Datamodelling and Databases [2ID50]: Homework Assignment Week 6

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1. We can derive $\beta \rightarrow\rightarrow \gamma$, since $\beta \rightarrow y$ and by using the replication rule. And from $\beta \rightarrow\rightarrow \gamma$ and $\alpha \rightarrow\rightarrow \beta$ we derive $\alpha \rightarrow\rightarrow \gamma - \beta$ by multivalued transitivity. And since it is the case that $\gamma - \beta = \gamma$, we obtain $\alpha \rightarrow\rightarrow \gamma$.

2. Consider the shopping database with the purchase table:
purchase(tID, cID, sID, pID, date, quantity, price)

In this table the following constraints hold:
tID,pID → cID,sID,date,quantity,price (in other words tID,pID is a superkey)
tID → cID,sID,date (every transaction is done by one customer, in one store, on one date)
sID,pID,date,quantity → price (for the same quantity of a product, on a certain date, in a certain store, everyone pays the same price)

Note that when we do not have multivalued dependencies in a relation, then when it is in BCNF, it will also be in 4Nf. Hence it suffices to decompose the relation purchase in BCNF. This is exactly what I will do. We start by calculating purchase$^+$

tID → cID, sID, date, quantity, price, tID, pID

cID → cID

sID → sID, price

pID → pID, tID, cID, sID, date, quantity, price

date → date, price

quantity → quantity, price

price → price

We see that tID and pID are candidate keys, sID, date and quantity are not however. From this we conclude that sID → sID, price, date → date, price and also quantity → quantiy, price are not allowed in the BCNF. So we can decompose purchase into purchase_1 (tID, pID, price, cID), purchase_2(date,price), purchase_3(sID, price) and purchase_4(quantity, price). In the first result of our decomposition, purchase_1, tID and pID are superkeys. In purchase_2 date is a candidate key and price only determines itself. In purchase_3 sID is a candidate key and price again only determines itself and

finally in purchase_4 quantity is a candidate key and price again determines itself. So we have 4 relations in BCNF.

3.

cust (cID, cName) :- customer(cID, cName, street, city)

st(sID, sName):- store(sID, ,"Albert Heijn", street, city)

purch(sID, cID):- purchase(tID, pID, sID, cID, date, quantity, price)

ah(cName):- cust(cID,cName), st(sID, sName), purch(cID,sID)

?ah(cName)

4.

st(sName, sID):- store (sID, sName, street, city)

stcity(sName):- store (sID, sName, street, "Eindhoven")

chain(sName):- st(sName, A), st(sName, B), A≠B

notehv(sName):- chain(sName), not stcity(sName)

?notehv(sName)

5. The meaning of the query in plain English is: List all the customer names who have made a purchase in all the stores in their city.