$$G(i, n, b, l, p, t, f)$$

$$nbp \rightarrow tf, \quad bl \rightarrow n, \quad pt \rightarrow f, \quad t \rightarrow b, \quad ib \rightarrow l$$

Problem 1a

Set of all minimal keys: $\{ibp,\ ipt\}$

Problem 1b

$$\{pt\}+= ptfb$$

This violates BCNF because the left side of all FD's must be a superkey of G.

Problem 1c

$G = inblptf$

$T = \{nbp \rightarrow tf,\ bl \rightarrow n,\ pt \rightarrow f,\ t \rightarrow b,\ ib \rightarrow l\}$

$\{pt\}+= ptfb \ \ * violation$

$G1 = ptfb$

$T1 = \{pt \rightarrow f, \quad t \rightarrow b\}$

$\{t\}+= tb \ \ * violation$

$G11 = tb$

$T11 = \{t \rightarrow b\}$

$G12 = tpf$

$T12 = \{pt \rightarrow f\}$

$G2 = ptiln$

$T = \emptyset$

BCNF Sub-relations:

$G1(t, b)$: $t \rightarrow b$

$G2(t, p, f)$: $pt \rightarrow f$

$G3(p, t, i, l, n)$

Problem 1d

The following FDs are not preserved be decomposition:

$$nbp \to tf, \quad bl \to n, \quad ib \to l$$

You can tell because no part of them is carried through to the sub-relations.

Problem 1e

$R = inblptf$

$G = \{nbp \to t,\ bl \to n,\ pt \to f,\ t \to b,\ ib \to l\}$

$R1(n, b, p, t)$: $nbp \to t$

$R2(b, l, n)$: $bl \to n$

$R3(p, t, f)$: $pt \to f$

$R4(t, b)$: $t \to b$

$R5(i, b, l)$: $ib \to l$

Since none of the above relations are superkeys of R, must add relation that is key:

$R6(i, p, t)$