

Database Assignment 1

Question 1

(i)

Scenario 1: $T \rightarrow P \rightarrow QR$

- $T \rightarrow P$ and $P \rightarrow QR$, then $T \rightarrow QR$ (transitive rule)
- $T \rightarrow QR$, then $TV \rightarrow VQR$ (augmentation rule)
- $U \rightarrow TV$ and $TV \rightarrow VQR$, then $U \rightarrow VQR$ (transitive rule)
- $U \rightarrow VQR$, then $UPSTW \rightarrow VQRPSTW$ (augmentation rule)

If $UPSTW \rightarrow VQRPSTW$ is valid and it covers the entire relational table, then the left hand side of the functional dependency (U,P,S,T,W) is a minimal super key.

Scenario 2: $Q \rightarrow RUW \rightarrow V$

- $RW \rightarrow V$, then $RUW \rightarrow VU$ (augmentation rule)
- $Q \rightarrow RUW$ and $RUW \rightarrow VU$, then $Q \rightarrow VU$ (transitive rule)
- $Q \rightarrow VU$, then $QPRSTW \rightarrow VUPRSTW$ (augmentation rule)

If $QPRSTW \rightarrow VUPRSTW$ is valid and it covers the entire relational table, then the left hand side of the functional dependency (Q,P,R,S,T,W) is a minimal super key.

(ii)

Scenario 1:

- In the functional dependency $UPSTW \rightarrow VQRPSTW$, there exist the following:
 - Partial dependency $T \rightarrow P$. This partial dependency is a violation of the 2NF requirement.
 - Transitive dependency $P \rightarrow QR$. This transitive dependency is a violation of 3NF requirement.
 - Non-trivial dependency $Q \rightarrow RUW$. This non-trivial dependency is a violation of BCNF requirement.
- Hence the relational table BOOK is in 1NF.

Scenario 2:

- In the functional dependency $QPRSTW \rightarrow VUPRSTW$, there exist the following:
 - Partial dependency $Q \rightarrow RUW$. This partial dependency is a violation of the 2NF requirement.
 - Transitive dependency $RW \rightarrow V$. This transitive dependency is a violation of 3NF requirement.
- Hence the relational table BOOK is in 1NF.

(iii)

In the functional dependency $UPSTW \rightarrow VQRPSTW$, we need to remove the transitive dependency $P \rightarrow QR$ and split the table into 5 relational tables, $T1 = (R,W,V)$, $T2 = (P,Q,R)$, $T3 = (Q,R,U,W)$, $T4 = (T,P)$, $T5 = (U,T,V)$

- In $T1 = (R,W,V)$, the minimal super key is (R,W) and the relational table has no partial, transitive or non-trivial dependency, hence it is in BCNF.
- In $T2 = (P,Q,R)$, the minimal super key is (P) and the relational table has no partial, transitive or non-trivial dependency, hence it is in BCNF.
- In $T3 = (Q,R,U,W)$, the minimal super key is (Q) and the relational table has no partial, transitive or non-trivial dependency, hence it is in BCNF.
- In $T4 = (T,P)$, the minimal super key is (T) and the relational table has no partial, transitive or non-trivial dependency, hence it is in BCNF.
- In $T5 = (U,T,V)$, the minimal super key is (U) and the relational table has no partial, transitive or non-trivial dependency, hence it is in BCNF.