Umeå University
Department of Computing Science

Introduction to Database Managment 7.5 p
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Exercises, Chapter/Topic 5

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Problem 1

a) Canonical Cover

The given relation and functional dependencies are: $R[ABCDEFGH]$, and
$\mathcal{F}_1 = \{A \to CG,\ ACF \to B,\ B \to F,\ DE \to A,\ DEG \to BF,\ DF \to E,\ G \to A\}$

1. Decompose each FD into RHS simple form:
   $\{A \to C,\ A \to G,\ ACF \to B,\ B \to F,\ DE \to A,\ DEG \to B,\ DEG \to F,\ DF \to E,\ G \to A\}$

2. LHS-reduce each FD $\{A \to C,\ A \to G,\ ACF \to B,\ B \to F,\ DE \to A,\ DEG \to B,\ DEG \to F,\ DF \to E,\ G \to A\}$
   $= \{A \to C,\ A \to G,\ AF \to B,\ B \to F,\ DE \to A,\ DE \to B,\ DE \to F,\ DF \to E,\ G \to A\}$

3. Test each remaining FD for redundancy of the resulting set of FDs, removing the ones which are not needed to preserve the closure. $\{A \to C,\ A \to G,\ AF \to B,\ B \to F,\ DE \to A,\ DE \to F,\ DF \to E,\ G \to A\}$

Hence, $\mathcal{F}_{min} = \{A \to C,\ A \to G,\ AF \to B,\ B \to F,\ DE \to A,\ DE \to F,\ DF \to E,\ G \to A\}$

b) find dependency-preserving 3NF representation

1. use the canonical cover from a)

2. define Schemes
   $R_0\{A,C,G\} : A \to C,\ A \to G,\ G \to A$
   $R_1\{A,B,F\} : B \to F,\ AF \to B$
   $R_2\{A,D,E,F\} : DE \to A,\ DE \to F,\ F \to E$

3. test removing relations
   None of the above relations can be removed.

c) candidate keys

Three candidate keys for R were found: $\{B,D,H\}, \{D,E,H\}, \{D,F,H\}$

d) losless extension

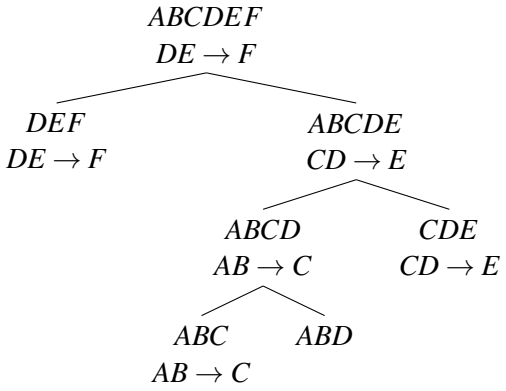
e) which relations not BCNF

f) show that there is no lossless, dependency-preserving, acyclic BCNF possible

f) show that 3NF normalization from d) is acyclic/fully independent

Problem 2 - BCNF Normalization

Yes can. not cyclic.



Problem 3 - BCNF Normalization

Yes can, but cyclic.