Information and Database Management Systems I

(CIS 4301)

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Homework 4

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Pledge (Must be signed[1] according to UF Honor Code)

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

Student signature

[1] Each student is obliged to print out this page, fill in the requested information in a handwritten and readable manner, make the *handwritten* signature, scan this page into PDF, and put this page as the first page of the PDF submission.

Homework 4

Poll ACE Workshop
Charles Richardson

(Q1a) $R(A,B,C,D,E)$ $F=\{A\to BC, CD\to E, B\to D, E\to A\}$

1. Show $AC\to BE$

$A\to BC$ Given
$AC\to BBC$ Augmentation
$AC\to BC$ Simplification

Decomp	Pseudo	Trans
$A\to B$	$AD\to E$	$BC\to A$
$A\to C$	$E\to B$	
$CD\to E$	$E\to C$	
$B\to D$	$BC\to E$	
$E\to A$	$AB\to E$	

$BC\to E$ Computed FD
$BBC\to BE$ Augment B, clear left B
$A\to B \wedge AB\to BE$ Pseudotransitivity
$AC\to BE$ Result

2. Show $B\to E$

If $B\to E \wedge E\to C$ then $B\to C$ and aug D
$BD\to CD \wedge CD\to E$ then $BD\to E$
$BD\to E \wedge B\to D$ then $B\to E$

$\Rightarrow$ Circular Logic, not valid FD

b) $F=\{AB\to E, AC\to F, BEF\to D\}$

$ABC\to CE$ $ABC\to BF$ Augment B & C to 1st, 2nd FDs
$ABC\to ABCEF$ Union 1st & 2nd FDs
$ABC\to BEF\to D$ (A) (C) $\to$ ABC is candidate key

c) $F=\{AB\to C, BC\to D, ACD\to B, D\to EF, BE\to C\}$

$BC\to D \wedge D\to EF$ $= BC\to EF$
$AB(C)\to C \wedge (A)BC\to (A)D$ $= ABC\to ACD$ or $ABC\to D$
$ABC\to D \wedge D\to EF$ $= ABC\to EF$
$B(C)E\to C \wedge BC(E)\to D(E)$ $= BCE\to CDE$ or $BCE\to D$
$AB(C)E\to D(E) \wedge (ABCE\to (A)D$ $= ABCE\to ADE$ or $ABCE\to D$

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Question 2

a) $F = \{A \to B, AB \to C, D \to ACE, C \to E\}$

$G = \{A \to BCE, B \to \emptyset, C \to E, D \to ABCE, E \to \emptyset\}$

$A^+ = ABCE$
$B^+ = B$
$C^+ = CE$
$D^+ = ABCDE$
$E^+ = E$

Finding the closure of each attribute in the relation F, removed the special case of the reflexivity rule (Ex. $A \to A$), subbed into G.

b) $F = \{AB \to C, C \to D, BD \to E, D \to A\}$

$ACF^+ = ACF + D = ACDF \Rightarrow$ Does not functionally determine E
$DF^+ = DF + A = ADF \Rightarrow$ Does not functionally determine E
$AB^+ = AB + C + D + E = ABCDE \Rightarrow$ Functionally determines E

c) $F = \{AB \to C, C \to D, BD \to E, D \to A\}$

$A \to BC$ cannot be logically implied
Proof by calculating closure
$A^+ = A \Rightarrow$ A only implies itself & null.
Counterexample:

d) $F = \{A \to B, B \to G, AC \to D, DF \to E, FG \to BH\}$ BDE G4
ACF is the candidate Key since the attributes of it are not implied by any other

e) $F = \{A \to BC, CD \to E, B \to D, E \to A\}$
$ACE^+ = ACE \subseteq (A \subseteq ACE) = ABCE = (CD \subseteq ABCE) = (B \subseteq ABCE) = ABCDE$
$= (CD \subseteq ABCDE) = ABCDE$
$ACE^+ = ABCDE$

f) $F^+ = F = \{A \to B, A \to A, A \to AB, AB \to B, AB \to AB, AC \to BC, AC \to AC, AC \to ABC, AB \to BC, ABC \to ABC, B \to B, C \to C\} \Rightarrow$ 12 FDs

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Question 3 a) $F = \{A \to DE, BCE \to EG, E \to C, DG \to EF\}$

Left side reduction

$BCE \to EG$

$CE^+ = CE$ ⇒ Cannot remove B
$BE^+ = BCEG$ ⇒ Remove C ⇒ $BE \to EG$
$B^+ = B$ ⇒ Cannot remove E

$DG \to ER$

$G^+ = G$ ⇒ Cannot remove D ⇒ $DG \to ER$
$D^+ = D$ ⇒ Cannot remove G

Right side Reduction

$BE \to EG$

Ignoring $BE \to E$ $BE^+ = BEC$ ⇒ Remove E
Ignoring $BE \to G$ $BE^+ = BEC$ ⇒ Cannot remove G ⇒ $BE \to G$

$A \to DE$

Ignoring $A \to D$ $A^+ = ACE$ ⇒ Cannot remove D
Ignoring $A \to E$ $A^+ = AD$ ⇒ Cannot remove E

$DG \to EF$

Ignoring $DG \to E$ $DG^+ = DGF$ ⇒ Cannot remove E
Ignoring $DG \to F$ $DG^+ = DGE$ ⇒ Cannot remove F

$E \to C$

Ignoring $E \to C$ $E^+ = E$ ⇒ Cannot remove C

⇒ Minimal Cover of F is $F = \{A \to DE, BE \to G, E \to C, DG \to ER\}$

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~~CD→∅~~

~~CD→B~~ ~~CG→∅~~

Question 3 b) $F = \{AB \to C, C \to A, BC \to D, ACD \to B, D \to EG, BE \to C, CG \to BD, CE \to G\}$

LHS Reduction

$AB \to C$
- $A^+ = A \Rightarrow$ Cannot remove B
- $B^+ = B \Rightarrow$ Cannot remove A

$BC \to D$
- $B^+ = B \Rightarrow$ Cannot remove C
- $C^+ = AC \Rightarrow$ Cannot remove B

$ACD \to B$
- $CD^+ = CD + A + B + EG \Rightarrow$ Remove A
- $D^+ = DEG \Rightarrow$ Cannot remove C
- $C^+ = AC \Rightarrow$ Cannot remove D

$\Rightarrow CD \to B$

$BE \to C$
- $E^+ = E \Rightarrow$ Cannot remove B
- $B^+ = B \Rightarrow$ Cannot remove E

$CG \to BD$
- $G^+ = G \Rightarrow$ Cannot remove C
- $C^+ = AC \Rightarrow$ Cannot remove G

$CE \to G$
- $E^+ = E \Rightarrow$ Cannot remove C
- $C^+ = AC \Rightarrow$ Cannot remove E

RHS Reduction

$D \to EG$
- Ign $D \to G$: $D^+ = DE \Rightarrow$ Cannot remove G
- Ign $D \to E$: $D^+ = DG \Rightarrow$ Cannot remove E

$CG \to BD$
- Ign $CG \to B$: $CG^+ = ABCDG \Rightarrow$ Remove B
- Ign $CG \to D$: $CG^+ = ABCDG \Rightarrow$ Remove D

$\Rightarrow CG \to \emptyset$

$AB \to C$ Ign $AB \to C$: $AB^+ = AB \Rightarrow$ Cannot remove C

$C \to A$ Ign itself: $C^+ = C \Rightarrow$ Cannot remove A

$BC \to D$ Ignore itself: $BC^+ = ABC \Rightarrow$ Cannot remove D

$CD \to B$ Ign itself: $CD^+ = ABCDEG \Rightarrow$ Remove B $\Rightarrow CD \to \emptyset$

$BE \to C$ Ign itself: $BE^+ = BE \Rightarrow$ Cannot remove C

$CE \to G$ Ign itself: $CE^+ = ACE \Rightarrow$ Cannot remove G

$\Rightarrow$ Min Cover of $F = \{AB \to C, C \to A, BC \to D, D \to EG, BE \to C, CE \to G\}$

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Homework 4

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A→E

A→EF A→H

Question 3 a) F={A→BCD, AC→EF, AG→H, CD→FG}

LHS Reduction

AC→EF $C^+ = C$ ⇒ Cannot remove A
$A^+ = ABCDEFG$ ⇒ Remove C } → A→EF

AG→H $A^+ = ABCDEFG$ ⇒ Remove G } ⇒ A→H

CD→FG $C^+ = C$ ⇒ Cannot remove D
$D^+ = D$ ⇒ Cannot remove C

RHS Reduction

A→BCD Lyn A→B: $A^+ = ACDEFHG$ ⇒ Cannot remove B
Lyn A→C: $A^+ = ABDEFH$ ⇒ Cannot remove C
Lyn A→D: $A^+ = ABCEFH$ ⇒ Cannot remove D

A→EF Lyn A→E: $A^+ = ABCDFHG$ ⇒ Cannot remove E } A=E
Lyn A→F: $A^+ = ABCDEHFG$ ⇒ Remove F

CD→FG Lyn CD→F: $CD^+ = CDG$ ⇒ Cannot remove F
Lyn CD→G: $CD^+ = CDF$ ⇒ Cannot remove G

Min Cover of F = {A→B, A→C, A→D, A→E, A→H, CD→F, CD→G}

Standard Form = {A→B, A→C, A→D, A→E, A→H, CD→F, CD→G}

Question 4 a) F={CF→D, AE→F, D→A, AC→B}

Step 1: Isolated Attr: B

Step 2: Attr only on LHS: C, E

Step 3: Attr only on RHS: B,

Step 4: Union of 1 & 2: CE

Step 5: $CE^+ = CE \neq R$

Step 6: Attr on both sides: A, D, F

Step 7: $ACE^+ = ABCDEF = R$
$CDE^+ = ABCDEF = R$
$CEF^+ = ABCDEF = R$

Candidate Keys:

ACE
CDE
CEF

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Question 4b) $F = \{AB \to C, CD \to F, F \to A, CE \to D\}$

Step 1: Isolated Attr: $\emptyset$

Step 2: Attr only on LHS: B, E

Step 3: Attr only on RHS: $\emptyset$

Step 4: Union 1 ∩ 2: BE

Step 5: $BE^+ = BE \neq R$

Step 6: Attr both sides: ACDF

Step 7: $ABE^+ = ABCDEF = R$

$BCE^+ = ABCDEF = R$

$BDE^+ = BDE \neq R$

$BEF^+ = ABCDEF = R$

Candidate Keys

ABE
BCE
BEF

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