

# Data Management Homework 4

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1. (a) Following closures are computed:

- i.  $(BC)^+ = BCD$
- ii.  $(BDEFG)^+ = BCDEFG$
- iii.  $(HEFG)^+ = BCDEFGH$
- iv.  $(EFG)^+ = DEFG$
- v.  $(EFGH)^+ = BCDEFGH$

- (b) I is not in any functional dependency, it must be part of the key. H is only on the left side, therefore it must be part of the key, while D is only on the right side, hence it does not appear in any key.

Now, we have to add attributes to HI to get keys while ignoring D: HICEF, HICEG, HICFG we remove because C is in the closure of EFG which we can always get if we have at least two attributes of EFG.

The remaining keys are: HIEF, HIEG, HIFG. They are all fit the requirements.

2. (a) Following Five FDs are computed:

- i.  $Us \rightarrow YeBa$
- ii.  $Ye \rightarrow ReMo$
- iii.  $UsRe \rightarrow Ba$
- iv.  $Da \rightarrow Ye$
- v.  $Us \rightarrow Mo$

- (b) Combine 1+5:

- i.  $Us \rightarrow YeBaMo$
- ii.  $Ye \rightarrow ReMo$
- iii.  $UsRe \rightarrow Ba$
- iv.  $Da \rightarrow Ye$

Now, 1+3 LHS:

- i.  $Us \rightarrow YeBaMo$

ii.  $Ye \rightarrow ReMo$

iii.  $Da \rightarrow Ye$

Now, 1+2 RHS

i.  $Us \rightarrow YeBa$

ii.  $Ye \rightarrow ReMo$

iii.  $Da \rightarrow Ye$

We cannot perform any further steps, so this is a minimal cover.

(c) Towards 3NF:

i. We have three tables BaUsYe, MoReYe, DaYe.

ii. We cannot remove a table without losing information as no relation is a subset of another.

iii. We can get a global key by analyzing the FDs, Us and Da only appear on the left, while Mo and Ba only appear on the right. We conclude Us and Da are part of the key while Mo and Ba certainly are not. Ye and Re are in the closure of UsDa, hence we make **UsDa** the global key.

Since no relation contains the entire key, we have to add this relation. We end up with four tables: **BaUsYe**, **MoReYe**, **DaYe**, **DaUs**.

3. (a) A and B only appear on the left and must therefore be part of the key. D on the other hand appears only on the right side, hence it is not part of the key. We add from CEF, but from AB F is already in the closure, hence we add C or E. **ABC** is key (closure is full), **ABE** as well.

(b) i.  $CF \rightarrow E$  is a into key dependency.

ii.  $AE \rightarrow C$  is a partial dependency.

iii.  $F \rightarrow D$  is a transitive dependency.

iv.  $E \rightarrow F$  is a partial dependency.

v.  $B \rightarrow F$  is a partial dependency.

(c)

4.

5.