# CS 5200
# Assignment - FD and Normalization
# Marks: 55

**Ques 1.** [15 Marks] Consider the following relation with sample data.

AIRPORT KLX TABLE

| Date | AirlineID | AirlineName | TerminalID | NumberOfGates | NumberOfDepartingFlights |
|---|---|---|---|---|---|
| 11-Dec | UA | United | A | 20 | 34 |
| 11-Dec | NW | Northwest | A | 20 | 17 |
| 11-Dec | AA | American | A | 20 | 11 |
| 11-Dec | DL | Delta | B | 15 | 20 |
| 11-Dec | JB | Jet Blue | B | 15 | 6 |
| 12-Dec | UA | United | A | 20 | 29 |
| 12-Dec | DL | Delta | B | 15 | 20 |
| 12-Dec | SWA | Southwest | C | 15 | 17 |

- *The AIRPORT KLX Table captures the data about daily departing flights at the KLX Airport.*
- *Each airline operating at KLX airport has a unique Airline ID and an Airline Name.*
- *Each terminal at KLX airport has a unique Terminal ID and a fixed Number of Gates.*
- *Each airline is permanently assigned to one (and only one) terminal at the KLX Airport.*
- *Each terminal at KLX Airport can have multiple airlines assigned to it.*
- *Each day (Date), this table records the Number of Departing Flights at KLX Airport for each airline.*

a) Using the Airport KLX Table, describe an example that illustrates the insertion anomaly.

b) Using the AIRPORT KLX Table, describe an example that illustrates the deletion anomaly.

c) Using the AIRPORT KLX Table, describe an example that illustrates the modification anomaly.

a)

if you want to store a new gate without any assigned airline, you are not able to do so.

For example, if KLX Airport wants to add a new Terminal D with 25 gates but has no airlines assigned yet, there is no way to insert this information into the table

b)

if a gate is closed, so you wan to delete it form the table. You can not do that since the gate information is tied to multiple airlines

Ex. Suppose KLX Airport wants to remove Terminal A because it is being decommissioned.

c)

if you want to update departing gate of delta airline, you may not be able to update it. Since, the there are two date tied to delta airline

Ex. Suppose Delta Airlines (DL) moves to Terminal C instead of Terminal B

**Ques 2.** [40 Marks] Consider the following relation scheme and FDs:

Employee(EmpID, EmpName, Spl, Mgr, ProjNo, PTitle, SName, SLoc, Bonus)
Spl- Specialization
Mgr – Manager
ProjNo – Project Number
PTitle – Project Title
SName – Supervisor Name
SLoc – Supervisor Location
given the following functional dependencies:

1) EmpID→EmpName
2) ProjNo→ProjTitle, SName
3) SName→SLoc
4) EmpID, ProjNo, Spl → Bonus
5) EmpID, Spl → Mgr
6) Mgr→Spl

Answer the following questions:

1) Find all keys [10 Marks]

2) Obtain a lossless-join BCNF decomposition of Employee. [10 Marks]

3) Find a minimal cover for this set of FDs. [10 Marks]

4) Obtain a lossless-join dependency-preserving 3NF decomposition of Employee via 3NF synthesis. [10 Marks]

1)

1)

A B C D E F G

Employee ( EmpID, EmpName, SPL, MGr, ProjNO, PTitle, SName,
H I
SLoc, Bonus )

A → B

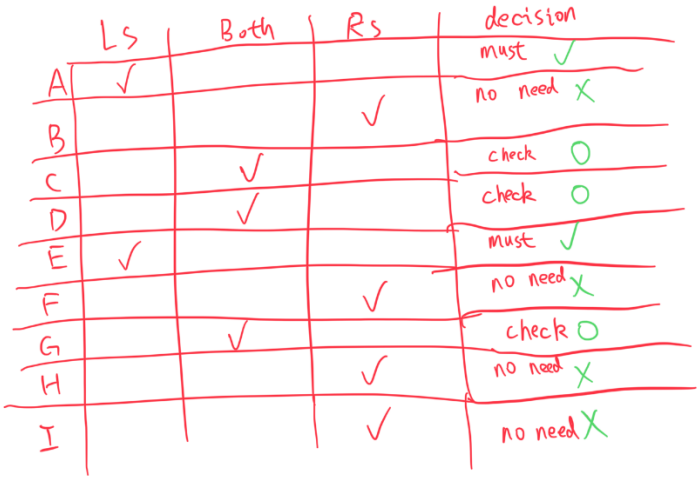
E → F, G

G → H

AEC → I

AC → D

D → C




A, E must be there

AEC⁺ {AECBFGHID} ✓

AED⁺ {AEDBFGHCI} ✓

AEG {AEGBFH} X

key is AEC, AED

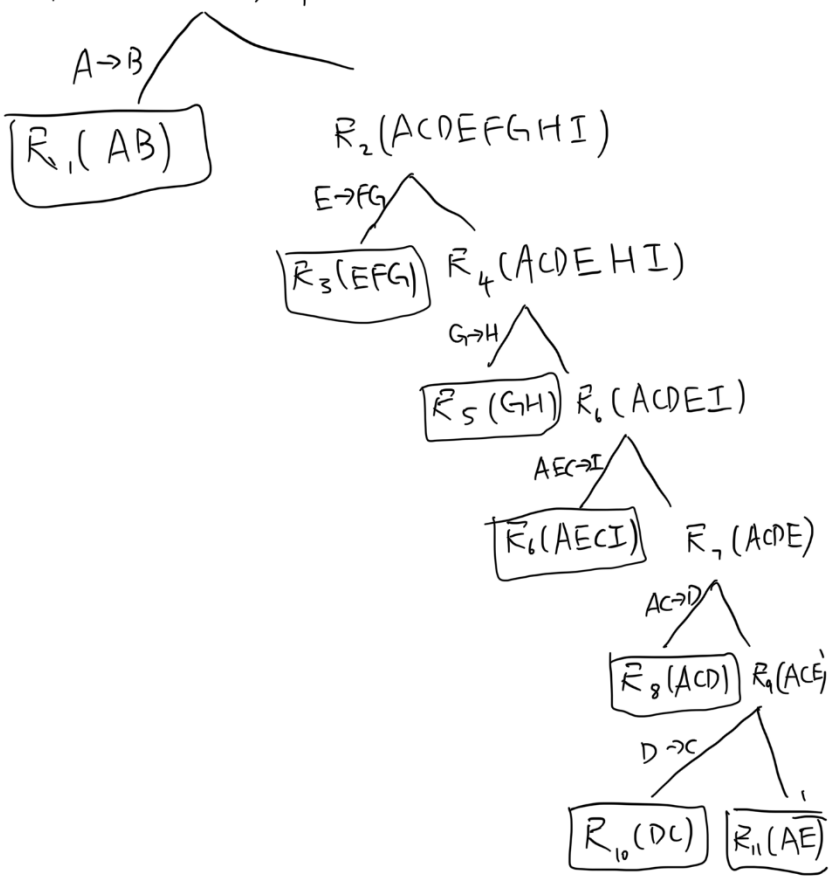
{ EmpID, ProjD, SPL }

{ EmpID, ProjD, MGr }

2)

Employee ( EmpID (A), EmpName (B), SPL (C), MGr (D), ProjNO (E), PTitle (F), SName (G), SLoc (H), Bonus (I) )

2) R ( A, B, C, D, E F G H I)




$R_1(AB)$, $R_3(EFG)$, $R_5(GH)$, $R_6(AECI)$

$R_8(ACD)$, $R_{10}(DC)$, $R_{11}(AE)$

3)

A B C D E F G H I

Employee ( EmpID, EmpName, SPL, MGr, Proj NO, PTitle, SName, SLoc, Bonus )

$A \to B$
$E \to F, G$
$G \to H$
$AEC \to I$
$AC \to D$
$D \to C$

→

$A \to B$
$E \to F$
$E \to G$
$G \to H$
$AEc \to I$
$Ac \to D$
$D \to C$

| | Redue LHS | Final FDs |
|---|---|---|
| $A \to B$ | | $A \to B$ |
| $E \to F$ | | $E \to F$ |
| $E \to G$ | | $E \to G$ |
| $G \to H$ | | $G \to H$ |
| $AEc \to I$ | AE {AEBFG}<br>AC {ACBD}<br>EC {ECFG} | $AEC \to I$ |
| $AC \to D$ | A {AB}<br>C {C} | $AC \to D$ |
| $D \to C$ | | $D \to C$ |

| | closure given FD | closure no FD | req |
|---|---|---|---|
| $A \to B$ | $A^+$ {AB} | $A^+$ {A} | ✓ |
| $E \to F$ | $E^+$ {EFG} | E {EG} | ✓ |
| $E \to G$ | $E^+$ {EGF} | E {EF} | ✓ |
| $G \to H$ | G {GH} | G {G} | ✓ |
| $AEc \to I$ | AEC {AECBFGDIH} | AEC {AECBFGDH} | ✓ |
| $AC \to D$ | AC {ACBD} | AC {ACB} | ✓ |
| $D \to C$ | D {DC} | D {D} | ✓ |

minimal Cover :

1. EmpID → EmpName
2. Proj NO → ptitle
3. Proj NO → SName
4. SName → sloc
5. EmpID, ProjNO, SPL → Bouns
6. EmpID , SPL → MGr
7. MGr → SPL

4)

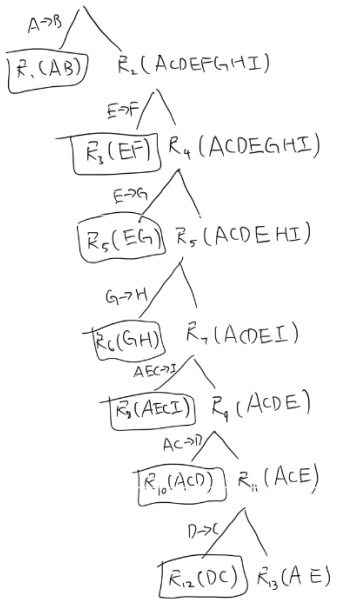
Employee ( EmpID (A), EmpName (B), SPL (C), MGr (D), Proj NO (E), PTitle (F), SName (G), SLoc (H), Bonus (I) )

minimal cover:

1. EmpID → EmpName
2. Proj NO → Ptitle
3. Proj NO → SName
4. SName → sloc
5. EmpID, ProjNO, SPL → Bonus
6. EmpID, SPL → MGr
7. MGr → SPL

A → B
E → F
E → G
G → H
AEC → I
Ac → D
D → C

R(ABCDEFGHI)




remove redundancy

R1 (A, B)
R2 (EFGH)
R3 (AECI)
R4 (ACD)
↓
R1 (EmpID, EmpName)
R2 (Proj NO, Proj title, SName, sLoc)
R3 (EmpID, Proj NO, spl, Bonus)
R4 (EmpID, SPL, MGr)