Graded Assignment “Analyse et Conception I”

In the graded assignment, you are asked to develop a data model for the new tram system of the city of Luxembourg ☺. More precisely, you should:

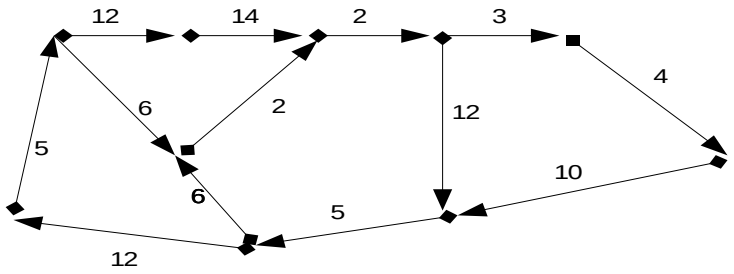
- Develop a complete conceptional data model in UML for the below described specification (including data types and cardinalities of relationships). Use as much as possible a self-explaining naming for entities, entity attributes, and relationships.
- Define 3 different non-simple constraints in OCL. For each constraint, a description in English should be given together with the OCL form of the constraint.
- Implement your data model and the constraints within PostgreSQL.
- If possible, make your own suggestions of what additional information would be useful for such an application and add it to your model (please describe your additions in an extra file such that I can understand them). If your suggestion makes sense, then it will be considered as a plus.

Please create a zip archive of your UML model (in PDF or JPEG format), the constraints as described in a separate file (in PDF), the PostgreSQL dump file (in human-readable form – such that I can read it and also imported the SQL commands into my Docker PostgreSQL installation), and possibly files with additional explanations, and upload this zip file to Moodle until **May 21, 2018**. Submissions per email will not be accepted; late submissions will reduce the maximal score for the assignment by 1 point for every day of delay.

Managing The Tram System of the City of Luxembourg

In the near future, the city of Luxembourg will have a large and complicated tram system. The CEO of the Luxembourg tram corporation wants to simplify the management of the tram system using an information system, and you are asked to develop a database design for this scenario and implement it in PostgreSQL.

The tram is organized in lines which go from a start station to a final station (note that the start and the final station can be the same, such that we also have *circle lines*). Of course, a station can be reached by several lines. A line is composed of several segments which are the "links" between one station and the next station. You can assume that each segment has a unique section identification number and a direction. This implicates that for two different stations A and B where you can go from A to B and from B to A there must be (at least) two segments between these two stations (but note that it is also possible that there is more than one segment from A to B for the same direction – there might be "parallel rails"). Between two subsequent stations on the same line, the average time for the travel between these two stations is known. This information can be used to determine the expected time needed to go from some station to another station on the same line. One problem of this data modeling exercise is therefore the representation of the geometry of the tram system in a database. It might be helpful to consider the tram system as a graph as shown in the illustration on the next page.



But the management of the tram also includes the organization of many other information. First of all, information about the different coaches must be stored. Especially, the administration wants to have an immediate overview about what coach is currently used on what line, when the train started at the first station of a line, who is the driver of this train, but also when the train was last time in maintenance. For each train, a list of known problems should be stored since this information is needed for maintenance.

Obviously, trains are steered by drivers such that relevant information on all drivers must be available in the system. This information includes name, home address including (possibly several) phone numbers, email addresses, working days and hours, what driver is responsible for a train at any time. Note that the latter information must also be kept for the past, such that the management can see what driver was steering what trains in the last year. The personal detail information of drivers (phone number, home address, email addresses, working hours etc) can immediately be deleted when a driver leaves the company, but the history of the relation coach-driver must be kept.

The management also plans to introduce a subscription system for customers. A registered customer (registration should require the input of some “standard information” – the management asks your help to define this information) will get a numbered electronic ID card, which will be used to record between which stations he was onboard a coach. This information together with the resp. time must be stored in the system to allow the generation of a monthly invoice for the customer. Banking information of each customer must in this case be stored, since the invoice amount will be automatically deduced from the customer’s account. As an alternative, customers can also buy prepaid electronic ID cards, where the currently still available amount must be recorded. As a service, each customer can, after successful login to the tram web site, check his current balance and get a history of all his rides (time, departure, destination) in the last month – both for prepaid and non-prepaid cards.

The management also asks for your active participation in this project. Thus, you are asked to make suggestions what other information would be useful to be stored in such a system. Please describe any additions from your side in a short README file.