Total: 64/100

70040 12

Normalisation

Submitters

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Emarking

Database CW2

Exercise 1. 15/25

1.

(a) A → BC

(b) B → AC

(c) C → AB

	Minimal cover
C is extraneous in A → BC because C ∈ {A}$^+$ = {B} + {C}	(a) A → B (b) B → AC (c) C → AB
A is extraneous in B → AC because A ∈ {B}$^+$ = {A} + {C}	(a) A → B (b) B → C (c) C → AB
B is extraneous in C → AB because B ∈ {C}$^+$ = {A} + {B}	(a) A → B (b) B → C (c) C → A

The minimal cover for the given FD set is {A → B, B → C, C → A}. Correct

2.

	Minimal cover
RU→S and S→RU is redundant. We can remove one.	(a) P → S, (b) PQ → ST, (c) S → RU, (d)PT → V
S is extraneous in PQ → ST because P → S makes S ∈ {P}$^+$	(a) P → S, (b) PQ → T, (c) S → RU, (d)PT → V

The minimal cover for the given FD set is {P → S; PQ → T; S → RU; PT →V}

-10 Incorrect: The minimal cover is: P->S, PQ->T, S->RU, RU ->S, PT ->V. Where did the RU->S go?

Exercise 2. 25/25

(a) One key is AB.

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

(b) Firstly, calculate the canonical cover. Correct

A, B → C

A → D, E

B → F

F → G, H

D → I, J

According to the cover, we gain:

R1(A, B, C), R2(A, D, E), R3(B, F), R4(F, G, H), R5(D, I, J) Correct

Exercise 3. 15/25

(1) R1(A, C, B, D, E), A → B, C → D
Candidate key {A, C, E}
a) the Strongest Normal Form:
Check for 1NF: It's in 1NF because it contains only atomic values.
Check for 2NF: It's not in 2NF because it contains partial dependencies. Partial Dependency occurs when a non-prime attribute is functionally dependent on part of a candidate key. For {B}, it is functionally dependent on {A}, which is part of the candidate key {A, C, E}
Correct
b) Decompose into BCNF:
Ra (A, B)
Rb (C, D)
Correct
Rc (A, C, E)

(2) R2(A, B, F), AC → E, B → F
Since AC → E is ignored because it is not related to the relation.
R2(A, B, F), B → F
Candidate key {A, B}
a) the Strongest Normal Form:
Check for 1NF: It's in 1NF because it contains only atomic values.
Correct
Check for 2NF: It's not in 2NF because it contains partial dependencies. For a non-prime attribute {F}, it is functionally dependent on {B}, which is part of the candidate key {A, B}. So, this is partial dependency and makes the relation not in 2NF.
b) Decompose into BCNF:
Ra (B, F)
Correct
Rb (A, B)

(3) R3(A, D), D → G, G → H
Since D → G, G → H should be ignored because it is not related to this relation schema.
R3(A, D)
Candidate key {A, D}
a) the Strongest Normal Form:
Check for 1NF: It's in 1NF because it contains only atomic values.
Check for 2NF: Cannot decide this because we do not know any functional dependency about it.
b) Decompose into BCNF:
-5 The relation is already in BCNF
Ra (A, D)
Rb (D, G)
Rc (G, H)

(4) R4(D, C, H, G), A → I, I → A
Since A → I, I → A should be ignored because it is not related to this relation schema.
R4(D, C, H, G)
Candidate key {D, C, H, G}
a) the Strongest Normal Form:
Check for 1NF: It's in 1NF because it contains only atomic values.
Check for 2NF: Cannot decide this because we do not know any functional dependency about it.

Check for 3NF: A is not prime because it is not a member of candidate key {D, C, H, G}.
It is not in 3NF. Neither the LHS of every nontrivial FD is a superkey, nor every attribute on the RHS of a FD is prime.
b) Decompose into BCNF: -5 The relation is already in BCNF
Ra (D, C, H, G)
Rb (A, I)

Exercise 4. 9/25
(1) C → D, C → A, B → C
(a)
{A}+ = {A}
{C}+ = {C, D, A}
{B}+ = {B, C, D, A}
{D}+ = {D}
candidate key: {B} Correct
(b) The highest normal form
Check for 1NF: It's in 1NF because it contains only atomic values.
Check for 2NF: It's not in 2NF because it contains partial dependencies. For non-prime attribute {D}, it depends on {C}.
Check for 3NF: It's not in 3NF because it contains transitive dependencies. One transitive dependency is B → C and C → D. -2 This relation is in 2NF. C->D and C->A violates 3NF as non-prime attributes are determined by another non-prime attribute.
(c) Decompose into BCNF:
Ra (C, D)
Rb (A, C) Correct
Rc (B, C)
(2) B → C, D → A
(a)
{A}+ = {A}
{B}+ = {B, C}
{C}+ = {C}
{D}+ = {D, A}
candidate key: {B, D} Correct
(b) The highest normal form
Check for 1NF: It's in 1NF because it contains only atomic values. -2 Incorrect, this relation is 1NF. D->A and B->C makes A and C partially functionally dependent on BD.
Check for 2NF: It's in 2NF because it contains no partial dependencies.
Check for 3NF: It's in 3NF because it contains no transitive dependencies.
Check for BCNF: It's not in BCNF because for all non-trivial FDs, not every LHS of every FD is a superkey.
(c) Decompose into BCNF:
Ra (B, C)
Rb (A, D) Correct
Rc (B, D)
(3) ABC → D, D → A
(a)

{A}+ = {A}
{B}+ = {B}
{C}+ = {C}
{D}+ = {D, A}
{ABC}+ = {A, B, C, D}
candidate key: {A, B, C}, {B, C, D}

Correct

(b) The highest normal form
Check for 1NF: It's in 1NF because it contains only atomic values.
Check for 2NF: It's in 2NF because it contains no partial dependencies.
Check for 3NF: It's not in 3NF because it contains transitive dependencies.

-2 The highest normal form is 3NF when using ABC as the key. D->A violates BCNF as D is not part of the key. If you use BCD as the key then you get a lower normal form.

(c) Decompose into BCNF:
Ra (A, D)
Rb (B, C, D)

-1 This decomposition is not dependency persevering, pulling AD out does not preserve ABC. There is no dependency persevering decomposition for this question.

(4) A → B, BC → D, A → C
(a)
{A}+ = {A, B, C}
{B}+ = {B}
{C}+ = {C}
{D}+ = {D}
{BC}+ = {B, C, D}
candidate key: {A, D}

-2 The key is only A

(b) The highest normal form
Check for 1NF: It's in 1NF because it contains only atomic values.
Check for 2NF: It's not in 2NF because it contains partial dependencies. For {B}, it is functional dependent on {A}, which is part of the candidate key {A, D}.
Check for 3NF: It's not in 3NF because it is not in 2NF.

-2 Relation is in 2NF. BC -> D violates 3NF as D is determined by non-prime attributes B and C

(c) Decompose into BCNF:
Ra (B, C, D)
Rb (A, B)
Rc (A, C)

BCD, ABC is adequate as it does not cause any violations, you don't need to break it down further. (No marks deducted)

(4) AB → C, AB → D, C → A, D → B
(a)
{A}+ = {A}
{B}+ = {B}
{C}+ = {C, A}
{D}+ = {D, B}
{AB}+ = {A, B, C, D}
candidate key: {A, B}, {C, D}

-2 Missing two candidate key (AD and BC)

(b) The highest normal form
Check for 1NF: It's in 1NF because it contains only atomic values.
Check for 2NF: It's in 2NF because it contains no partial dependency.
Check for 3NF: It's not in 3NF because it contains transitive dependency.

-2 The highest normal form is 3NF when using AB as the key. D->A and C->A violated BCNF as D and C are not part of the key.

(c) Decompose into BCNF:
Ra (A, C)

Rb (B, C)

Rc (B, D)

Rd (A, D)

-1 This decomposition is not dependency persevering. There is no dependency persevering decomposition for this question.