

Please read 7.8 and 10.3 of the textbook and then answer the following, trying not to look at your notes or at the textbook. Quiz #6, on Wednesday 11st April, will consist of questions taken or inspired from Part I and Part II of this homework.

## Part I — Questions

1. Consider the relation  $R(A, B, C, D, E)$  and the functional dependencies  $\{A, B\} \rightarrow C, B \rightarrow D, C \rightarrow E$ . Answer the following:

1.  $A$  by itself is not a primary key, but what is the only key that contains  $A$ ?
2. List the non-prime attributes.
3. This relation is not in 2NF: what transformation can you operate to obtain a 2NF?
4. One of the relation you obtained at the previous step is likely not to be in 3NF. Can you normalize it? If yes, how?

2. What are the two different categories of U.M.L. diagram?

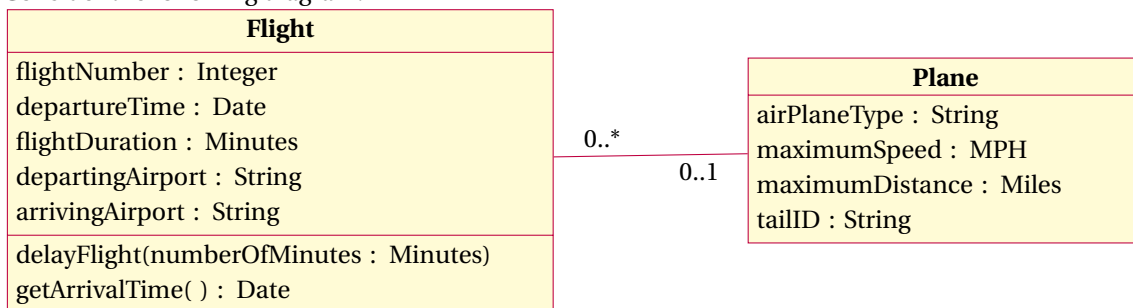
3. Can a C++ developer working on Linux and a Java developer working on MacOS use the same class diagram as a basis to write their programs?

4. What kind of diagram should we use if we want to ...

1. describe the functional behavior of the system as seen by the user?
2. capture the flow of messages in a software?
3. represent the workflow of actions of an user?

5. Name two reasons why one would want to use a U.M.L. class diagram over an E.-R. diagram to represent a conceptual schema.

6. Consider the following diagram:



Give the number of attributes for both classes, and suggest two operations for the class that doesn't have any. Discuss the multiplicities: why did the designer pick those values?

7. Briefly explain the difference between an aggregation and a composition association.

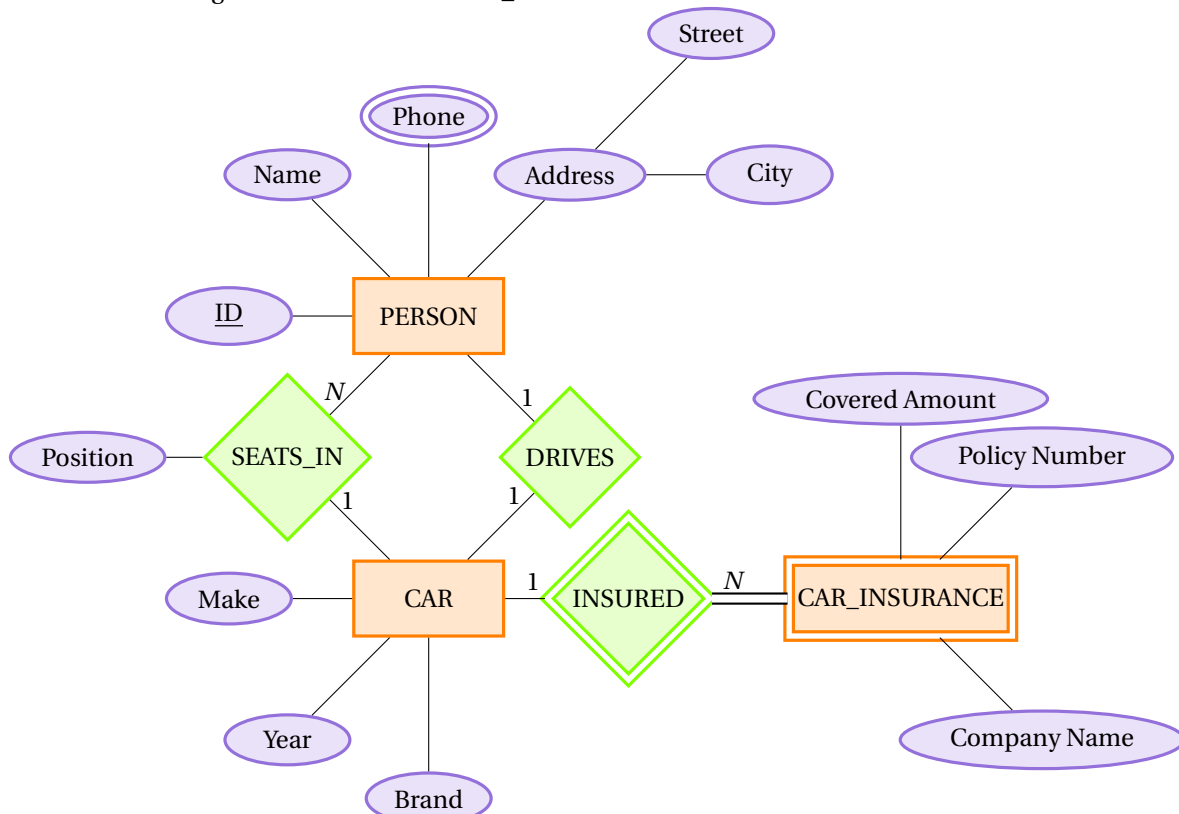
8. How is generalization (or inheritance) represented in a U.M.L. class diagram? Why is such a concept useful?

## Part II — Problems

This part will help you in assessing your level of understanding of this lecture, prepare you for the rest of your cursus, and give you an idea of the kind of problem you will be asked to solve during the exams. I'll assume that you will have successfully completed those problems by the time Homework #7 is released (Wednesday 11st April), so don't wait and let me know if you had difficulties solving them.

### Problem 1

Consider the following E.R. schema for the CAR\_INFO database:



Note that a car can have at most one driver,  $N$  passengers,  $N$  insurances, and that car insurances exist only if they are “tied up” to a car (i.e., they are weak entities, and their identifying relationship is called “Insured”).

1. Find the key attribute for “Car”, and the partial key for “Car Insurance”. If you can't think of any, add a dummy attribute and make it be the key.
2. Convert that E.-R. diagram to a relational database schema.
3. Convert the E.-R. diagram to a U.M.L. class diagram. Comparing Figure 7.16 with Figure 7.2 from your textbook should guide you.

### Problem 2

In this exercise, we will install and explore the basic functionalities of MySQL Workbench, which is a cross-platform, open-source, and free graphical interface for database design.

1. Install MySQL Workbench: use your package manager, or download the binaries from <https://dev.mysql.com/downloads/workbench/>.
2. Once installed, execute the software. Under the panel “MySQL Connections”, you should see your local installation listed as “Local instance 3306”. Click on the top-right corner of that box, and then on “Edit Connections”. Alternatively, click on “Database”, on “Manage Connections”, and then on “Local instance 3306”.
3. Check that all the parameters are correct. Normally, you only have to change the name of the user to “testuser”, and leave the rest as it is. Click on “Test the connection”, and enter your password (which should be “password”) when prompted. If you receive a warning about “Incompatible/nonstandard server version or connection protocol detected”, click on “Continue anyway”.
4. Now, click on the box “Local instance 3306”, and enter your password. A new tab appears, you can see the list of schemas in the bottom part of the left panel.
5. Click on “Database”, and then on “Reverse Engineering” (or hit `ctrl + r`), click on “next”, enter your password, and click on “next”. You should see the list of the schemas stored in your database. Select one (any one, we are just exploring the functionalities at that point), click on “next”, and then click on “execute”, “next”, and “close”.
6. You’re back on the previous view, but you should now see “E.E.R. diagram” on the top of the middle panel. Click on “E.E.R. diagram” twice, scroll down if needed, and you should see the E.E.R. diagram.
7. This diagram isn’t exactly an E.-R. diagram, and it’s not a U.M.L. diagram either. Yet, you should still be able to understand parts of it, and should try to modify it. Make some relations mandatory, change their name, add an attribute, change the name of another, insert a couple of elements in an entity, add a row in a table, etc. Make sure you understand the meaning of the lines between the entities.
8. Once you’re done, try to “Forward Engineer” by hitting “Ctrl” + “G”. Click on “next” twice, enter your password, click on “next” once more, and you should see the SQL code needed to produce the table you just designed using the graphical tool.

### Problem 3

*This problem requires you to have successfully completed Problem 1 and Problem 2.*

Using the relational database schema you obtained in question 2 of Problem 2, write the SQL implementation of that database. Then, using MySQL Workbench, use the “Reverse Engineering” function to obtain a E.E.R. diagram of your database, and compare it with the U.M.L. diagram you draw in question 3 of Problem 2. Apart from the difference inherent to the nature of the diagram (i.e., U.M.L. Vs E.E.R.), how are they the same? How do they differ? Is the automated tool as efficient and accurate as you are?

