Decomposition

Goal

Eliminate redundancy by decomposing a relation into several relations in a higher normal forms.

Definition

Let R be a relation schema.

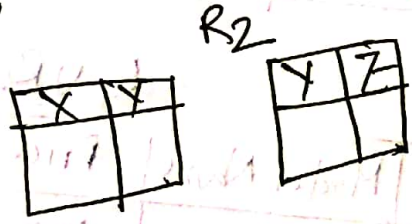
A set of relation schemas $(R_1, R_2, \ldots R_n)$ is a decomposition of R if

$$R = R_1 \cup R_2 \cup \ldots \cup R_n$$

Example Relation $R(X, Y, Z)$, there can be 2 subsets.

$R_1(X, Y)$

& $R_2(Y, Z)$



We get, $R = R_1 \cup R_2$

Problem With decomposition

While Reconstructing, we may not able to get original relation.

⇒ Information may loose.

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R

Model Name	Price	Category
a_{11}	100	Canon
S_{20}	200	Nikon
a_{20}	150	Canon

Table : 01

Model Name	Category
a_{11}	Canon
S_{20}	Nikon
a_{20}	Canon

Price	Category
100	Canon
200	Nikon
150	Canon

$R_1 \cup R_2$

Model Name	Price	Categor
a_{11}	100	Canon
a_{11}	150	Canon
S_{20}	200	Nikon
a_{20}	100	canon
a_{20}	150	Canon

Table : 02

* When Union operation is performed, The table we get is not similar to original table.
Thus information is lost.

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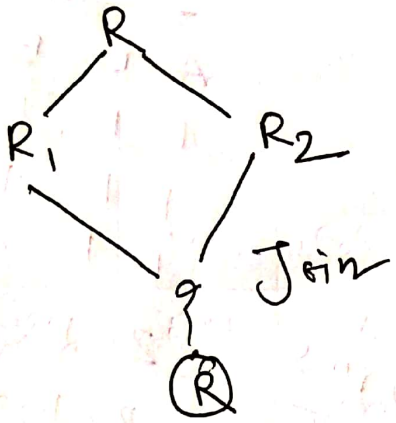
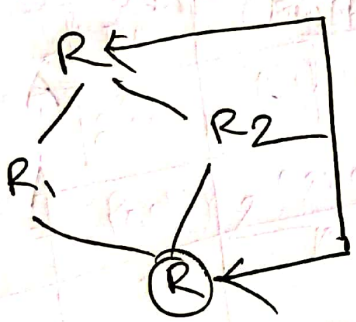
To Convert in a Relation into higher order NF, decomposition is performed



Lossless Join Decomposition

The decomposition of a relation R is said to be lossless Join decomposition if it is feasible to reconstruct the relation R from decomposed sub relations using joins.



with out loss

Ex

R (A B C)

1	1	1
2	1	2
3	2	1
4	3	2

⇒

R1 (A, B)

1	1
2	1
3	2
4	3

R2 (B, C)

1	1
1	2
2	1
3	2

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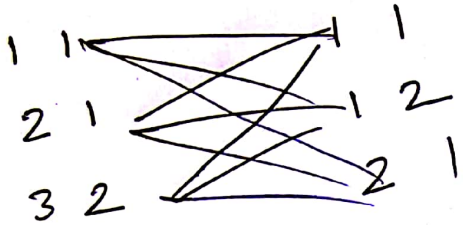
Cartesian Product or Natural Join

R_1 (A B) R_2 (B, C)



grows

$R_1 \times R_2$

A	B	B	C
1	1	1	1
1	1	1	2
1	1	2	1
2	1	1	1
2	1	1	2
2	1	2	1
3	2	1	1
3	2	1	2
3	2	2	1

$R_1 \bowtie R_2$

A	B	B	C
1	1	1	1
1	1	1	2
2	1	1	1
2	1	1	2
3	2	2	1

$R_1.B = R_2.B$

Resultant table $R_1 \bowtie R_2$

A	B	C
1	1	1
1	1	2
2	1	1
2	1	2
3	2	1

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Now, Our main example was

R(A, B, C)			R1(A, B)		R2(B, C)	
1	1	1	1	1	1	1
2	1	2	2	1	1	2
3	2	1	3	2	2	1
4	3	2	4	3	3	2

$\Rightarrow$

is this Relation Lossless Join decomposition?

$R_1 \bowtie R_2$

R1(A, B)		R2(B, C)		A	B	C
1	1	1	1	1	1	1
2	1	1	2	~~1~~	1	2
3	2	2	1	2	1	1
4	3	3	2	2	1	2
				3	2	1
				4	3	2

Lossy

(I) attribute(R_1) $\cup$ attribute(R_2) = attribute(R)

R_1 (A, B) R_2 (B, C)

(II) attribute(R_1) $\cap$ attribute(R_2) $\neq \phi$

[There must have common attribute]

(III) The Common attribute must be Super Key.

if the " " is a SK of any relation or both, the would be a Lossless decomposition.

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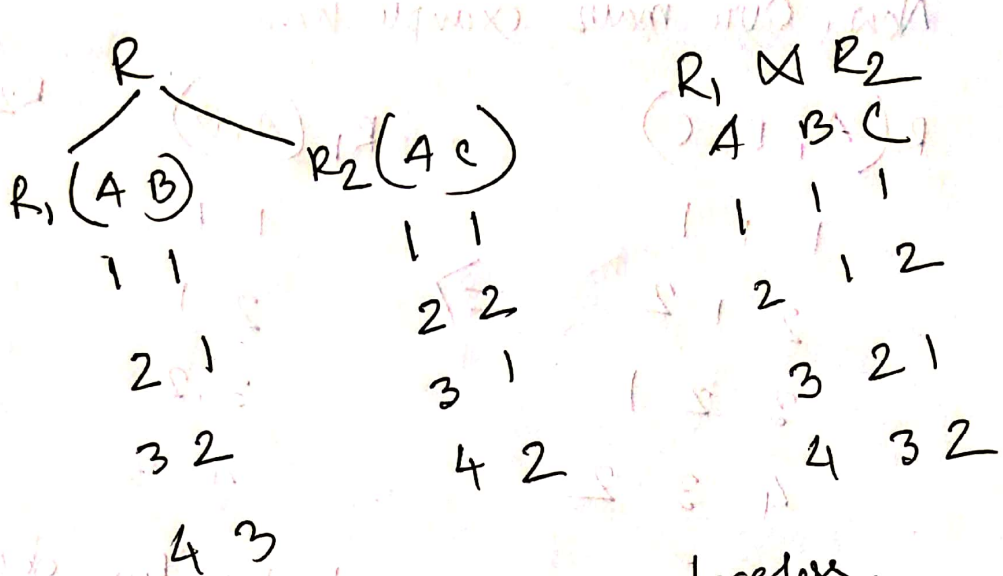

This decomposition is Lossless.

Here A is candidate Key. The dependency are

$A \rightarrow A$
$A \rightarrow B$ } A determine A & B.

if R is decomposed into R_1 & R_2 then decomposition is lossless if

(I) $att(R_1) \cup att(R_2) = att(R)$ ✓

(II) $att(R_1) \cap att(R_2) \neq \emptyset$ ✓

(III) $att(R_1) \cap att(R_2) \rightarrow att(R_1)$ ✓
or
$att(R_1) \cap att(R_2) \rightarrow att(R_2)$ ✓

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