1st Seminar – Structural Modelling

We are designing a social transportation service where anyone can announce planned car trips. Others are notified of this through our system and they can join as passengers (even for just a short fragment of the trip) if they share the fuel cost with the owner of the car. A car trip is split into one or more fragments. The owner doesn't necessarily drive throughout the whole trip, it's up for debate, although he or she must be present for every fragment of the trip.
Up until now our service operated in a closed development environment, trips were organised in an ad-hoc manner, and related data weren't saved systematically. We would like to publish our service soon. Information related to trip organizing must be made available on the website, thus we need a way to keep records of such information.

1 Graph-Based Structure Modelling

We would like to design the data model of our system, so we put together some common scenarios based on observations of previous trips.

a. Ann plans a trip from Szombathely to Debrecen through Győr and Budapest. Bob takes a trip from Győr to Budapest and then from there to Kecskemét. Construct a graph model based on these scenarios according to the given relations!
b. Daniel is from Győr and he doesn't own a car. Which graph operation can be used to determine where Daniel can go from Győr by joining others as a passenger? (Suppose that the other drivers are flexible regarding the time of the trip.)
c. Christine decided that she will travel with Ann from Szombathely to Budapest; Daniel requested passage from Győr to Kecskemét. Since Ann worked late last night she would like to sleep after the departure so Christine will drive to Budapest. Bob himself will drive throughout his trip. Extend the graph with this knowledge.
d. This isn't Bob's first social trip. He announced a trip from Kecskemét to Győr through Budapest. Extend the graph again with this knowledge.
e. Which graph operation can provide a simplified view of the latest graph, which only shows the announcers, the trips and the fragments of the trips? What will be the properties of the result graph?

2 Attribute Modelling

We gathered some data about previous trips which are summarized in the following table.

# of ratings	total	category	name	password	plate	smokes	A/C	payment	DL number
6	24	car			`ABC-123`		no		
17	71	person	Ann	qwe		no			`KL2048`
16	49	person	Bob	pass		yes			`MN4096`
14	45	person	Christine	12345		yes		card	
1	5	person	Daniel	friend		no		transfer	
0	0	car			`DEF-456`		yes		
7	31	person	Emily	2501		no		card	
2	8	person	Francis	appletree		no		Bitcoin	

Table 1: The `Trips` table.

After a trip cars and passengers can be rated on a scale from 1 to 5 based on how pleasant they made the journey. The table above includes the ratings gathered so far.

a. Besides the ratings of passengers and cars, available air conditioning and smoking habit can be important factors when someone chooses from the available trips. However the users must not see the driver's password and drivers licence number, and must not know the method of payment used by other passengers. Which operation (known from attribute modelling) can provide the necessary information for this view?

b. Ranking is based on the average of ratings and not the sum of ratings. Which operation makes it possible to extend the attribute model with the result of this calculation?
c. Emily and Francis are looking for a passage together. Emily would like a car with a ranking above 4 if possible. Francis considers cars with air conditioning only. Which operation will provide the potential choices?

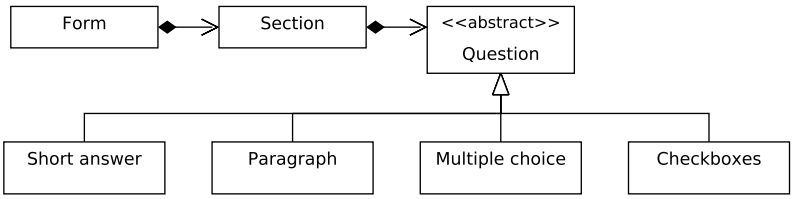
3 Type Modelling

We would like to design a database scheme for our service. In order to do this it's important to distinguish the different types in the system and to look for validation rules.

a. What could be the basic element and connection types according to the text above? Draw a type graph!
b. What could be the classification of the elements described in the table based on their available attributes and relations?
c. Define a type hierarchy based on the previous sub-task!
d. (*Bonus task*) Draw a metamodel based on the type graph, type hierarchy and domain of attributes. With what kind of (well-formedness) constraints can we extend the metamodel?

4 Form

Create a form based on the following metamodel through which the passengers can provide feedback about the driver after a trip. For time efficiency reasons most of the feedbacks are gathered with the help of yes/no and multiple choice questions. Passengers can summarize their experience in the form of a short textual opinion.



a. What information do we need to identify the driver?
b. Gather some questions, group them according to their types, then create a model of the finished form.
c. Did we use top-down or bottom-up design?
d. If a passenger rates the driver less than 3 in the scale from 1 to 5 then we would definitely like a textual opinion. How can we express this in the model (and in which model)?

Bonus Assignment: Implementation

a. Create a data structure (in your favourite programming language) that can represent the contents of our transportation service!
b. Extend the program with a procedure (method) that can enumerate the possible destinations from a given city based on published trips (without changing cars)!
c. Create a smarter version of the previous method that leaves out the passages (on demand) where there would be a smoking passenger during at least one fragment of the trip!