Part 3: Functional Dependencies, Decompositions, and Normal Forms

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S = {I→DGF, H→CEA, BI→J, B→H, CI→K}

1. • Violates: I+=DGFI, so I is not a super key and I+=DGFI violates BCNF.

• Violates: H+ = ACEH so H+ = ACEH also violates BCNF.

• Met: BI+ = ABCDEFGHIJK so BI is the super key. The FD does not violate BCNF.

* Violates: B+ = ABCEH also violates BCNF.
* Violates: CI+ = CDFGIK

b)

* Decompose R using I+ = DGFI and this yield two relations: R1 = DGFI, R2 = ABCEHIJK.
* Project the FDs onto R1 = DGFI:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| D | G | F | I | closure | FDs |
| √ |  |  |  | D+ = D | Nothing |
|  | √ |  |  | G+ = G | Nothing |
|  |  | √ |  | F+ = F | Nothing |
|  |  |  | √ | I + = DGFI | Meet the BCNF, end the decomposition |

* Project the FDs onto R2 = ABCEHIJK

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | E | H | I | J | K | closure | FDs |
| √ |  |  |  |  |  |  |  | A+ = A | Nothing |
|  | √ |  |  |  |  |  |  | B+ = ACEH | Violates BCNF, abort the projection |

* Decompose R2 using H+ = ACEH. This yield two relations: R3 = ACEH, R4 = BHIJK
* Project the FDs onto R3 = ACEH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A | C | E | H | closure | FDs |
| √ |  |  |  | A+ = A | Nothing |
|  | √ |  |  | C+ = C | Nothing |
|  |  | √ |  | E+ = E+ | Nothing |
|  |  |  | √ | H+ = ACEH | Meet the BCNF, end the decomposition |

* Project the TDs onto R4 = BHIJK

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | H | I | J | K | closure | FDs |
| √ |  |  |  |  | B+ = ABCEH | B->H, Violates BCNF, abort the projection |

* Decompose R4 using B-> H. This yield two relations: R5 = BH, R6 = BIJK
* Project the TDs onto R5 = BH

|  |  |  |  |
| --- | --- | --- | --- |
| B | H | closure | FDs |
| √ |  | B+ = ABCEH | Meet BCNF |
|  | √ | H+ = ACEH | Nothing |
| √ | √ | BH+ = ABCEH | Meet BCNF, end the decomposition |

* Project the TDs onto R6 = BIJK

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| B | I | J | K | closure | FDs |
| √ |  |  |  | B+ = ABCEH | Nothing |
|  | √ |  |  | I+ = DGFI | Nothing |
|  |  | √ |  | J+ = J | Nothing |
|  |  |  | √ | K+ = K | Nothing |
| √ | √ |  |  | BI+ = ABCDEFGHIJK | BI->J, violates BCNF, abort the projection |

* Decompose R6 using BI->J. This yield two relations: R7= BIJ; R8=JK
* Project the TDs onto R7 = BIJ

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| B | I | J | closure | FDs |
| √ |  |  | B+ = ABCEH | Nothing |
|  | √ |  | I+ = DGFI | Nothing |
|  |  | √ | J+ = J | Nothing |
| √ | √ |  | BI+ = ABCDEFGHIJK | Meet the BCNF, end the decomposition |

* Project the TDs onto R8 = JK

|  |  |  |  |
| --- | --- | --- | --- |
| J | K | closure | FDs |
| √ |  | J+ = J | Nothing |
|  | √ | K+ = K | Nothing |
| √ | √ | JK+ = JK | Nothing |

Satisfy the BCNF

Final Decomposition

1. R2 = DGFI, with FD: I -> DGF
2. R3 = ACEH, with FD: H -> CEA
3. R5 = BH, with FD: B -> H
4. R7 = BIJ, with FD: BI -> J
5. R8 = JK, with no FD

* Decompose R using FD B → CD. B+ = BCDAG, so this yields two relations: R1 = ABCDG and