Table of Contents

Introduction

Complete this take-home exam using any resources you choose, except for any other person's help. ***Submit your solutions to the Blackboard exam assignment link as one file before Sunday, December 4, 2019 at 11:59pm.*** All components must be submitted as ONE PDF file that you attach in your assignment folder. No other formats will be accepted without prior permission. Please name the document cs425_e2_<alaska.edu email username>.pdf. For example, my submission would be called cs425_e2_jquan2.pdf

Exam solutions not meeting the format requirements will be penalized.

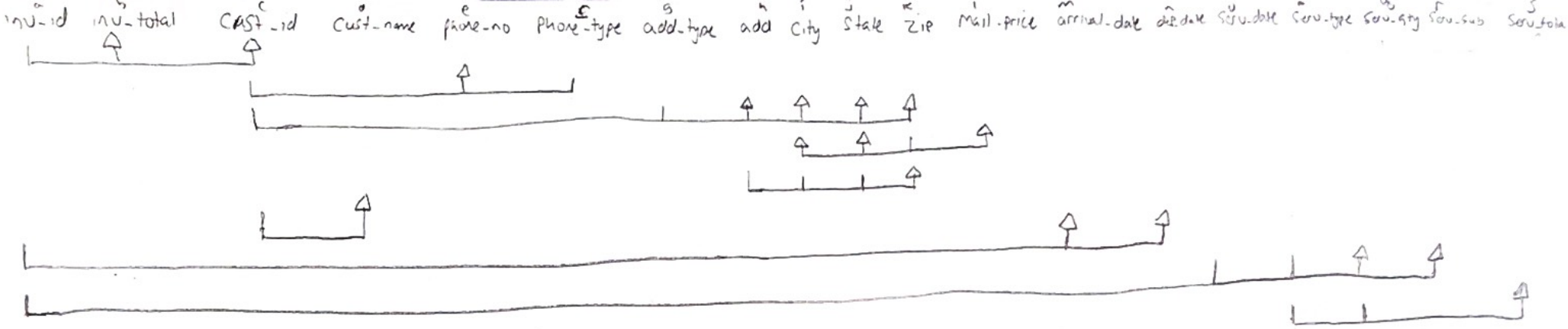
BE SURE TO READ THE ENTIRE EXAM FIRST

Personal Statement

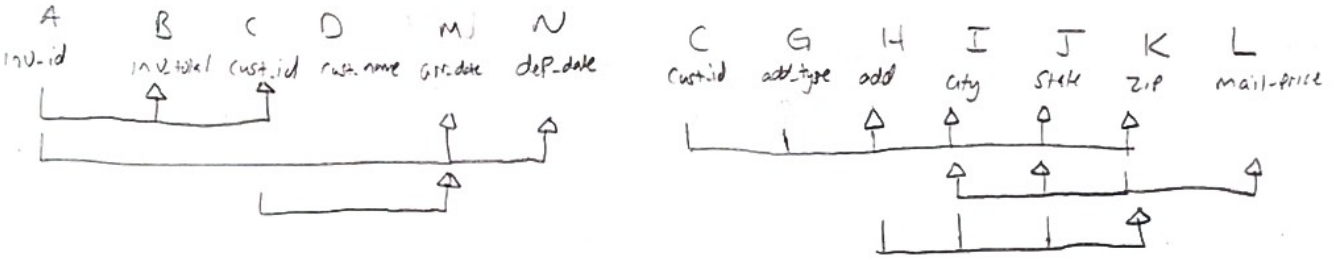
Turning in this exam to Blackboard constitutes your signature on the following statement.

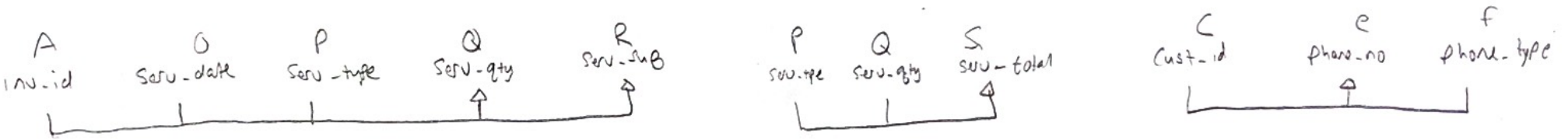
This exam presentation is my own work. I acknowledged any assistance I received in its preparation within the paper or presentation, in accordance with academic practice. If I used data, ideas, words, diagrams, pictures, or other information from any source, I have cited the sources fully and completely in footnotes and bibliography entries. This includes sources which I have quoted or paraphrased. In typing my name following the word "Signature," I intend that this certification will have the same authority and authenticity as a document executed with my handwritten signature.

Electronic Signature Chris McClure



1NF: This is in 1NF because there are no repeated, composite, or multiple values.





2NF: Many things are made up of parts of the primary key. Fixed by splitting anything that relies on part of the key into different tables.

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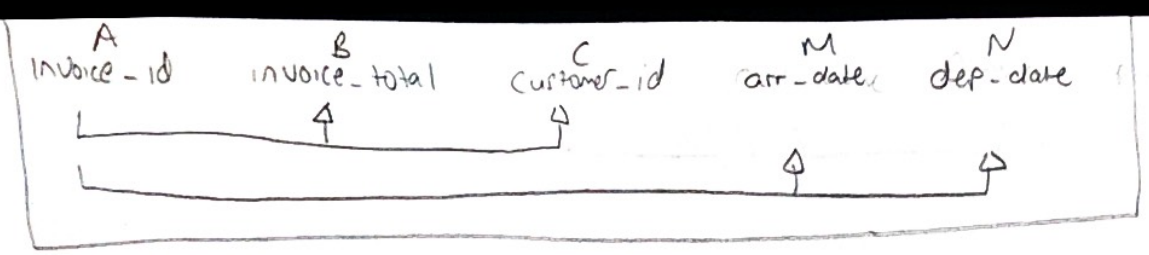

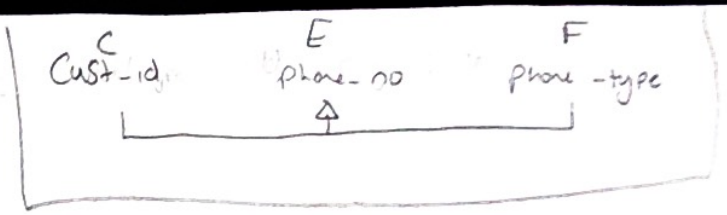

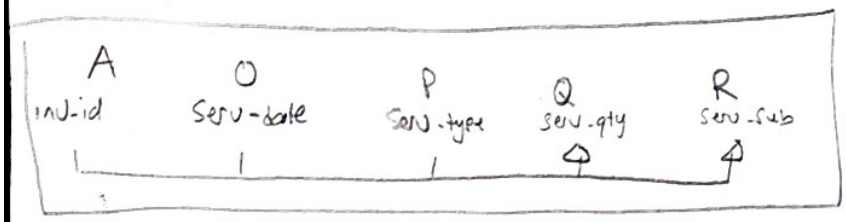

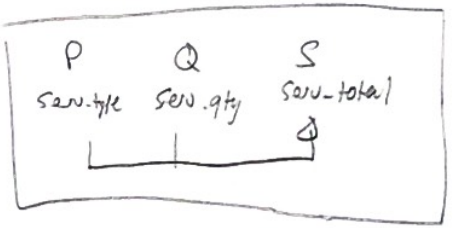

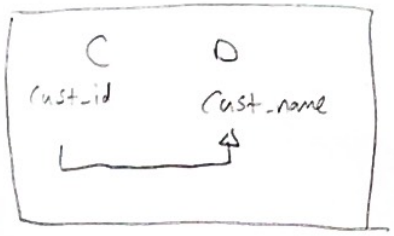

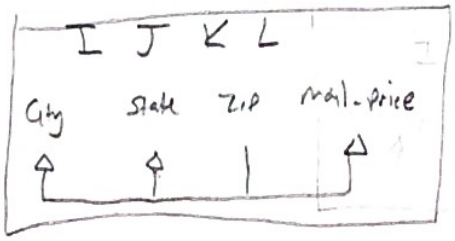

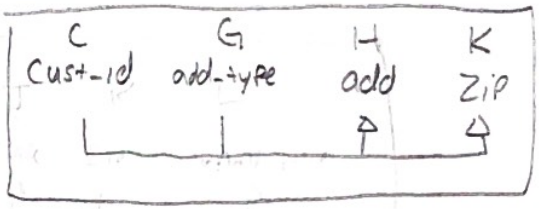

3NF, fixed by removing dependencies that didn't depend on the entire key and created new tables.

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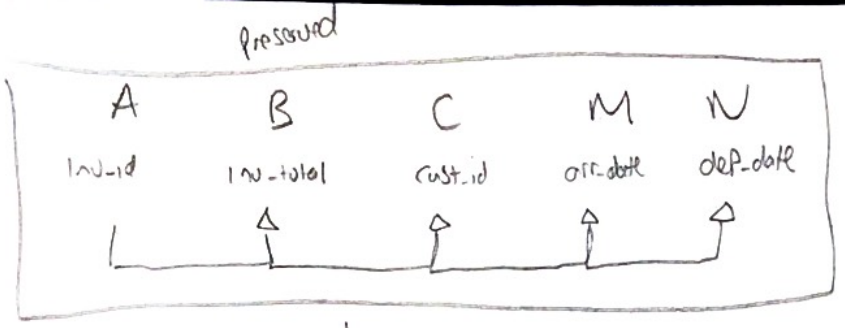

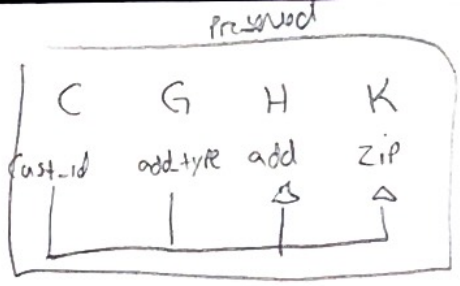

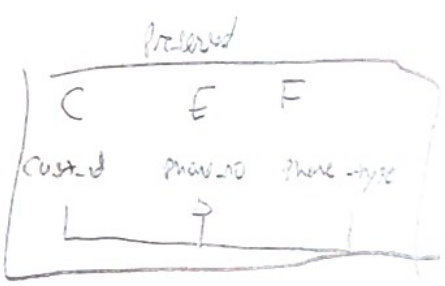

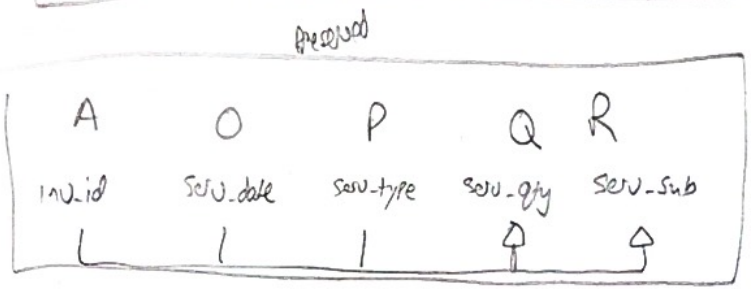

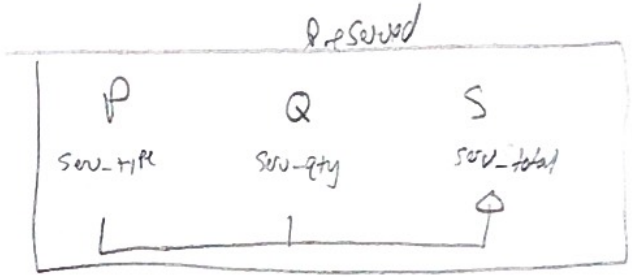

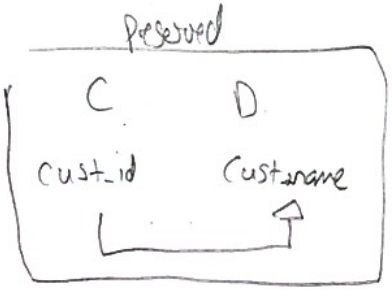

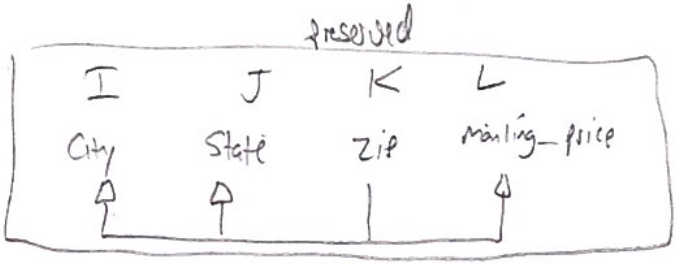

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Bernstein's Synthesis: $F = \{A \to B, A \to C, A \to M, A \to N, CF \to E, AOP \to Q, AOP \to R, PQ \to S, C \to D, K \to I, K \to J, K \to L, CG \to H, CG \to K\}$

Reduce LHS: $CF \to E$: $C^+ = CD$ $F^+ = F$; $AOP \to Q$: $A^+ = ABCMN$, $O^+ = O$, $P^+ = P$; $PQ \to S$: $P^+ = P$, $Q^+ = Q$; $CG \to H$: $C^+ = CD$, $G^+ \to G$

Check for redundancy:

$A \to B$	$A \to C$	$A \to M$	$A \to N$	$CF \to E$	$AOP \to Q$	$AOP \to R$	$PQ \to S$	$C \to D$	$K \to I$	$K \to J$	$K \to L$
A^+	A^+	A^+	A^+	CF^+	AOP^+	AOP^+	PQ^+	C^+	K^+	K^+	K^+
ACMN	ABMN	ABCN	ABCM	CDF	ABCMNOPR	ABCMNOPQS	PQ	C	JL	IL	IJ

$CG \to H$: CG^+ = CGKD

$CG \to K$: CG^+ = CGHD

Left	Middle	Right	prime	nonprime
AFOPRG	CQK	BMNERSD IJLH		

$R_1(\underline{A}B)$ $R_2(\underline{A}C)$ $R_3(\underline{A}M)$ $R_4(\underline{A}N)$ } $S(\underline{A}BCMN)$

$R_5(\underline{CF}E)$ $R_1(\underline{C}FE)$

$R_6(\underline{AOP}Q)$ $R_7(\underline{AOP}R)$ } $T(\underline{AOP}QR)$

$R_8(\underline{PQ}S)$ $R_2(\underline{PQ}S)$

$R_9(\underline{C}D)$ $R_3(\underline{C}O)$

$R_{10}(\underline{K}I)$ $R_{11}(\underline{K}J)$ $R_{12}(\underline{K}L)$ } $U(\underline{K}IJL)$

$R_{13}(\underline{CG}H)$ $R_{14}(\underline{CG}K)$ } $V(\underline{CG}HK)$

$R_{15}(\underline{AFGOP})$ $R_4(\underline{AFGOP})$

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
S	a	a	a										a	a					
R_1			a		a	a													
T	a													a	a		a	a	
R_2																a	a		a
R_3			a	a															
U									a	a	a	a							
V		a					a	a			a								
R_4	a	a_1	a_2	a_3	a	a	a	a_4	a_7	a_6	a_5	a_8	a_9	a_{10}	a	a	a_{11}	a_{12}	a_{13}

Lossless!

Dependencies are preserved by observation.

1.) R(ABCDE)

F = {A → B, C → D}

Z = ABCDE

(R - BC) = ADE⁺ = ADEB

Y = ABDE

(R - BD) = AE⁺ = AEB

Y = ABE

(R - BE) = A⁺ = AB

Y = AB $R_1(AB)$

Z = ACDE

(R - AD) = CE⁺ = CED

Y = CDE

(R - DE) = C⁺ = CD

Y = CD $R_2(CD)$

Z = ACE $R_3(ACE)$

L	M	R	P	NP
AC		BD	AC	BD

$\frac{A^+}{AB}$ $\frac{C^+}{CD}$ $\frac{AC^+}{ABCD}$

	A	B	C	D	E
R_1	a	a			
R_2			a	a	
R_3	a	a_1	a	a_2	a

A → B ∈ R_1, C → D ∈ R_2

Lossless! Dependencies are preserved by observation

2.) R(ABC) F = {AB → C, B → C}

Reduce LHS: $\frac{A^+}{A}$ $\frac{B^+}{BC}$

F' = {B → C}

Z = ABC

(R - AC) = B⁺ = BC

Y = BC $R_1(BC)$

Z = AB $R_2(AB)$

L	M	R	P	NP
B		C	B	C

	A	B	C
R_1		a	a
R_2	a	a	a_1

B → C ∈ R_1

Lossless! Dependencies are preserved by observation.

3) R(ABCDE) F = {D → B, CE → A}

Z = ABCDE

(R - AB) = CDE⁺ = CDEB

Y = BCDE

(R - BC) = DE⁺ = DEB

Y = BDE

(R - BE) = D⁺ = DB

Y = DB $R_1(DB)$

Z = ACDE

(R - AD) = CE⁺ = CEA

Y = ACE

(R - AC) = E⁺ = E

(R - AE) = C⁺ = C

(R - CE) = A⁺ = A

} no violations!

$R_2(ACE)$

Cont'd

3) Z = CDE $R_2R_3(CDE)$

(R₁ - CD) = E⁺ = E

(R - CE) = D⁺ = D

(R - DE) = C⁺ = C

L	M	R	P	NP
DCE		BA	DCE	BA

$R_2(DB)$ $R_3(CDE)$

$R_1(ACE)$

	A	B	C	D	E
R_1	a		a		a
R_2		a		a	
R:	a_2	a_1	a	a	a

D → B ∈ R_1

D → B ∈ R_2

lossless! Dependencies CE → A ∈ R_2 are preserved by observation.

4) R(ABCDE) F = {A → DE, BC → A, DE → B}

Z = ABCDE

(R - BE) = ACD⁺ = ACDE

Y = ACDE

(R - CE) = AD⁺ = ADE

Y = ADE

(R - DE) = A⁺ = AE

Y = AE $R_1(AE)$

Z = ABCD

(R - AD) = BC⁺ = BCA

Y = ABC

(R - AB) = C⁺ = C

(R - AC) = B⁺ = B

(R - BC) = A⁺ = AE

} no violations!

$R_2(ABCD)$

Cont'd

$R_1(AE)$ $R_2(ABCD)$

L	M	R	P	NP
CD	ABE		DEC	AB

$\frac{BC^+}{BCDE}$ $\frac{DEC}{DECBA}$

	A	B	C	D	E
R_1	a				a
R_2	a	a	a	a	a_1

Lossless, missing DE → B

Z = DE

$Z_{R_1} = (Z \cap R_1) = DE \cap AE = E$

$Z_{R_1} = Z_{R_1}^+ = \frac{E^+}{E} = E$

$Z_{R_1} = (Z_{R_1} \cap R_1) = E \cap AE = E$

$Z = (Z_{R_1} \cup Z) = E \cup DE = DE$

$Z_{R_2} = (Z \cap R_2) = DE \cap ABCD = D$

$Z_{R_2} = Z_{R_2}^+ = \frac{D^+}{D} = D$

$Z_{R_2} = (Z_{R_2} \cap R_2) = D \cap ABCD = D$

$Z = (Z_{R_2} \cup Z) = D \cup DE = DE$

Fail. DE → B is not preserved.

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5) R(ABCDEF) $F=\{A\to DB, C\to DAO, AE\to FC\}$

Reduce RHS:

$F'=\{A\to B, C\to A, C\to D, AE\to F, AE\to C\}$

$Z=ABCDEF$

$(R-\underline{BC}): ADEF^+ = ADEF\underline{B}$

$Y=ABDEF$

$(R-\underline{BD}): AEF^+ = AEF\underline{B}$

$Y=ABEF$

$(R-\underline{BE}): AF^+ = AF\underline{B}$

$Y=ABF$

$(R-\underline{BF}): A^+ = A\underline{B}$

$Y=AB$ $R_1(\underline{AB})$

L	M	R	P	NP
E	AC	DFB	AE	BCDF

AE^+

AECADBF

$Z=ACDEF$

$(R-\underline{AD}): CEF^+ = CEF\underline{A}$

$Y=ACEF$

$(R-\underline{AE}): CF^+ = CF\underline{A}$

$Y=ACF$

$(R-\underline{AF}): C^+ = C\underline{A}$

$Y=CA$ $R_2(\underline{CA})$

	A	B	C	D	E	F
R_1	a	a				
R_2	a		a			
R_3			a	a	a	a
R_4	a_1	a_3	a	a_2	a	a

Lossless! Missing AE→DF, AE→C

$Z=CDEF$

$(R-\underline{DE}): CF^+ = CF\underline{D}$

$Y=CDF$

$(R-\underline{DF}): C^+ = C\underline{D}$

$Y=CD$ $R_3(\underline{CD})$

$Z=CEF$

$(R-\underline{CE}): F^+ = F$

$(R-\underline{CF}): E^+ = E$

$(R-\underline{EF}): C^+ = CABD$

} no violations!

$R_4(\underline{CEF})$

$Z=AE$

$Z_{R_1}=(Z\cap R_1): AE\cap AB = A$

$Z^+_{R_1}=A^+_{R_1}=AB$

$Z_{R_1}=(Z_{R_1}\cap R_1): AB\cap AB = AB$

$Z=(Z\cup Z_{R_1}): AE\cup AB = ABE$

$Z=ABE$

$Z_{R_2}=(Z\cap R_2): ABE\cap CA = A$

$Z^+_{R_2}=A^+=AB$

$Z_{R_2}=(Z_{R_2}\cap R_2): AB\cap CA = A$

$Z=(Z\cup Z_{R_2}): ABE\cup A = ABE$

$Z=ABE$

$Z_{R_3}(Z\cap R_3): ABE\cap CD = \emptyset$

$Z_{R_4}(Z\cap R_4): ABE\cap CEF = E$

$Z^+_{R_4}=E^+=E$

$Z_{R_4}=(Z_{R_4}\cap R_4): E\cap CEF = E$

$Z=(Z\cup Z_{R_4}): ABE\cup CEF = ABCEF$ (find A!)

Preserved!

$A\to B \in R_1$

$C\to AD \in R_2, R_3$

6) R(ABCDE) $F=\{D\to B, CE\to A\}$

$Z=ABCDE$

$(R-\underline{AB}): CDE^+ = CDE\underline{B}$

$Y=BCDE$

$(R-\underline{BC}): DE^+ = DE\underline{B}$

$Y=BDE$

$(R-\underline{BE}): D^+ = D\underline{B}$

$Y=DB$ $R_1(\underline{DB})$

$Z=ACDE$

$(R-\underline{AD}): CE^+ = CE\underline{A}$

$Y=ACE$

$(R-AC): E^+ = E$

$(R-AE): C^+ = C$

$(R-CE): A^+ = A$

} no violations

$R_2(\underline{ACE})$

$Z=CDE$

$(R-CD): E^+ = E$

$(R-CE): D^+ = DB$

$(R-DE): C^+ = C$

$R_3(CDE)$

$R_1(DB)$ $R_2(ACE)$ $R_3(CDE)$

	A	B	C	D	E
R_1		a		a	
R_2	a		a		a
R_3	a_2	a_1	a	a	a

Lossless

$D\to B \in R_1$

$CE\to A \in R_2$

Preserved

7.) Duplicate problem

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