Homework #3

1. a) i) A 🡪 B Invalid, tuples 1 & 2 cause violation

ii) B 🡪 C Valid

iii) C 🡪 B Invalid, tuples 1 & 3 cause violation

iv) B 🡪 A Invalid, tuples 1 & 5 + 4 & 6 cause violation

v) C 🡪 A Invalid, tuples 1 & 3 & 5 + 4 & 6 cause violation

b) Yes, {A, B} is a candidate key.

2. a) Closure {A, B}+ = {A, B, C}

b) Closure {C, D}+ = {B, C, D, E}

c) Closure {D, E}+ = {B, D, E}

3. a) Using Key Heuristic 2

Step 1: Base set = {A, B}

{A, B}+ = {A, B, C, D, E, F, G, H, I, J} KEY

Minimal key is {A, B}. Adding any other attributes in R to {A, B} will result in further super keys.

b) Step 1: Key is {A, B}

Step 2: A, B 🡪 C OKAY

Step 3: A 🡪 D, E VIOLATION

A+ = {A, D, E, I, J}

R1(A, D, E, I, J) VIOLATION

R2(A, B, C, F, G, H) VIOLATION

Step 4: B 🡪 F VIOLATION

B+ = {B, F, G, H}

R21(B, F, G, H) VIOLATION

R22(A, B, C) OKAY

Step 5: F 🡪 G, H VIOLATION

F+ = {F, G, H}

R211(B, F) OKAY

R212(F, G, H) OKAY

Step 6: D 🡪 I, J VIOLATION

D+ = {D, I, J}

R11(A, D, E) OKAY

R12(D, I, J) OKAY

Final relations:

R0(A, B, C)

R1(B, F)

R2(F, G, H)

R3(A, D, E)

R4(D, I, J)

4. a) Using Key Heuristic 2

Step 1: Base set = {E}

E+ = {E} NOT KEY

Step 2: Add attributes

{A, E}+ = {A, E} NOT KEY

{B, E}+ = {A, B, C, D, E, G} NOT KEY

{C, E}+ = {A, C, E, G} NOT KEY

{D, E}+ = {D, E} NOT KEY

{E, F}+ = {E, F} NOT KEY

{E, G}+ = {E, G} NOT KEY

{E, H}+ = {E, H} NOT KEY

Step 3: Add more attributes

{B, E, F}+ = {A, B, C, D, E, F, G, H} KEY

{B, E, H}+ = {A, B, C, D, E, F, G, H} KEY

{B, C, E}+ = {A, B, C, D, E, G}

{A, D, E}+ = {A, D, E}

{A, E, F}+ = {A, E, F}

{C, D, E}+ = {A, C, D, E, G}

{C, E, F}+ = {A, C, E, F, G}

{D, E, F}+ = {D, E, F}

{A, E, G}+ = {A, E, G}

{B, E, G}+ = {A, B, C, D, E, G}

{C, E, G}+ = {A, C, E, G}

{D, E, G}+ = {D, E, G}

{A, E, H}+ = {A, E, H}

{C, E, H}+ = {A, B, C, D, E, F, G, H} KEY

{D, E, H}+ = {D, E, H}

{E, F, G}+ = {E, F, G}

{E, F, H}+ = {E, F, H}

{E, G, H}+ = {E, G, H}

{A, B, D, E}+ = {A, B, C, D, E, G}

{B, C, D, E}+ = {A, B, C, D, E, G}

{A, D, E, F}+ = {A, D, E, F}

{C, D, E, F}+ = {A, C, D, E, F, G}

{A, B, E, G}+ = {A, B, C, D, E, G}

{B, C, E, G}+ = {A, B, C, D, E, G}

{A, D, E, G}+ = {A, D, E, G}

{B, D, E, G}+ = {A, B, C, D, E, G}

{C, D, E, G}+ = {A, C, D, E, G}

{A, E, F, G}+ = {A, E, F, G}

{C, E, F, G}+ = {A, C, E, F, G}

{D, E, F, G}+ = {D, E, F, G}

{A, D, E, H}+ = {A, D, E, H}

{A, E, F, H}+ = {A, E, F, H}

{D, E, F, H}+ = {D, E, F, H}

{A, E, G, H}+ = {A, E, G, H}

{D, E, G, H}+ = {D, E, G, H}

{E, F, G, H}+ = {E, F, G, H}

{A, C, D, E, F}+ = {A, C, D, E, F, G}

{A, B, C, E, G}+ = {A, B, C, D, E, G}

{A, C, D, E, G}+ = {A, C, D, E, G}

{A, D, E, F, G}+ = {A, D, E, F, G}

{C, D, E, F, G}+ = {A, C, D, E, F, G}

{A, D, E, F, H}+ = {A, D, E, F, H}

{A, D, E, G, H}+ = {A, D, E, G, H}

{A, E, F, G, H}+ = {A, E, F, G, H}

{D, E, F, G, H}+ = {D, E, F, G, H}

{A, D, E, F, G, H}+ = {A, D, E, F, G, H}

R has 3 keys: {B, E, F}, {B, E, H}, {C, E, H}.

b) B → C, D VIOLATION

B, F → H VIOLATION

C → A, G VIOLATION

C, E, H → F OKAY

C, H → B VIOLATION

c) Step 2: B → C, D VIOLATION

B+ = {A, B, C, D, G}

R1(A, B, C, D, G)

R2(B, E, F, H)

Step 3: B, F 🡪 H VIOLATION

{B, F}+ = {B, F, H}

R21(B, F, H) OKAY

R22(B, E, F) OKAY

Step 4: C 🡪 A, G VIOLATION

C+ = {A, C, G}

R11(A, C, G) OKAY

R12(B, C, D) OKAY

Final relations:

R0(B, F, H)

R1(B, E, F)

R2(A, C, G)

R3(B, C, D)

d) The resulting decomposition is not functional dependency preserving.

Both C, E, H → F and C, H → B are not represented in the final relations.

No single final relation includes the necessary attributes to ensure preservation.