

# Exam SD-202 databases

2021-06-22, 8:30am-11:30am

Documents and Internet are authorized.

Website of the class : <https://clarus.github.io/telecom-database-course/>

## 1 General questions

5 points

1. How do we generally choose the number of leafs per node in a B-tree ?  
Why do we make such a choice ?
2. Give two advantages in using a database system rather than directly using the file system to register data.
3. Which keyword do we use to filter the results from an aggregated request ?
4. Why is it not possible, in general, to update the data directly in a vue ? Give an example to illustrate the challenge.
5. Give an example of conceptual difference between the relational algebra set theory and SQL.

## 2 Relational algebra

1 point

1. Express the following request :  
SELECT DISTINCT NumAccident  
FROM Accident, Car  
WHERE  
Accident.NumCar = Car.NumCar AND  
Car.Size > 6  
using the following operators of the relational algebra :
  - selection  $\sigma$
  - projection  $\pi$
  - join on a column  $\bowtie_c$

### 3 Functional dependencies

7 points

1. By coming back to the definition, show that the transitivity rule holds :  
*If  $A \rightarrow B$  and  $B \rightarrow C$  then  $A \rightarrow C$ .*
2. How to represent an unordered list in first normal form? Give an example, with some clients having each a list of phone numbers.
3. Does the BCNF form implies 2NF and 3NF ?
4. Given the following attributes :

Adresse, Cat, Account, Datecorder, Label, Place, NCli,  
NOrder, Name, NPro, Price, QOrder, QStock

with the following functional dependencies :

- $NCli \rightarrow Name, Adresse, Place, Cat, Account$
- $NPro \rightarrow Label, Price, QStock$
- $NOrder \rightarrow NCli, Datecorder$
- $NOrder, NPro \rightarrow QOrder$

Decompose this relation into a BCNF form.

5. On the tables given by the BCNF decomposition from the previous question, write the SQL requests to obtain :
  - the list of the places for which there exists at least one client,
  - the places of the clients who order the product named "FOO-BAR",
  - the sum of all the prices of the products in stock,
  - the places of the clients who ordered at least one item,
  - the places from which no clients ordered something.
6. Propose a minimal cover for the following set of functional dependencies :

$\{D \rightarrow B, BE \rightarrow C, DA \rightarrow D, C \rightarrow F, DE \rightarrow F, FGH \rightarrow C, A \rightarrow B, AD \rightarrow G\}$

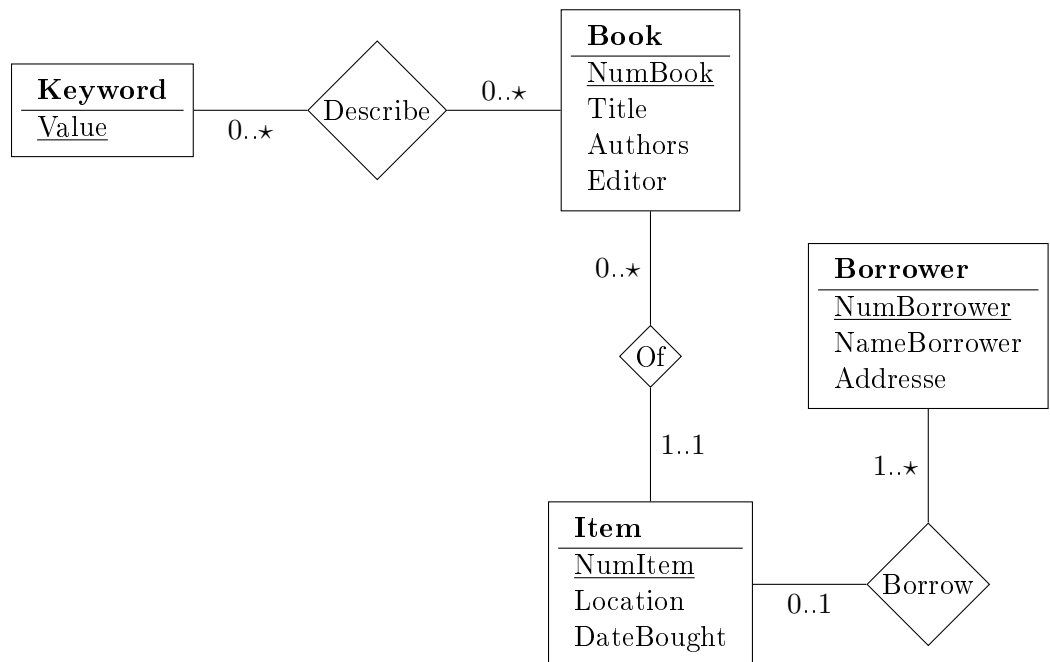
We suppose that the attributes are the letters  $A, B, \dots, H$ .

### 4 Entity-relationship model

7 points

1. Given the following relational schema :
  - Folder(NumFolder, Title, DateRecording, #NameDirection, #NameDepart, #NameService)
  - Service(NameService, Manager, #NameDepart)
  - Employee(NumEmp, NameEmp, Adresse, #NameService)

- `Departement`(`NameDepart`, `Localisation`, `#NameDirection`)
  - `Direction`(`NameDirection`, `President`, `Adresse`)
- give a corresponding entity-relationship diagram. We suppose that the attributes with a `#` are foreign keys.
2. Give an extension of this diagram so that the date of arrival of an employee in a service is also stored.
  3. Give a relation schema corresponding to the following ER-diagram :



4. Write the SQL requests to obtain :
  - the number of occurrences of each keyword,
  - the items corresponding to a given keyword "foo",
  - people who borrowed an item from each editor,
  - the borrower having the largest number of items of the same book.