Part 2

1. 1. All FD’s:

LPR -> Q. The set closure of LPR+ is {L, P, Q, R, S, T} therefore the left hand side of this FD is not a super key. BCNF violation

LR -> ST. The set closure of LR+ is {L, R, S, T} therefore the left hand side of this FD is not a super key. BCNF violation

M -> LO. The set closure of M+ is {L, M, O} therefore the left hand side of this FD is not a super key. BCNF violation

MR -> N. The set closure of MR+ is {L, M, N, O, R, S, T} therefore the left hand side of this FD is not a super key. BCNF violation

Therefore, all of 4 FD’s violates BCNF

* 1. part2We choose FD LPR -> Q to decompose the relation V.

LPR+ is {L, P, Q, R, S, T}

R1 = {L, P, Q, R, S, T}, R2 = {L, M, N, O, P, R}

S1 = {LPR -> Q, LR -> ST}, S2 = {M -> LO, MR -> N}

**Decompose R1**

LPR -> Q. The set closure of LPR+ is {L, P, Q, R, S, T}

LR -> ST. The set closure of LR+ is {L, R, S, T} therefore the left hand side of this FD is not a super key. BCNF violation

R1.1 = {L, R, S, T}, R1.2 = {L, P, Q, R}

S1.1 = {LR -> ST}, S1.2 = {LPR -> Q}

**Decompose R2**

M -> LO. The set closure of M+ is {L, M, O} therefore the left hand side of this FD is not a super key. BCNF violation

MR -> N. The set closure of MR+ is {L, M, N, O, R} therefore the left hand side of this FD is not a super key. BCNF violation

We use M -> LO to decompose. M+ is {L, M, O}

R2.1 = {L, M, O}, R2.2 = {M, N, P, R}

S2.1 = {M -> LO}, S2.2 = {MR -> N}

**Decompose R2.2**

MR -> N. The set closure of MR+ is {M, N, R} therefore the left hand side of this FD is not a super key. BCNF violation

MR+ is {M, N, R}

R2.2.1 = {M, N, R}, R2.2.2 = {M, R, P}

Result: R1.1 = {L, R, S, T}, R1.2 = {L, P, Q, R}, R2.1 = {L, M, O}, R2.2.1 = {M, N, R}, R2.2.2 = {M, R, P}

S1.1 = {LR -> ST}, S1.2 = {LPR -> Q}, S2.1 = {M -> LO}, S2.2.1 = {MR -> N}, S2.2.2 has no functional dependency.

1. AB → CD, ACDE → BF, B → ACD, CD → AF, CDE → F G, EB → D
2. To find a minimal basis, we’ll first eliminate redundant FDs.

We will simplify to singleton RHS before doing so, since it may be possible to eliminate some but not all of FDs that we get from one of our original FDs. Add an index to each FD

1 AB -> C

2 AB -> D

3 ACDE -> B

4 ACDE -> F

5 B -> A

6 B -> C

7 B -> D

8 CD -> A

9 CD -> F

10 CDE -> F

11 CDE -> G

12 EB -> D

Now we will look for redundant FDs to eliminate.

|  |  |  |  |
| --- | --- | --- | --- |
| FD | Exclude these when computing closure | Closure | Decision |
| 1 | 1 | AB+ = ABCD | discard |
| 2 | 12 | AB+ = ABCD | discard |
| 3 | 123 | No way to get B without this FD | keep |
| 4 | 124 | ACDE+ = ABCDF | discard |
| 5 | 1245 | B+ = ABCD | discard |
| 6 | 12456 | No way to get C without this FD | keep |
| 7 | 12457 | No way to get D without this FD | keep |
| 8 | 12458 | No way to get A without this FD | keep |
| 9 | 12459 | No way to get F without this FD | keep |
| 10 | 1245 10 | CDE+ = ABCDEFG | discard |
| 11 | 1245 10 11 | No way to get G without this FD | keep |
| 12 | 1245 10 12 | EB+ = ABCD | Discard |

We get 6 FDs left, union

ACDE -> B B -> CD CD -> AF CDE -> G

Then we simplify LHS of FDs

CDE -> B B -> CD CD -> AF CDE -> G

Union again we get CDE -> BG, B -> CD, CD -> AF

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Minimal basis = {B –> CD, CD -> AF, CDE -> BG}

1. E only appears in LHS

A, F, G only appear in RHS

BCD appear on both side

H does not appear on both sides

We need to check BCD

BEH+ = ABCDEFGH, so BEH is a key

Then we don’t need to check any sets that has B

CEH+ = CEH, DEH+ = DEH, so both of them are not keys

CDEH+ = ABCDEFGH, so CDEH is a key

Then we don’t need to check any sets that has CD

Therefore, only BEH and CDEH are keys for this relation.

1. Minimal basis= {B –> CD, CD -> AF, CDE -> BG}

The set of relations that would result would have these attributes:

R1(B, C, D) R2(A, C, D, F) R3(B, C, D, E, G)

Since R3 contains R1, we can delete R1

Both R­2 and R3 don’t contain a key, so we need to add on to relation

Therefore, the final answer is R1(B, E, H), R2(A, C, D, F) R3(B, C, D, E, G)

1. Since we have FDs B -> CD and CD -> AF in the relation

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | D | E | F | G | H |
| 1 | 1 | 2 | 4 | 6 | 9 | 6 | 3 |
| 1 | 2 | 2 | 5 | 7 | 8 | 5 | 2 |
| 1 | 3 | 2 | 6 | 8 | 7 | 4 | 1 |

Therefore, redundancy is allowed in this relation.