Part2

1. Consider a relation V with attributes LMNOPQRST and functional dependencies W
2. LPR+ = LPRQST, not a superkey, violates BCNF

LR+ = LRST, not a superkey, violates BCNF

M+ = MLO, not a superkey, violates BCNF

MR+ = MRN, not a superkey, violates BCNF

1. For the sake of conciseness, subsets that produce ‘obvious’ results that do not contribute to the answer have been omitted (i.e. subsets such as {L} have been omitted since it’s closure is itself and does not give any information about the FDs).

LPR+ = LPRQST violates BCNF of V; chosen for decomposition

Decomposing with LPR produces relations R1 = LPRQST, R2 = LMNOPR

R1 = LPRQST

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **L** | **P** | **Q** | **R** | **S** | **T** | **Closure** | **FDs** |
| ✓ | ✓ |  | ✓ |  |  | LPR+ = LPRQST | Superkey |
| ✓ |  |  | ✓ |  |  | LR+ = LRST | Violates BCNF |

R1 = LPRQST

LR+ = LRST violates BCNF of LPQRST

Produced relations: R3 = LRST, R4 = LPRQ

R3 = LRST

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **L** | **R** | **S** | **T** | **Closure** | **FDs** |
| ✓ | ✓ |  |  | LR+ = LRST | Superkey  LR+ = ST |

R4 = LPRQ

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **L** | **P** | **R** | **Q** | **Closure** | **FDs** |
| ✓ | ✓ | ✓ |  | LPR+ = LPRQST | Superkey  LPR+ = Q |

R2 = LMNOPR

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **L** | **M** | **N** | **O** | **P** | **R** | **Closure** | **FDs** |
|  | ✓ |  |  |  |  | M+ = MLO | Violates BCNF |

M+ = MLO violates BCNF of LMNOPR

Produced relations: R5 = MLO, R6 = MNPR

R5 = MLO

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| **M** | **L** | **O** | **Closure** | **FDs** |
| ✓ |  |  | M+ = MLO | Superkey  M+ = LO |

R6 = MNPR

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| --- | --- | --- | --- | --- | --- |
| **M** | **N** | **P** | **R** | **Closure** | **FDs** |
| ✓ |  |  | ✓ | MR+ = MRN | Violates BCNF |

R6 = MNPR, MR+ = MRN, R7 = MRN, R8 = MPR

R7 = MRN

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| --- | --- | --- | --- | --- |
| **M** | **R** | **N** | **Closure** | **FDs** |
| ✓ | ✓ |  | MR+ = MRN | Superkey  MR+ = N |

R8 = MPR

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| --- | --- | --- | --- | --- |
| **M** | **P** | **R** | **Closure** | **FDs** |

Final decomposition and projection of FDs:

R3 = LRST,

R4 = LPQR

R5 = LMO

R7 = MNR

R8 = MPR

Projecting FDs onto relations:

R3: LR → ST

R4: LPR → Q

R5: M → LO

R7: MR → N

R8: No FDs

1. Consider a relation P with attributes ABCDEFGH and functional dependencies T.

T = {AB→CD, ACDE→BF, B→ACD, CD→AF, CDE→FG, EB→D}

1. S1:

AB → C

AB → D

ACDE → B

ACDE → F

B → A

B → C

B → D

CD → A

CD → F

CDE → F

CDE → G

EB → D

AB → C: A+ = A, B+ = BACDF, reduced to B → C

AB → D: B+ = BACDF, reduced to B → D

ACDE → B: Nothing yields B, no reduction

ACDE → F: CD+ = CDAF, reduced to CD → F

B → A: singleton no reduction

B → C: singleton no reduction

B → D: singleton no reduction

CD → A: Nothing yields A, no reduction

CD → F: Nothing yields F, no reduction

CDE → F: CD+ = CDAF, reduced to CD → F

CDE → G: Nothing yields G, no reduction

EB → D: B+ = BACDF, reduced to B → D

New set S2:

1. ACDE → B
2. B → A
3. B → C
4. B → D
5. CD → F
6. CD → A
7. CDE → G

Try to eliminate FDs:

ACDE → B ACDE+S2-{a} = ABCDEFG, therefore this FD is needed

B → A, B+S2 – {(b)} = BCDAF, removed since B → CD, CD → A

B → C, B+ S2 – {(b), (c)} = BD, needed

B → D, B+ S2 – {(b), (d)} = BC, needed

CD → F, CD+ S2 – {(b), (e)} = CDA, needed

CD → A, CD+ S2 – {(b), (f)} = CDF, needed

CDE → G, CDE+ S2 – {(b), (g)} = CDEAFB, needed

Final set:

ACDE → B

B → C

B → D

CD → A

CD → F

CDE → G



|  |  |  |  |
| --- | --- | --- | --- |
| Attribute | LHS | RHS | Conclusion |
| A | ✓ | ✓ | Check |
| B | ✓ | ✓ | Check |
| C | ✓ | ✓ | Check |
| D | ✓ | ✓ | Check |
| E | ✓ | 🗶 | In all keys |
| F | 🗶 | ✓ | Not in any key |
| G | 🗶 | ✓ | Not in any key |
| H | 🗶 | 🗶 | In all keys |

* Any attribute that does not appear in the RHS implies that it cannot be obtained by the FDs and therefore must be in the key
* Any attribute that only appears in the RHS must be inferred from some FD in the set and therefore cannot

CDEH+ = ABCDEFGH, a superkey

BEH+ = ABCDEFGH, a superkey

AEH+ = AEH, not a superkey

CEH+ = CEH, not a superkey

DEH+ = DEH, not a superkey

ACEH+ = ACEH, not a superkey

ADEH+ = ADEH, not a superkey

All other possibilities must include CDEH or BEH and therefore are not minimal.

Keys: CDEH, BEH

1. Minimal basis:

ACDE → B

B → C

B → D

CD → A

CD → F

CDE → G

Revised FDs after joining RHSs:

ACDE → B

B → CD

CD → AF

CDE → G

Result set relations:

R1 {ACDEB}, R2{BCD}, R3{CDAF}, R4{CDEG}, discard R2 because it is in R1

Final set relations:

R1 {ACDEB}, R3{CDAF}, R4{CDEG}

1. Relation that violates BCNF: CD projects onto R1 and produces ACD and it is not a superkey.

Since there exists a relation that violates BCNF, this schema allows redundancy.