CS2005 Database Systems

Assignment 2

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Section: 4H

Q 1) Consider the relation R(A, B, C, D, E, I) and a set of FDs F = {A → C, AB → C, C → DI, CD → I, EC → AB, EI → C}. Compute the minimal cover for F (i.e. F_c). Also find all possible Keys (minimal of super keys i.e. Candidate keys) of R.

- Step 1 : Decomposition

{A → C, AB → C, C → D, C → I, CD → I, EC → A, EC → B, EI → C}

Step 2 : Remove trivial and extraneous FDs

{A → C, ~~AB~~ → C, C → D, C → I, ~~CD~~ → I, EC → A, EC → A, EI → C}

⇒ {A → C, C → D, C → I, EC → A, EC → B, EI → C}

Step 3: Remove Redundant FDs

$\{A \to C, C \to D, C \to I, EC \to A, EC \to B, EI \to C\}$

$A^+ = \{A\} \Rightarrow$ Keep $A \to C$

$\{A \to C, C \to D, C \to I, EC \to A, EC \to B, EI \to C\}$

$C^+ = \{CI\} \Rightarrow$ Keep $C \to D$

$\{A \to C, C \to D, C \to I, EC \to A, EC \to B, EI \to C\}$

$C^+ = \{CD\} \Rightarrow$ Keep $C \to I$

$\{A \to C, C \to D, C \to I, EC \to A, EC \to B, EI \to C\}$

$EC^+ = \{ECBDI\} \Rightarrow$ Keep $EC \to A$

$\{A \to C, C \to D, C \to I, EC \to A, EC \to B, EI \to C\}$

$EC^+ = \{ECADI\} \Rightarrow$ Keep $EC \to B$

$\{A \to C, C \to D, C \to I, EC \to A, EC \to B, EI \to C\}$

$EI^+ = \{EI\} \Rightarrow$ Keep $EI \to C$

The minimal cover is:

$F_c = \{ A \to C, C \to D, C \to I, EC \to A, EC \to B, EI \to C \}$

→ Answer

Finding Candidate keys

- $AB \not\subset \emptyset E \not\subset$ (cutting)

ABE (Not a CK)

$\times A^+ = \{ACDI\}$ $\times AB^+ = \{ABCDI\}$

$\times B^+ = \{B\}$

$\checkmark AE^+ = \{AECDIB\} \to SK$

$\times E^+ = \{E\}$

$\times BE^+ = \{BE\}$

- $AE \to CK$

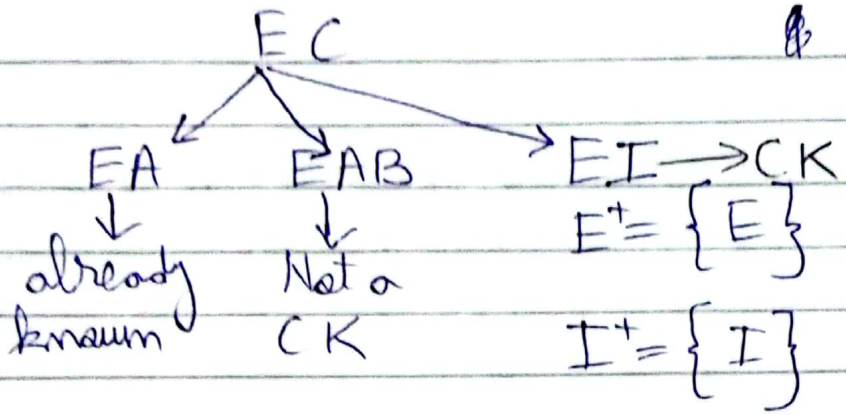
$\times A^+ = \{ACDI\}$ $\times E^+ = \{E\}$ PA so far = {A, E}

AE

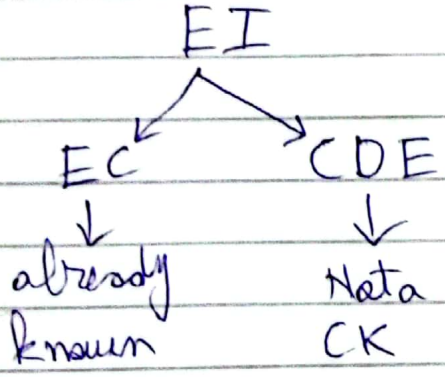
↓

$EC \to CK$

$\times E^+ = \{E\}$ $\times C^+ = \{CDI\}$ PA so far = {A, E, C}



PA so far = {A, E, C, I}



Candidate keys = {AE, CE, EI}

Prime Attributes = {A, E, C, I}

Non Prime Attributes = {B, D}

Answer

Q2) Find out whether the following set of functional dependencies for the relation R(A, B, C, D, E, G) are equivalent or not. Show all the steps.

$F1 = \{ A \xrightarrow{(1)} C,\ AB \xrightarrow{(2)} C,\ C \xrightarrow{(3)} DG,\ CD \xrightarrow{(4)} G,\ EC \xrightarrow{(5)} AB,\ EG \xrightarrow{(6)} C \}$

and

$F2 = \{ A \xrightarrow{(1)} C,\ C \xrightarrow{(2)} D,\ C \xrightarrow{(3)} G,\ EC \xrightarrow{(4)} A,\ EC \xrightarrow{(5)} B,\ EG \xrightarrow{(6)} C \}$

Checking whether the FDs of F1 are present in F2 or not

(1) $A^+ = \{ACDG\} \Rightarrow A \rightarrow C$ is present in F2

(2) $AB^+ = \{ABCDG\} \Rightarrow AB \rightarrow C$ is present in F2

(3) $C^+ = \{CDG\} \Rightarrow C \rightarrow DG$ is present in F2

(4) $CD^+ = \{CDG\} \Rightarrow CD \rightarrow G$ is present in F2

(5) $EC^+ = \{ECGDAB\} \Rightarrow EC \rightarrow AB$ is present in F2

(6) $EG^+ = \{EGCDAB\} \Rightarrow EG \rightarrow C$ is present in F2

Checking whether the FDs of F2 are present in F1 or not

① $A^+ = \{ACDG\} \Rightarrow A \rightarrow C$ is present in F1

② $C^+ = \{CDG\} \Rightarrow C \rightarrow D$ is present in F1

③ $C^+ = \{CDG\} \Rightarrow C \rightarrow G$ is present in F1

④ $EC^+ = \{ECABDG\} \Rightarrow EC \rightarrow A$ is present in F1

⑤ $EC^+ = \{ECABDG\} \Rightarrow EC \rightarrow B$ is present in F1

⑥ $EG^+ = \{EGCDAB\} \Rightarrow EG \rightarrow C$ is present in F1

Since all the FDs in F1 are present in F2 and all the FDs in F2 are present in F1 so we can conclude that F1 and F2 are equivalent.

$F1 \equiv F2$

Answer

(Q3) Consider the relation R(A, B, C, D, E, G) and a set of FDs F={D→E, ABC→BDE, B→G, A→C, ABC→G}. Compute the minimal cover for F (i.e. F_c). Also find all possible keys (i.e. minimal of superkeys) of R.

- Step 1: Decomposition

{D→E, ABC→B, ABC→D, ABC→E, B→G, A→C, ABC→G}

Step 2: Remove trivial and extraneous FDs

{D→E, ~~ABC→B~~, AB↛D, AB↛E,

- B→G, A→C, ~~AB↛G~~}

⇒{D→E, AB→D, AB→E, B→G, A→C}

Step 3: Remove Redundant FDs

{(D→E), AB→D, AB→E, B→G, A→C}

$D^+ = \{D\}$ ⇒ Keep D→E

$\{ D \to E, AB \to D, AB \to E, B \to G, A \to C \}$

$AB^+ = \{ABEGC\} \Rightarrow$ Keep $AB \to D$

$\{ D \to E, AB \to D, AB \to E, B \to G, A \to C \}$

$AB^+ = \{ABDGCE\} \Rightarrow$ Drop $AB \to E$

$\{ D \to E, AB \to D, B \to G, A \to C \}$

$B^+ = \{B\} \Rightarrow$ Keep $B \to G$

$\{ D \to E, AB \to D, B \to G, A \to C \}$

$A^+ = \{A\} \Rightarrow$ Keep $A \to C$

The minimal cover is :

$F_c = \{ D \to E, AB \to D, B \to G, A \to C \}$

↳ Answer

Finding Candidate Keys

AB ⊄ ∅ ≠ ∅ (cutting)

AB → CK

PA so far = {A, B}

$\alpha A^+ = \{AC\}$

$\alpha B^+ = \{BG\}$

AB

ABC → Not a CK

$AB^+ = \{ABCDEG\}$

→ SK

Candidate Keys = {AB}

Prime Attributes = {A, B}

Non Prime Attributes = {C, D, E, G}

Answer

Q4) Consider the relation R(A, B, C, D, E) and a set of FDs F = {C → AB, A → E, D → E, BD → C, CD → B}. Find all possible Keys of R.

~~ABCDE~~

BD → CK PA so far = {B, D}

∝ B^+ = {B}

∝ D^+ = {DE}

BD

CD CDD ⇒ CD → CK PAs for = {B, D, C}

∝ C^+ = {CABE}

∝ D^+ = {DE}

Candidate Keys = {BD, CD}

Prime Attributes = {B, D, C}

Non Prime Attributes = {A, E}

Answer

Q5) Consider the relation R(A, B, C, D) and a set of FDs F = {AB → C, CD → B, AD → B, AC → D}. Find all possible keys of R.

A B C D (cutting)

- AD → CK PA so far = {A, D}

∝ A^+ = {A}

∝ D^+ = {D}

AD

↓

AAC ⇒ AC → CK PA so far = {A, D, C}

∝ A^+ = {A}

∝ C^+ = {C}

AC

↓

AAB ⇒ AB → CK PA so far = {A, D, C, B}

∝ A^+ = {A}

∝ B^+ = {B}

Candidate Keys = {AD, AC, AB}
Prime Attributes = {A, D, C, B}
Non Prime Attributes = {Null}

Answer

Q6) Consider the relation R(A, B, C, D, E) and a set of FDs F={A → C, C → BD, D → A}. Find all possible keys of R.

~~A~~ ~~B~~ ~~C~~ ~~D~~ E (cutting)

AE → CK PA so far = {A, E}

∝ A^+ = {ACBD}

∝ E^+ = {E}

AE

↓

DE → CK PA so far = {A, E, D}

∝ D^+ = {DACB}

∝ E^+ = {E}

DE

↓

CE → CK PA so far = {A, E, D, C}

∝ C^+ = {CBAA}

∝ E^+ = {E}

Candidate Keys = { AE, DE, CE }

Prime Attributes = { A, E, D, C }

Non Prime Attributes = { B }

Answer

- Q7) Consider the relation R(A, B, C, D, E, G) and a set of FDs F = { ABC → CDEG, C → E, A → B, D → G }. Compute the minimal cover for F (i.e. F_c). Also find all possible keys (i.e. minimal of super keys) of R.

Step 1: Decomposition

- { ABC → C, ABC → D, ABC → E, ABC → G, C → E, A → B, D → G }

Step 2: Remove trivial and extraneous FDs

{ ~~ABC → C~~, ABC → D, ~~ABC~~ → E, ABC → G, C → E, A → B, D → G }

⇒ { AC → D, AC → G, C → E, A → B, D → G }

Step 3: Remove Redundant FDs

$\{AC \to D, AC \to G, C \to E, A \to B, D \to G\}$

$AC^+ = \{ACGEB\} \Rightarrow$ Keep $AC \to D$

$\{AC \to D, AC \to G, C \to E, A \to B, D \to G\}$

$AC^+ = \{ACDEBG\} \Rightarrow$ Drop $AC \to G$

$\{AC \to D, C \to E, A \to B, D \to G\}$

$C^+ = \{C\} \Rightarrow$ Keep $C \to E$

$\{AC \to D, C \to E, A \to B, D \to G\}$

$A^+ = \{A\} \Rightarrow$ Keep $A \to B$

$\{AC \to D, C \to E, A \to B, D \to G\}$

$D^+ = \{D\} \Rightarrow$ Keep $D \to G$

The minimal cover is:

$F_c = \{AC \to D, C \to E, A \to B, D \to G\}$

→ Answer

Finding Candidate Keys

A B C D E G (cutting)

AC → CK PA so far = {A, C}

- $A^+ = \{AB\}$
- $C^+ = \{CE\}$

AC

↓

ABC → Not a CK

SK ← $AC^+ = \{ACEBDG\}$

- Candidate keys = {AC}
- Prime Attributes = {A, C}
- Non Prime Attributes = {B, D, E, G}

Answer