Tyler Pham, G3phamty, 999643382
Gilberto Aristizabal, G3aristi, 999845707
Assignment 3
December 1, 2014

Part 2: Functional Dependencies, Decompositions, Normal Forms

1. Consider a relation schema R with attributes ABCDEFGH with functional dependencies S:

$$S = \{A \rightarrow CF,\ BCG \rightarrow D,\ CF \rightarrow AH,\ D \rightarrow B,\ H \rightarrow DEG\}$$

a. Which of these functional dependencies violate BCNF?
   Answer: $D \rightarrow B$ violates BCNF

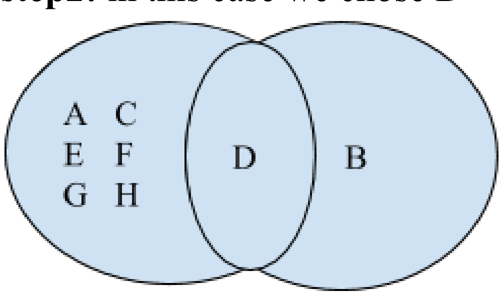
b. Employ the BCNF decomposition algorithm to obtain a lossless decomposition of R into a collection of relations that are in BCNF.

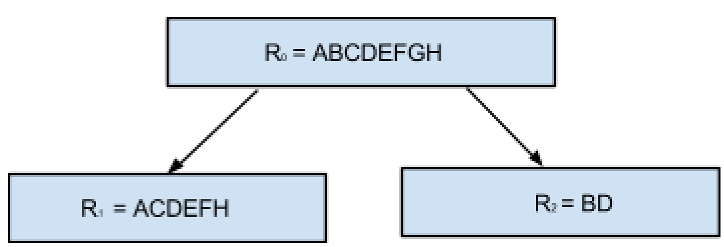
step1: check which FDs violate BCNF

A^+ = ABCDEFGH (its a key, follows BCNF)
BCG^+ = BCDG *
CF^+= ABCDEFGH (its a key, follows BCNF)
D^+= DB *
H^+= BDEGH *

* represents the FDs that violate BCNF, therefore we can choose any of these to branch of.

step2: in this case we chose D^+= DB * to branch off.

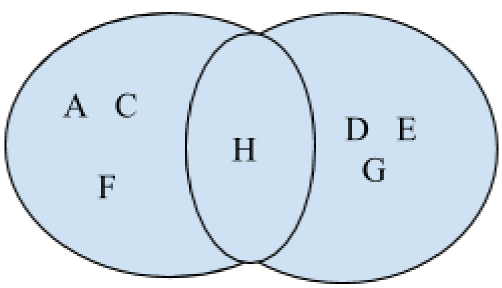


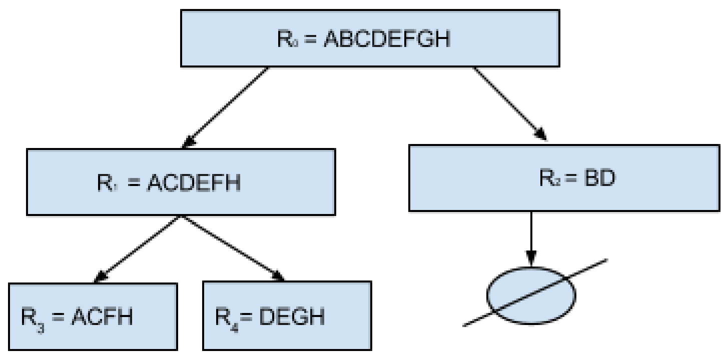


step3: R_2 is final, it's in BCNF form. Therefore we move on with R_1 projections

$A^+ = ABCDEFGH$ (its a key)
$C^+ = C$ (none)
$D^+ = DB$ (none, B its not in our set)
$E^+ = E$ (none)
$F^+ = F$ (none)
$G^+ = G$ (none)
$H^+ = DEGH$ (This works to branch off)

step4: here we chose $H \rightarrow DEGH$ to branch off





step5: R_3 projections and R_4 projections

*since A and CF are keys, there is no need to compute their projections, as they do not violate BCNF and anything with them will not either.

$C^+ = C$
$F^+ = F$
$H^+ = GDEG$ (none are in ACFH)

*we have to consider all combinations with the above FDs, to make sure they do not violate BCNF.

$CF^+ = CFAH$

$D^+ = D$
$E^+ = E$
$G^+ = G$
$H^+ = DEGH$ (not a new relation)

*Therefore, H does not have to be considered, as it was used to get to the current state.

$DE^+ = DE$

CH^+= BCEFGH

FH^+= BDEFGH

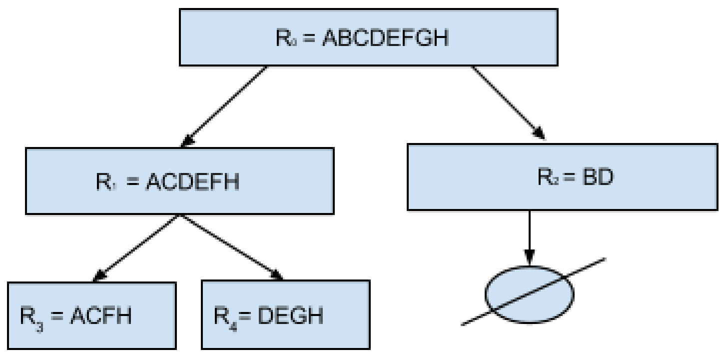
*the rest contain A or CF, so they are not computed.

DG^+ = DG

EG^+ = EG

DEG^+ = DEG

step6: final decomposition.



From this graph we can see that the final decomposition yields relations:

ACFH DEGH DB

where they can not be further decomposed and they hole BCNF form

step7: project the dependencies onto each relation in that final decomposition.

$ACFH^+$= ABCDEFGH

$DEGH^+$= BDEGH

BD^+= BD

CSC343 A3

g3phamty, 999643382, Tyler Pham
g3aristi, 999845707, Gilberto Aristizabal

December 1 2014

Part 2: Functional Dependencies, Decompositions, Normal Forms

2. a) By inspection $B^+ = ABCDEF$ which means A is a key and no superset of B can be a key. Since B never appears on the right hand side there is no way to obtain B through FD's, this implies that B is a superkey

   b) Simplified to singleton FD's

SET1

1 AB → E
2 AB → F
3 B → C
4 B → E
5 B → F
6 BCD → A
7 BCD → F
8 BCDE → A
9 BCE → D
10 DF → C

FD	To be excluded when computer closure	Closure	Decision
1	1	AB+=ABCDEF	Discard
2	1,2	AB+=ABCDEF	Discard
3	1,2,3	B+=BEF...	Keep
4	1,2,4	B+=BCF...	Keep
5	1,2,5	B+=ABCDEF	Discard
6	1,2,5,6	BCD+=ABCDEF	Discard
7	1,2,5,6,7	BCD+=BCDE...	Keep
8	1,2,5,6,8	BCDE+=BCDE...	Keep
9	1,2,5,6,9	BCE+=BCE...	Keep
10	1,2,5,6,10	DF+=DF...	Keep

SET2 (Kept 3,4,7,8,9,10)

3 B $\rightarrow$ C
4 B $\rightarrow$ E
7 BCD $\rightarrow$ F
8 BCDE $\rightarrow$ A
9 BCE $\rightarrow$ D
10 DF $\rightarrow$ C

Reduce LHS

7' = $BCD \rightarrow F$
$B^+ = ABCDEF$
$B \rightarrow F$

8' = BCDE $\rightarrow$ A
$B^+ = ABCDEF$ $B \rightarrow A$

9' = $BCE \rightarrow D$
$B^+ = ABCDEF$
$B \rightarrow D$

SET3

3 $B \rightarrow C$
4 $B \rightarrow E$
7 $B \rightarrow F$
8 $B \rightarrow A$
9 $B \rightarrow D$
10 $DF \rightarrow C$

FD	To be excluded when computer closure	Closure	Decision
3	3	B+=ABCDEF	Discard
4	3,4	B+=ABCDF..	Keep
7	3,7	B+=ABDE..	Keep
8	3,8	B+=BCDEF...	Keep
9	3,9	B+=ABEF...	Keep
10	3,10	B+=ABDFE...	Keep

The following set is a minimal basis

SET4 (Kept 4,7,8,9,10)

4 B $\rightarrow$ E
7 B $\rightarrow$ F
8 B $\rightarrow$ A
9 B $\rightarrow$ D
10 DF $\rightarrow$ C

c) These minimal basis can be combined
R1 (BE)
R2 (BF)
R3 (BA)

R4 (BD)

R5 (DFC)

Since B is a key, there are no need for duplicate tables with it, after combining tables we end up with

R1 (ABDEF)

R2 (CDF)

d) Because DF is not a superkey, this schema allows redundancy