CS 2541- Normal Forms: Inclass exercises. Solutions

Ques.1: R2(A,B,F), AB→ F, B→ F

First compute keys for R2. A,B do not appear on RHS of any dependency, so start by computing attribute set closure of {AB}. Since AB→ F, we have {AB}+ = {ABF} and therefore {AB} is the key.

Since we have B → F, i.e., F is partially dependent on the key, the relation is not in second normal form. Therefore it is not in 3NF (and therefore not in BCNF).

During BCNF decomposition, we have B → F as the non-BCNF relation therefore create new schema (A,B) (B,F). Both are in BCNF. Note however that now we have lost the dependency AB→ F.

Ques.2: Consider the schema R1=(C,T,H,R,S,G) with attributes Course(C), Time (T), Hour (H), Section (S), Grade (G) Room (R) and the dependencies:

C → T CS → G HS → R HT → R HR → C

a) Find the keys for R1.
First observe that H and S do not appear on the right hand side of any dependency, i.e., they cannot be derived from any other attribute. Therefore {HS} must be part of any key.
Next, compute attribute set closure starting with initial set $X=X^+$= {HS}.
Since HS →R, and LHS is in X^+ we add R to the closure to get X^+ = {HSR}
Next since HR is in closure, and HR →C we add C to the closure to get X^+ = {HSRC}
Since C →T and C is in closure, we add T to closure to get X^+= {HSRCT}.
Finally since CS→G and CS is in closure we add G to closure to get X^+= {HSRCTG} and therefore X={HS} is the key.

b) Is R1 in 3NF?
No- because not all dependencies are of the form A→B where A is superkey or B is prime attribute. For example, C→T does not satisfy this (it is a transitive dependency).

c) Is R1 in BCNF ? If not, then decompose into BCNF relations.
Since it is not in 3NF it is not in BCNF. To decompose, apply algorithm – note that we may end up with different schemas depending on which non-BCNF dependencies you remove first.
- Dependency C →T is not in BCNF. Therefore decompose into (C,T) and (H,S,C,R,G)
  - (C,T) is in BCNF since only dependency in this table is C→T
- CS→G is not in BCNF. Therefore decompose (HSCRG) into (CSG) and (HSCR)
- (HSCR) is not in BCNF since HR→C is not in BCNF. Therefore decompose into (HRC) and (HSR). Both these are in BCNF
- Final schema: (HRC), (HSR), (CSG) and (CT)

We have lost the dependency HT→ R.