Review Questions

Exercises

14.22. Prove that any relation schema with two attributes is in BCNF.

① FD exists

$\boxed{A \mid B}$ $A \to B$ then key is A $\{A\}^+ = \{AB\}$

then nontrivial FD $A \to B$ is A which is key.
LHS of

So it is in BCNF. vice versa

② FD doesn't exist

$\boxed{A \mid B}$

$\{A\}^+ = \{A\}$ $\{B\}^+ = \{B\}$

There's No non-trivial FDs

14.24. Consider the universal relation $R = \{A, B, C, D, E, F, G, H, I, J\}$ and the set of functional dependencies $F = \{\{A, B\}\to\{C\}, \{A\}\to\{D, E\}, \{B\}\to\{F\}, \{F\}\to\{G, H\}, \{D\}\to\{I, J\}\}$. What is the key for R? Decompose R into 2NF and then 3NF relations.

A B ~~C~~ ~~D~~ ~~E~~ ~~F~~ ~~G~~ ~~H~~ ~~I~~ ~~J~~

$\{AB\}^+ = \{ABCDEFGHIJ\}$

① key is AB

② 3NF

ⓐ check R is in 3NF

No. Because FD $A \to DE$'s LHS doesn't

superkey of AB and DE is not subset of

LHS(A) or key(AB)

ⓑ Find minimal basis

$S = \{AB \to C, A \to DE, B \to F, F \to GH, D \to IJ\}$

a) RHS should 1 attribute

$S = \{AB \to C,$

$A \to D, A \to E,$

$B \to F,$

$F \to G, F \to H,$

$D \to I, D \to J\}$

b) No redundant FD

$S = \{AB \to C,$ $\{AB\}^+ = \{ADEBFGHIJ\}$ X

$A \to D, A \to E,$ $\{A\}^+ = \{AE\}$ x $\{A\}^+ = \{AD$ x

$B \to F,$ $\{B\}^+ = \{B\}$ X

$F \to G, F \to H,$ $\{F\}^+ = \{F\}$ x

$D \to I, D \to J\}$

c) No redundant LHS

In $AB \to C$ if remove A, $\{B\}^+ = \{B, F, G, H\}$ x

If remove B, $\{A\}^+ = \{ADE\}$ x

$S = \{AB \to C, A \to D, A \to E, B \to F, F \to G, F \to H,$
$D \to I, D \to J\}$

ⓒ Combine same LHS

$S = \{AB \to C, A \to DE, B \to F, F \to GH, D \to IJ\}$

ⓓ create table

$R_1(ABC)$ $R_4(FGH)$

$R_2(ADE)$ $R_5(DIJ)$

$R_3(BF)$

14.25. Repeat Exercise 14.24 for the following different set of functional dependencies $G = \{\{A, B\}\rightarrow\{C\}, \{B, D\}\rightarrow\{E, F\}, \{A, D\}\rightarrow\{G, H\}, \{A\}\rightarrow\{I\}, \{H\}\rightarrow\{J\}\}$.

A B ~~C~~ D ~~E~~ ~~F~~ ~~G~~ ~~H~~ ~~I~~ ~~J~~

a) key of R = ABD

$\{ABD\}^+ = \{ABCDEFGHIJ\}$

$\{ABE\}^+ = \{ABCI\}$

b) check R is in 3NF

No. Because H→J is neither

lhs is superkey nor RHS is subset of lhs or key

c) Decompose

① Find minimal basis

S = { AB→C, BD→EF, AD→GH, A→I, H→J }

a) RHS 1 attribute b) No redundant FD

S = { AB→C, $\{AB\}^+ = \{ABI\}$ ×

BD→E, $\{BD\}^+ = \{BDFG\}$ ×

BD→F, $\{BD\}^+ = \{BDEGH\}$ ×

AD→G, $\{AD\}^+ = \{ADHI\}$ ×

AD→H, $\{AD\}^+ = \{ADGI\}$ ×

A→I, $\{A\}^+ = \{A\}$

H→J, $\{H\}$ ×

}

c) Remove lhs redundancy

In AB→C, If remove A, $\{B\}^+ = \{B\}$ ×

B, $\{A\}^+ = \{AI\}$ ×

② Combine

AB→C, BD→EF, AD→GH, A→I, H→J

③ create table

R1(ABC) R2(BDEF) R3(ADGH)

R4(AI) R5(HJ)

14.26. Consider the following relation:

A	B	C	TUPLE#
10	b1	c1	1
10	b2	c2	2
11	b4	c1	3
12	b3	c4	4
13	b1	c1	5
14	b3	c4	6

a. Given the previous extension (state), which of the following dependencies *may hold* in the above relation? If the dependency cannot hold, explain why *by specifying the tuples that cause the violation*.

i. $A \rightarrow B$, ii. $B \rightarrow C$, iii. $C \rightarrow B$, iv. $B \rightarrow A$, v. $C \rightarrow A$

① A→B can't hold

Because tuple 1. tuple 2. they both have same A but different B

② B→C holds

③ C→B can't hold

Because tuple 1, 4 have same C but different B

④ B→A can't hold

Because tuple 1 and 5

⑤ C→A can't hold

Because tuple 1 and 3

b. Does the above relation have a potential candidate key? If it does, what is it? If it does not, why not?

AB can be potential key

14.27. Consider a relation $R(A, B, C, D, E)$ with the following dependencies:

$$AB \rightarrow C,\ CD \rightarrow E,\ DE \rightarrow B$$

Is AB a candidate key of this relation? If not, is ABD? Explain your answer.

$\{AB\}^+ = \{ABC\}$ No

$\{ABD\}^+ = \{ABCDE\}$ yes

14.28. Consider the relation *R*, which has attributes that hold schedules of courses and sections at a university; *R* = {Course_no, Sec_no, Offering_dept, Credit_hours, Course_level, Instructor_ssn, Semester, Year, Days_hours, Room_no, No_of_students}. Suppose that the following functional dependencies hold on *R*:

{Course_no} → {Offering_dept, Credit_hours, Course_level}
{Course_no, Sec_no, Semester, Year} → {Days_hours, Room_no, No_of_students, Instructor_ssn}
{Room_no, Days_hours, Semester, Year} → {Instructor_ssn, Course_no, Sec_no}

Try to determine which sets of attributes form keys of *R*. How would you normalize this relation?

R = {cn, sn, dept, hours, level, ssn, sem, year, days, Rno, students}

FD = { cn → dept, hours, level
cn, sn, Sem, year → days, Rno, stud, ssn
Rno, days, sem, year → ssn, Cn, sn }

key {Sem, year}$^+$ = {sem, year}
{sem, year, cn}$^+$ = {sem, year, cn, dept, hours, level
{sem, year, cn, sn}$^+$ = {~~sem~~, ~~year~~, ~~cn~~, ~~sn~~ ~~dept~~, ~~hours~~, ~~level~~, ~~days~~, ~~Rno~~, ~~stud~~, ssn}

Todo

key 찾기 넣다!

14.30. Consider the following relation:

CAR_SALE(Car#, Date_sold, Salesperson#, Commission%, Discount_amt)

Assume that a car may be sold by multiple salespeople, and hence {Car#, Salesperson#} is the primary key. Additional dependencies are

Date_sold → Discount_amt and
Salesperson# → Commission%

Based on the given primary key, is this relation in 1NF, 2NF, or 3NF? Why or why not? How would you successively normalize it completely?

① 1NF
- All Attributes are atomic
- All non-key should be functionally dependent on key
⇒ yes in 1NF

② 2NF
- 1NF
- non-pk should fully functionally dependent on FD
⇒ No.
Commission % doesn't fully functionally dependent on PK
R1(Salesperson #, Commission %)
R2(car #, Salesperson #, date_sold, discount_amt)

③ 3NF
No. because sold → amt doesn't satisfy condition

Todo