The deadline to upload your solution to iCorsi is on the 8th of May, at 23:59. Late submission policy will apply; see the Intro slides for details. Upload a PDF file containing your answer. Write your name on the top left of the PDF file and name the file using the "HW4_FirstName_LastName" convention.

# Description

In this homework, you will improve your knowledge about functional dependencies.
Show all your work. Do not skip any steps in your solution to get all the points.
The solution **must not be handwritten** (e.g., you can use Word, LaTeX).

# Problems

1. Let R = BCDEFGHI with FDs

   $C \rightarrow D$
   $E \rightarrow D$
   $EF \rightarrow G$
   $EG \rightarrow F$
   $FG \rightarrow E$
   $FH \rightarrow C$
   $H \rightarrow B$

   (a) For each of the following sets of attributes compute its closure
      i. BC
      ii. BDEFG
      iii. HEFG
      iv. EFG
      v. EFGH

   (b) Find at least three keys of R *using the heuristics covered in class.*

2. Youtube is a video sharing website where users (**Us**), with a specific number of years of experience (**Ye**), can upload videos and gain views. Based on the number of views, each user earns a reputation (**Re**) and a badge (**Ba**) which is a sort of medal (e.g., bronze, silver and gold badge). The number of years of experience starts from the registration date (**Da**) on Youtube. Each user can gain some money (**Mo**) by number of views. Please note that the description above is not referring to the real Youtube, but it's useful to define the following exercise. The following FDs are satisfied:

   (a) Each user has a specific number of years of experience and a specific badge
   (b) The years of experience uniquely determine the user's reputation and the amount of money he gets
   (c) For each user and for each reputation is defined a unique badge
   (d) The registration date determines a single value of years of experience
   (e) Each user earns a specific amount of money for the views

   Answer the following questions:

   (a) Define the **five** FDs above, using the two chars in bold to define each FD.
   (b) Find a **minimal cover** for the FDs above using the algorithm covered in the class.

(c) Find a lossless-join and dependency-preserving the decomposition into relation in 3NF. This means:

i. Create the table from the minimal cover of the previous step

ii. Can you remove any redundant table? If it is possible, specify the table you can remove.

iii. Specify a **Global Key** for the relationship, illustrating all the steps performed to get it, using the heuristics shown in the class. Do we need to add a new table to store the Global Key?

3. Consider the relation scheme ABCDEF satisfying the following functional dependencies

CF $\rightarrow$ E
AE $\rightarrow$ C
F $\rightarrow$ D
E $\rightarrow$ F
B $\rightarrow$ F

(a) Using the heuristics seen in the class, find all the keys for the relation (showing all steps)

(b) Using $ABE$ of the keys obtained, classify each FDs (say if they are partial dependencies, transitive dependencies or into key dependency).

(c) Show that the given FDs are a minimal cover

4. Let the relation scheme R = ABCDEFGH with functional dependencies (FDs)

ABFH $\rightarrow$ DE
E $\rightarrow$ D
H $\rightarrow$ F
A $\rightarrow$ G
G $\rightarrow$ FH

(a) Explain why the relation is not in BCNF

(b) Using the algorithm covered in the class, find a minimal cover for the given FDs.

(c) Find a lossless-join and dependency-preserving the decomposition of R into relation in 3NF. This means:

i. Create the table from the minimal cover of the previous step

ii. Can you remove some redundant table? If it is possible, specify the table you can remove.

iii. Specify a **Global Key** for the relationship, illustrating all the steps performed to get it, using the heuristics shown in the class. Do we need to add a new table to store the Global Key?

5. Consider the relation scheme BCDEF satisfying the following functional dependencies:

B $\rightarrow$ D
CE $\rightarrow$ BDF

CE is a key and designated as primary. Explain why the relation is in 2NF but not in 3NF.