Christopher McArthur
40004257
Comp353
March 27th 2017

Assignment 3

Question 1:

Consider a relation with schema R(A, B, C, D) and FD's AB → C, C → D, and D → A.

A+ = A; B+ = B; C+ = CD; D+ = DA; AB+ = ABCD; AC+ = ACD; AD+ = AD; BC+ = ABCD; BD+ =ABCD; CD+ = ACD; ABC+ = ABCD; ABD+ = ABCD; BDC+ = ABCD; ABCD+ = ABCD+

b) What are all the keys of R? AB, BC, BD

c) What are all the superkeys for R that are not keys? ABC, ABD, BCD, ABCD

Question 2:

Show that each of the following are not valid rules about FD's by giving example relations that satisfy the given FD's (following the "if") but not the FD that allegedly follows (after the "then").

b) If AB → C and A→ C, then B→ C. “A = 1, B = 0, C = 1” : C == (A || B)

c) If AB→C, then A→ C or B→ C. “A = 0, B = 0, C = 1” : C == ~(A &&B)

Question 3:

Suppose we have relation R(A,B,C,D,E), with some set of FD's, and we wish to project those FD's onto relation S(A, B, C). Give the FD's that hold in S if the FD's for Rare:

a) AB → DE, C → E, D → C, and E → A.

A+ = A; B+ = B; C+ = ACE; AB+ = ABCDE; AC+ = ACE; BC+ =ABCDE;

“C → A, AB → C, BC → A”

b) A → D, BD→ E, AC→E, and DE→ B.

A+ = AD; B+ = B; C+ = C; AB+ = ABDE; BC+ = BC;

“ NONE ”

Question 4:

For each of the following relation schemas and Sets of FD's: do the following:

i) Indicate all the BCNF violations. Do not forget to consider FD's that are not in the given set, but follow from them. However, it is not necessary to give violations that have more than one attribute on the right side.

ii) Decompose the relations, as necessary, into collections of relations that are in BCNF.

d) R(A, B, C, D) with FD's , A → B, B →C, C → D, and D → A. " NO VIOLATIONS "

f) R(A, B, C, D, E) with FD's AB→ C, C → D, D → B, and D→ E. "AB+ = ABCDE, C+ = BCDE violates, D+ = BDE violates – neither are superkeys" Decomposing on C - R1(A,C) and R2(B,C,D,E). FD's of R1 { none } a,c is the key. FD's of R2 { C → D, D→B, D→E } "C+ = BCDE, D+ = BDE violates not a superkey" Decomsing on D – R2(C,D) and R3(B,D,E). FD's of R2 { C → D } " C+ = CD ". FD's of R3 { D → B, D → E } " D+ = BDE "

ANSWER: R1(A,C), R2(C,D), R3(B,D,E)

Question 5:

Let R(A, B, C, D, E) be decomposed into relations with the following three sets of attributes: {A, B, C}, {B, C, D}, and {A, C, E}. For each of the following sets of FD 's, use the chase test to tell whether the decomposition of R is lossless. For those that are not lossless, give an example of an instance of R that returns more than R when projected onto the decomposed relations and rejoined.

c) A→ D, D → E, and B→ D.

	A	B	C	D	E
S1	A	B	C	D1 → D	E1 → E
S2	A2	B	C	D	E2 → E
S3	A	B3	C	D3 → D	E

S1 HOLDS LOSSLESS JOIN

d) A→ D, CD→ E, and E→ D.

	A	B	C	D	E
S1	A	B	C	D1 → D	E1 → E
S2	A2	B	C	D	E2 → E
S3	A	B3	C	D3 → D	E

S1 HOLDS LOSSLESS JOIN

Question 6:

For each of the sets of FD's in QUESTION 5, are dependencies preserved by the decomposition?

NO AND NO

Question 7:

Consider a relation Stocks(B, 0, I, S, Q, D), whose attributes may be thought of informally as broker, office (of the broker), investor, stock, quantity (of the stock owned by the investor), and dividend (of the stock). Let the set of FD's for Stocks be S → D, I→ B, IS→ Q, and B→ 0.

a) What are all the keys for Stocks?

B+ = BO; O+ = 0; I+= BIO; S+ = DS; Q+ = Q; D+ = D; BO+ = BO; BI+ = BIO; BS+ = BSOD; BQ+ = BQO; BD+ = BDO; OI+ = BIO; IS+ = ISDBOQ; IQ+ = IQBO; ID+ = IDBO; SQ+ = SQD; SD+ = SD;

" IS, ISB, ISO, ISQ, ISD, ISBO, ISBQ, ISBD, ISOQ, ISOD, ISOQD, ISBOQ, ISBOD, ISBQD, ISOQD, ISBOQD "

b) Verify that the given FD's are their own minimal basis.

" These are minimal basis of their own. There are no redundancies "

c) Use the 3NF synthesis algorithm to find a lossless-join, dependency-preserving decomposition of R into 3NF relations. Are any of the relations not in BCNF?

R1(S,D); R2(I,B,O); R3(I,S,Q,D,B,O); R4(B,0); Since R1, R2, and R4 are subsets of R3 they are removed. R3 is the original relation schema thus is a lossess-join and dependency preserving. It is BCNF.

Question 8:

Verify, using the chase, that the decomposition of Example 3.27 has a lossless join.

Example 3.27: Consider the relation R(A, B, C, D, E) with FD's AB → C, C → B, and A → D. The final decomposition of R is thus S1 (A,B,C), S3 (A,D), and S4 (A,B,E).

	A	B	C	D	E
S1	A	B	C	D1 → D	E1
S3	A	B3	C3	D	E3
S4	A	B	C4 → C	D4 → D	E

S4 HOLDS LOSSLESS JOIN

Question 9:

Suppose we modified Algorithm 3.20 (BNCF decomposition) so that instead of decomposing a relation R whenever R was not in BCNF, we only decomposed R if it was not in 3NF. Provide a counterexample to show that this modified algorithm would not necessarily produce a 3NF decomposition with dependency preservation.