

Problem 1a

$$\{f, b\}^+ = f, b, c, d$$

Problem 1b

$$\begin{aligned} f, b &\rightarrow c \\ f, b &\rightarrow d \end{aligned}$$

Problem 1c

$f, b \rightarrow c$ is not because it is redundant to $f \rightarrow c$

$f, b \rightarrow d$ is not because of the redundancy: $f \rightarrow c$; $f, b \rightarrow d$

Problem 1d

Exactly 2 candidate keys: $\{b, e, f\}$ & $\{d, e, f\}$

Problem 1e

No, it does not violate 3NF, because every element in B (d) is a member of some key $\{d, e, f\}$

Problem 1f

R is decomposed into the following relations:

$$\begin{aligned} R_1(c, f): f &\rightarrow c \\ R_2(b, c, d): b, c &\rightarrow d \\ R_3(a, b, d, e): d, e &\rightarrow a; d, e \rightarrow b \\ R_4(b, e, f) \end{aligned}$$