

July 17, 2018

Assignment-5
COP - 4710

Due: July 24, 2018

[NO LATE SUBMISSIONS ACCEPTED FOR THIS ASSIGNMENT]

1) Prove or disprove the following Functional dependencies. Proof should use Armstrong's inference rules IR1 through IR3 only, and disproof should be through a counterexample.

a) $\{X \twoheadrightarrow Y, Z \twoheadrightarrow W\} \models \{XZ \twoheadrightarrow YW\}$

- 1) $X \twoheadrightarrow Y$ Given
- 2) $Z \twoheadrightarrow W$ Given
- 3) $XZ \twoheadrightarrow YZ$ IR2 on 1 by Z
- 4) $YZ \twoheadrightarrow YW$ IR2 on 2 by Y
- 5) $XZ \twoheadrightarrow YW$ IR3 with 3 and 4

b) $\{X \twoheadrightarrow Y, X \twoheadrightarrow W, WY \twoheadrightarrow Z\} \models \{X \twoheadrightarrow Z\}$

- 1) $X \twoheadrightarrow Y$ Given
- 2) $X \twoheadrightarrow W$ Given
- 3) $WY \twoheadrightarrow Z$ Given
- 4) $X \twoheadrightarrow XY$ IR2 on 1 by X
- 5) $XY \twoheadrightarrow WY$ IR2 on 2 by Y
- 6) $X \twoheadrightarrow WY$ IR3 with 4 and 5
- 7) $X \twoheadrightarrow Z$ IR3 with 6 and 3

c) $\{XY \twoheadrightarrow Z, Y \twoheadrightarrow W\} \models \{XW \twoheadrightarrow Z\}$

	W	X	Y	Z
T1	W1	X1	Y1	Z1
T2	W1	X1	Y2	Z2

Based on the above tuples (T1 and T2) the conclusion cannot be satisfied

d) $\{XY \twoheadrightarrow Z, Z \twoheadrightarrow X\} \models \{Z \twoheadrightarrow Y\}$

	X	Y	Z
T1	X1	Y1	Z1
T2	X1	Y2	Z1

Based on the above tuples (T1 and T2) the conclusion cannot be satisfied

2) Consider the following two sets of functional dependencies F and G:

$F = \{A \twoheadrightarrow C, AC \twoheadrightarrow D, E \twoheadrightarrow AD, E \twoheadrightarrow H\}$

$G = \{A \twoheadrightarrow CD, E \twoheadrightarrow AH\}$.

Prove that they are/are not equivalent. Show all your work.

$F^+ \{$
 $A^+ = \{A, C, D\}$
 $AC^+ = \{A, C, D\}$
 $E^+ = \{E, A, D, H, C\}$
 $\}$
 $G^+ \{$
 $A^+ = \{A, C, D\}$
 $E^+ = \{E, A, H, C, D\}$
 $\}$

Based on the closure from each functional dependency, we can see that they are equivalent.

3) Consider the Relational Schema BOOK of Problem 14.31 on page 499 of the text (Elmasri & Navathe - 7th ed.) [15.31 on page 540 - Elmasri & Navathe - 6th ed.] for which the set of Functional Dependencies is given.

a) What is the key for BOOK?

Dependencies:

$\text{Book_title} \rightarrow \text{Publisher, Book_type}$

$\text{Book_type} \rightarrow \text{List_price}$

$\text{Author_name} \rightarrow \text{Author_affil}$

Candidate key based on the above Functional Dependencies:

- $(\text{Book_type})^+ = \{\text{Book_Type, List_price}\}$

- $(\text{Book_Title})^+ = \{\text{Book_Title, Publisher, Book_Type, List_Price}\}$

- $(\text{Author_name})^+ = \{\text{Author_name, Author_affil}\}$

- $(\text{Book_Title, Book_Type})^+ = \{\text{Book_type, Book_Title, List_price, Publisher}\}$

- $(\text{Book Title, Author_name})^+ = \{\text{Book_Title, Author_Name, Publisher, Book_type, List_Price, Author_affil}\}$

The closure of (Book Title, Author_name) can determine all attributes, proving it is a key compared to all other closures. Every other closure has a missing attribute as well.

b) Decompose BOOK into 2NF Relations. Make sure that you have the minimum number of Relations in this decomposition.

R1- $\text{Book_Title} = \{\text{Publisher, Book_Type, List_Price}\}$

R2- Author_name= {Author_affil}

R3- (Book Title, Author_name)= {Publisher, Book_type, List_Price, Author_affil}

c) Decompose the result of part b) into 3NF Relations.

Using the Transitive rule, it can be said that:

- Book_type --> List_price

- Author_name --> Author_affil

Therefore:

Books(BookTitle (Key), Author_name (FK), book_type (FK), publisher)

Author(Author_Name (Key), Author_affil)

BookType(Book_type (Key), List_price)

Remember that for any decomposition, the key should be included in some Relation Schema.

4) For the universal relation $R = \{A, B, C, D, E, F, G, H, I, J\}$, and the set of functional dependencies $G = \{AB \rightarrow C, A \rightarrow DE, B \rightarrow F, F \rightarrow GH, \text{ and } D \rightarrow IJ\}$, determine if the following two decompositions D1 and D2 are dependency preserving and lossless join decompositions. Show all your work; correct answers alone will not fetch you good scores.

a) D1 = {R1, R2, R3, R4, R5}.

R1 = {A, B, C} R2 = {A, D, E} R3 = {B, F}

R4 = {F, G, H} R5 = {D, I, J}.

$G^+ \{$

$AB^+ = \{A, B, C, E, F, G, H, I, J\}$

$A^+ = \{A, D, E, I, J\}$

$B^+ = \{B, F, G, H\}$

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

$D^+ = \{D, I, J\}$

$\}$

Because we can infer everything that is in D1 to G then it is Dependency preserving

	A	B	C	D	E	F	G	H	I	J
ABC	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
ADE	A1	B22	B23	A 4	A 5	B26	B27	B28	A9	A10
BF	B31	A 2	B33	B34	B35	A6	A7	A8	B39	B310
FGH	B41	B42	B43	B44	B45	A6	A7	A8	B49	B410
DIJ	B51	B52	B53	A4	B55	B56	B57	B58	A9	A10

Row ABC is all a's therefore D1 is lossless

b) $D2 = \{R1, R2, R3, R4, R5\}$

$R1 = \{A, B, C, D\}$ $R2 = \{D, E\}$ $R3 = \{B, F\}$

$R4 = \{F, G, H\}$ $R5 = \{D, I, J\}$.

$G+ \{$

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

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

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

$F+ = \{F, G, H\}$

$D+ = \{D, I, J\}$

$\}$

Because we can infer everything that is in D2 to G then it is Dependency preserving

	A	B	C	D	E	F	G	H	I	J
ABCD	A1	A2	A3	A4	B15	A6	A7	A8	A9	A10
DE	B21	B22	B23	A4	A5	B26	B27	B28	A9	A10
BF	B31	A 2	B33	B34	B35	A6	B37	B38	B39	B310
FGH	B41	B42	B43	B44	B45	A6	A7	A8	B49	B410
DIJ	B51	B52	B53	A4	B55	B56	B57	B58	A9	A10

There is no rows of a's after looping, can never change B15 in relation ABCD, therefore it is NOT lossless

Using the SCIS Moodle system, submit your work in the form of a .pdf file which contains your initials.

In addition to the above, submit the hard copy of your assignment in class on the due date. THIS TIME, NO LATE ASSIGNMENTS WILL BE ACCEPTED.

Good Luck!