Exercise 0

Soit la base de donnée sur les schémas de relations suivants, représentée ci-dessous : —

Orders = {Num, Cname, Pname, Qty} ;
Suppliers = {Snom, Status, City} ;
Products = {Pname, Fname, Price}.

Orders

Num	Cname	Pname	Qty
1535	Jean	Cornas	6
1854	Jean	Bordeaux	20
1254	Paul	Chablis	20
1259	Paul	Chablis	25
1596	Paul	Cornas	12

Suppliers

Sname	Status	City
Vini	SARL	Dijon
BonVin	SA	Dijon
Chapoutier	SA	Valence
SaV	Association	Antraïgues

Products

Pname	Sname	Price
Cornas	BonVin	20
Cornas	Chapoutier	18
Bordeaux	Vini	8.2
Boudes	Vini	4.3
Bordeaux	Chapoutier	18.5
Chapoutier	Chapoutier	5.1
Chablis	Chapoutier	5

Writes the following queries in relational algebra

1. Give all orders.
2. Give the names of the products ordered.
3. Give the names of the products ordered by Jean.
4. Give the names of Bordeaux or Cornas suppliers sold at a price lower than 10e.
5. Give the names of products whose name is the same as the name of a supplier.
6. Give the name, price and potential suppliers of the products ordered by John.
7. Give the pairs of suppliers who live in the same city. Same without duplicates, i.e., we return either {(Vini, BonVin)} or {(BonVin, Vini)} but not both.
8. Give the names of the products which cost more than 15e or which are ordered by John.
9. Give the names of the products which have not been ordered.
10. Give the names of products ordered at least once in quantities greater than 10 and whose price is less than 15 from at least one supplier.
11. Give the names of the products which are supplied by all the suppliers.
12. Give the names of the most expensive products.

Answers

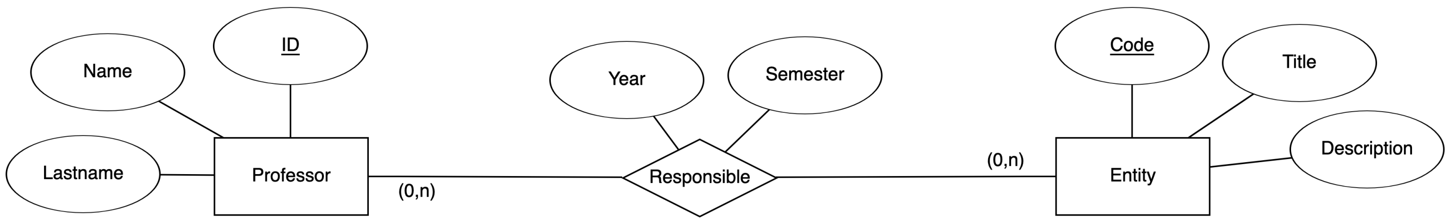
1. Orders
2. $\pi_{Pname}(Orders)$
3. $\pi_{Pname}(\sigma_{Cname='Jean'}(Orders))$
4. $\pi_{Sname}(\sigma_{(Pname='Cornas' \vee Pname='Bordeaux') \wedge Price<10}(Products))$
5. $\pi_{Pname}(Products) \cap \rho_{Sname/Pname}(\pi_{Pname}(Suppliers))$
    1. The answer $\pi_{Pname}(\sigma_{Pname=Sname}$(Product)) is not correct because it is limited to only the sold products
6. $\pi_{Pnom,Prix,Fnom}$(Products $\bowtie$ $\sigma_{Cnom=\backslash Jean\backslash}$(Orders))
7. $\sigma Sname < Sname$(Suppliers $\bowtie$ $\rho_{Pnom/Snom\prime,Status/Status\prime}$(Suppliers))
8. $\pi_{Pname}(\sigma_{Cname=\backslash Jean\backslash}$(Orders)) $\cup \pi_{Pname}(\sigma Prix \geq 15$(Products))
9. π_{Pname}(Produits) \\ π_{Pname}(Orders)
10. $\pi_{Pname}(\sigma_{Prix\leq 15}$(Produits))$\cap\pi_{Pnom}(\sigma_{Qte\geq 10}$ (Orders))
11. $\pi_{Pname}(Products \div Fournisseurs)\$withoutexplicitdivision\$\pi_{Pname}$(Products) \\ $\pi_{Pname}(((\pi_{Pname}(Products)) \times (\pi_{Sname}(Suppliers)))$ \\ $\pi_{Pnom,Sname}(Products))$
12. π_{Pnom}(Products) \\ $\pi_{Pnom}(\sigma Price < Price\prime(Products \times \rho_{Pname/Pname\prime,Sname/SName\prime,Price/Price\prime})(Products)))$

Exercise 1

A university proposes different Teaching Units (TU) under the responsibility of individual professors. The responsible can change depending on the year or the semester.

Option 1

A first attempt for such modelling is presented below. Is it correct? Can you identify any situations that is not well represented in this model?

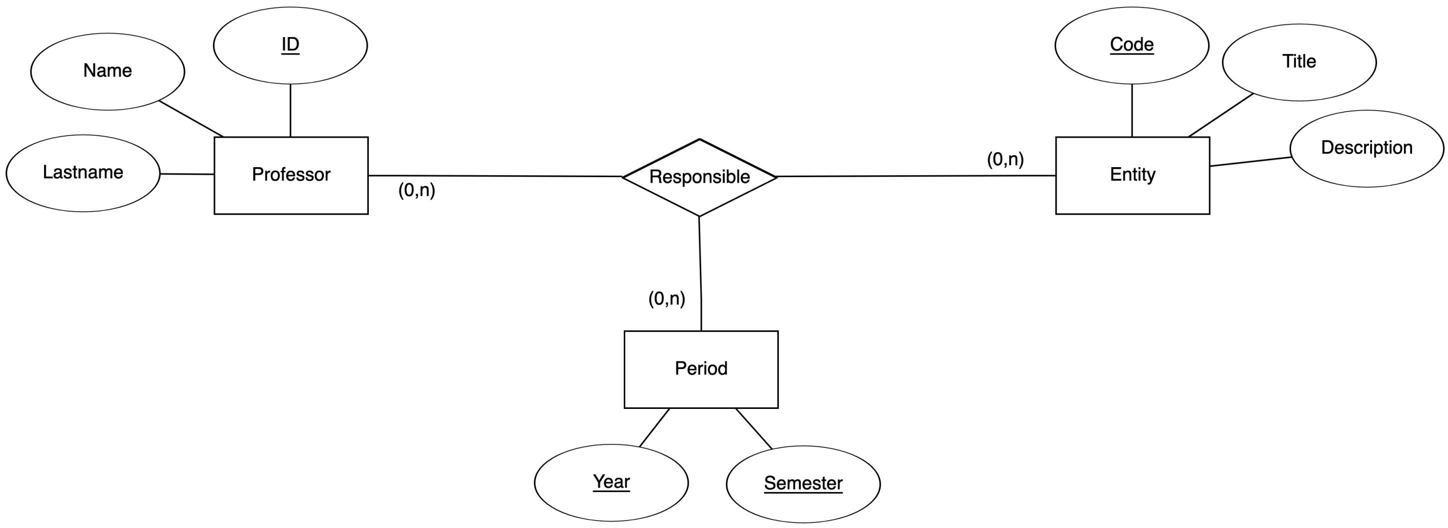


Answer

The model includes a binary relationship, i.e., "Responsible", which represents a set of pairs in this case <Professor, TU>. Each pairs is strictly unique, therefore the models **does not allow** the case where a given professor teaches the same TU for different years or semester. The model forces us to create each time a unique pairs <Prof,TU>. The model is also a good example for understading that the attributes of the relationship do not contributo to uniquely identify the pairs.

Option 2

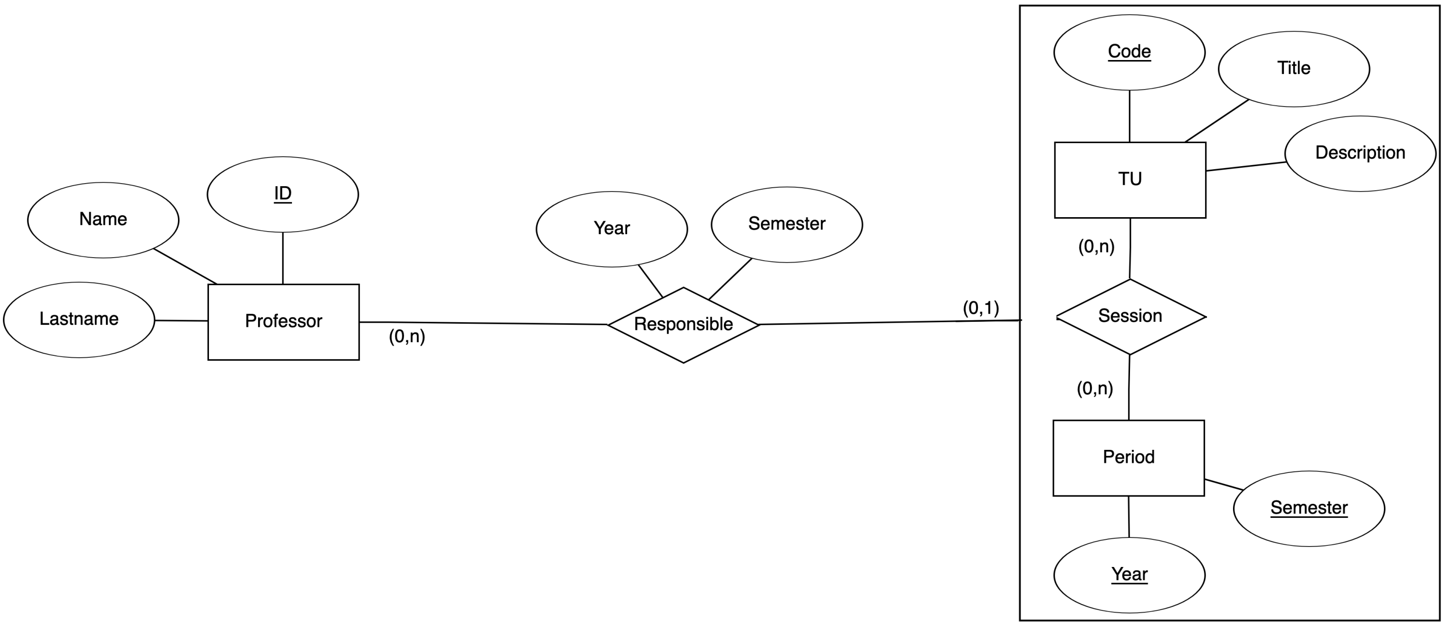
A second proposal (below) makes use of a ternary relation, extrapolating an additional entity Period that is uniquely identified by Year and Semester. Such an approach resolves the previous issue. However, an additional constraint becomes relevant. We would like to avoid the cases in which two given professors are responsible for the same unit during the same period. Is such modelling correct under such constraint? If no, how can we solve?



Answer

No, because we can form all the possible triplets (Professor, period, TU). So two teachers can be responsible for the same period. Of course if we put a "1" on the side of the TU for the maximum cardinality this does not answer the question since it will mean that an TU can only be given once,

at a single period and with only one teacher...
A solution that satisfies the constraint makes use of an Aggregation (this is also called a pseudo-entity) the TUs and the periods are grouped together to create sessions, via an N to N association between the two. This allows these groups to participate in the "Responsible" association with a maximum cardinality of 1.



Exercise 2: Modelling

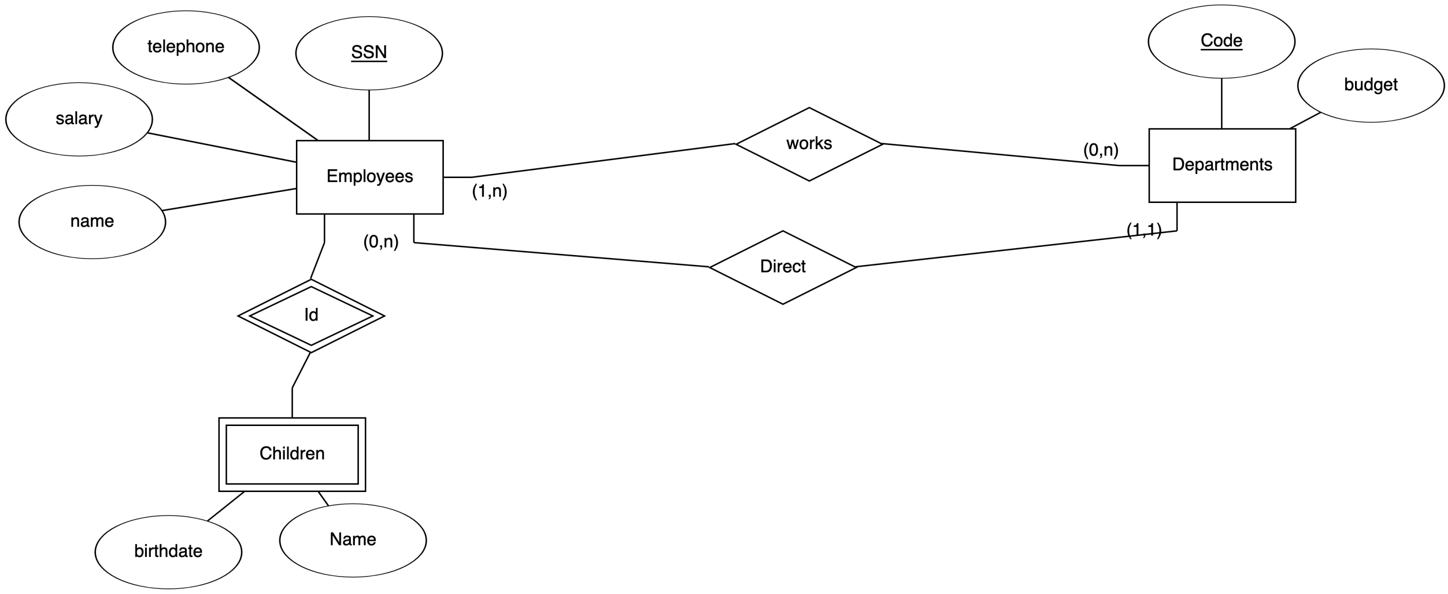
Model using the ER Diagram and then translate into the relational model.

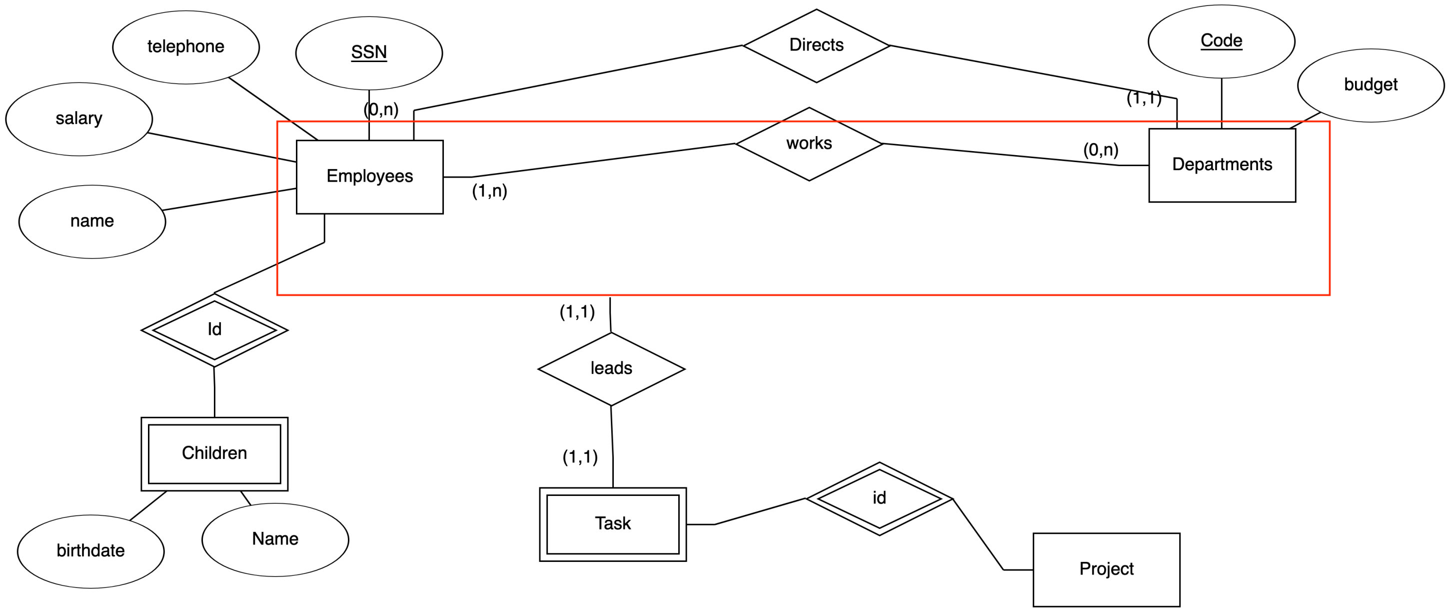
Organization

A company stores information about its employees. They have a social security number that identifies them, a name, a salary and a telephone number. The departments of the company are identified by a unique number, and they have a name and a budget. Employees can have children with a first name and date of birth (we will assume here that only one parent works in the company). Each employee works in departments, each department is headed by one of its employees.

The same company wants to integrate the management of its projects, each of which has a number identifier, a description, and is broken down into different numbered tasks.

Solution





Additional Constraints

The departments are involved in these tasks, according to an involvement rate expressed as a percentage of the task (for example, department X takes charge of 30% of a task Y). Each task has a single leader among the employees, who then acts on behalf of one of the departments in which he is assigned. Naturally, we want the department in question to be fully involved in this task.

Finally, we want to make sure that the sum of the departments' participation in a given task is not greater than 100%. What to do with this constraint at this stage? By what means can we guarantee it in the final application?

Translation into Relational Schema

Translate the final mode into a relational schema. List the relations, underline the keys with a solid line, the foreign keys with a dotted line. To disambiguate foreign keys, specify which relationship each foreign key refers to. If constraints are not translated, list them so as not to lose them later.

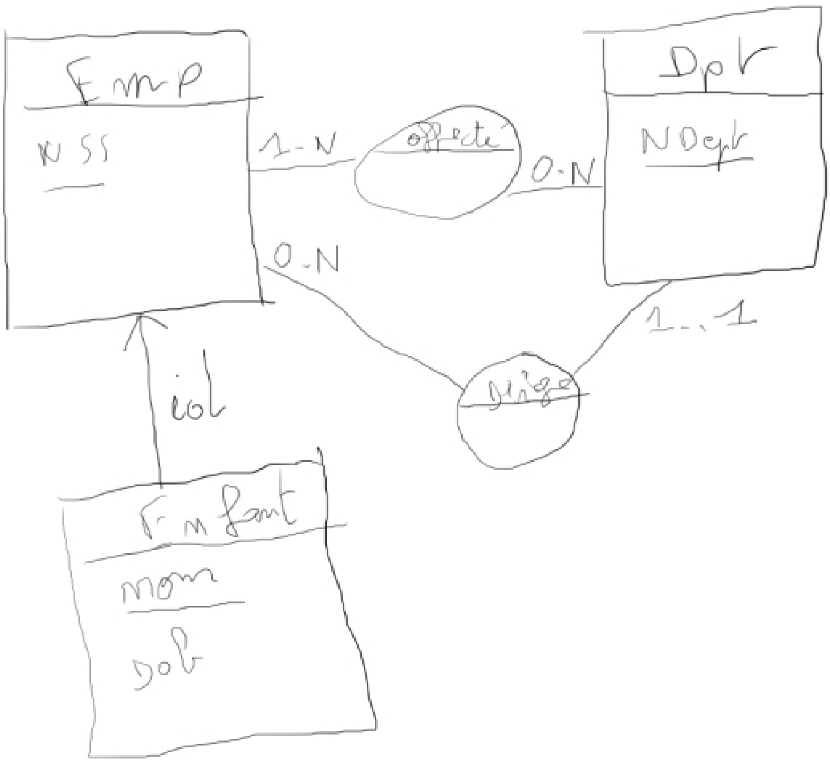
employee(**NSS_emp**, nam_emp, salary_emp, tel_emp)
children(# **NSS_parent**, **nam_enf** ,birth_enf)
departements(**numd_ept**, # NSS_directeur)
works(# **NSS_emp**, # **num_dept**)
projets(**num_projet**, description_projet)
tasks(# **num_projet**, **num_tache**)
leads(# (**num_projet**, **Num_tache**), # nss_emp, # num_dept)

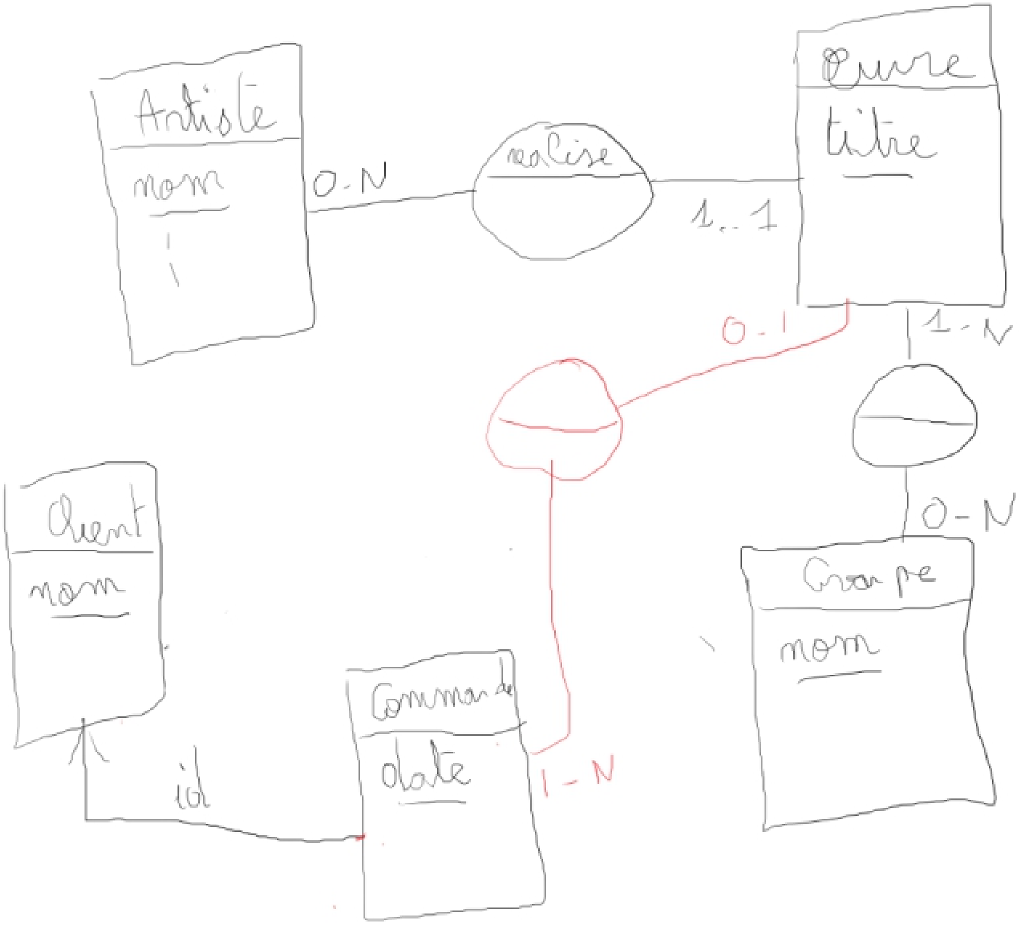
Art Gallery

We consider the database of an art gallery. It keeps information about the artists (a unique name, a city of birth, a style). Each work (they are all original) is made by an artist, with a year of production, a unique title, and a price. It belongs to one or more groups of works that are created to classify them (portraits, work of Picasso,...). Each group is identified by its name. The gallery keeps information about its customers (unique name, address, preferences.) Each customer can place orders on different dates; each order relates to one or more works.

Translation into Relational Schema

Translate the final mode into a relational schema. List the relations, underline the keys with a solid line, the foreign keys with a dotted line. To disambiguate foreign keys, specify which relationship each foreign key refers to. If constraints are not translated, list them so as not to lose them later.


Emp
NSS
1-N
affecté
0-N
Dpt
NDept
0-N
1..1
dirige
id
Enfant
nom
DoB


Artiste
nom
0-N
réalise
1..1
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titre
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1-N
0-N
Client
nom
id
Commande
date
1-N
Groupe
nom