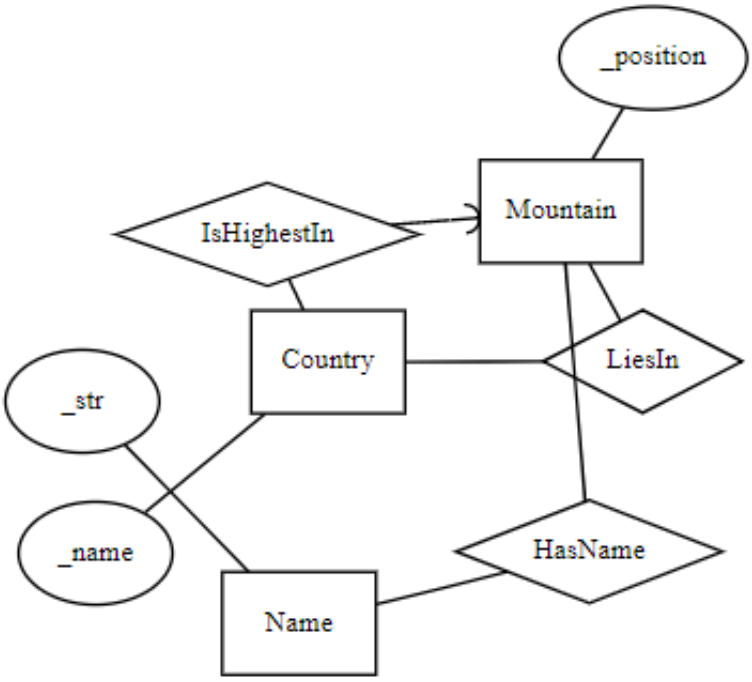
4. E-R Modelling (exam 2016)

The domain to model is mountains and countries:

- A mountain has a summit position (the latitude and longitude coordinates), which identifies it uniquely.
- A mountain can have many names: e.g. Mount Everest is also known as Chomolungma and Sagarmatha.
- There can be many mountains with the same name (e.g. many Stortinden in Norway), but not with the same summit position.
- A mountain can lie in many countries: e.g. Mont Blanc is on the border of France and Italy, and hence lies in both countries.
- Every country has a highest mountain: e.g. Mont Blanc is the highest mountan of both France and Italy. (We assume that every country has exactly one highest mountain, even though there might be borderline cases with countries that have no mountains and countries with many equally high highest mountain).
- Every country has a different name.

(a) Draw an Entity-Relationship diagram for this domain. Do not use multivalued attributes.

Solution:



(b) Show the corresponding database schema.

Solution:

Mountain(_position)

Name(_str)

HasName(_mountainPosition,_nameStr)

mountainPosition → Mountain.position

nameStr → Name.str

Country(_name,mountainPosition)

mountainPosition → Mountain.position

LiesIn(_mountainPosition,_countryName)

mountainPosition → Mountain.position

countryName → Country.name

(c) Modify the schema so that it enforces the following constraint: The highest mountain of a country is a mountain that lies in that country.

Solution:

The extra constraint: change Country to

Country(_name,mountainPosition)

(name,mountainPosition) → LiesIn(_countryName, mountainPosition)

It is enough to do this in the schema; it would be more difficult in the E-R diagram.