MVD & 4NF

classes (course, teacher, book)

(cEb) ∈ classes

PB → t_1 DB_1

→ t_2 PB_2

course	teacher	book
DB	t_1	DB_1
DB	t_1	DB_2
DB	t_2	DB_1
DB	t_2	DB_2

key = courses, teacher, book

in a BCNF

Redundancy

Multivalued Dependency MVD

$\alpha, \beta \subseteq R$, $\alpha \twoheadrightarrow \beta$ holds on R, if

for all $t_1, t_2 \in r \Rightarrow t_1[\alpha] = t_2[\alpha]$.

$\exists\ t_3, t_4 \in R$ such that

$t_1[\alpha] = t_2[\alpha] = t_3[\alpha] = t_4[\alpha]$

$t_3[\beta] = t_1[\beta]$

$t_3[R-\beta] = t_2[R-\beta]$

$t_4[\beta] = t_2[\beta]$.

$t_4[R-\beta] = t_2[R-\beta]$

	α	β	$R-\alpha-\beta$	
t_1	a_1, a_2	a_3 a. a_4	a_5, a_6	$y_1 z_1$
t_2	a_1, a_2	b_3, b_4	b_5, b_6.	$y_2 z_2$
t_3	$a_1 a_2$	a_3, a_4	b_5, b_6	
t_4	a_1, a_2	b_3, b_4,	a_5, a_6	

Suppose R portioned into three subsets x, y, z

$x \twoheadrightarrow y$ iff

$\forall (x_1, y_1, z_1)$ & (x_1, y_2, z_2)

there is $=$ (x_1, y_1, z_2)

(x_1, y_2, z_1)

4NF

R is a Relation

D - functional & MV dependencies

$\forall \alpha \twoheadrightarrow \beta$, $\alpha, \beta \in R$.

atleast one of the following holds

* $\alpha \twoheadrightarrow \beta$ is trivial ($\beta \subseteq \alpha$ or $\alpha \cup \beta = R$)
* α is a superkey for R.

$R = \{A, B, C, G, H, I\}$

$D = \{ A \to B, B \to HI, CG \to H \}$

(1) $A \to\!\!\to B$: 4NF,

A is not a Key

Trivial :

$\alpha \to\!\!\to \beta$, $\beta \subset \alpha$ OR

$\alpha \cup \beta = R$

Decomposition :

$R_1 = (A, B)$

$R_2 = R - \{B\} = \{A, C, G, H, I\}$

$R_1 = (A, B)$, P_1 find from D^+ on R_1

$A \to\!\!\to B$. Trivial, so in 4NF [$\because A \cup B = R$].

Restriction of MVD :

$\alpha \to\!\!\to (\beta \cap R_i)$

where $\alpha \subseteq R_i$ and $\alpha \to\!\!\to \beta$ in D^+

$R_2 = \{A, C, G, H, I\}$

$D_2 = \{ CG \to H, \ldots \}$

Not trivial [$\because$

Not in 4NF

Decompose R_2 :

$(A \cup B \subseteq R)$

$R_3 = (C, G, H)$, $D_3 = \{ CG \to H \}$. Trivial, 4NF

$R_4 = R - \{H\} = \{A, C, G, I\}$. $D_4 =$

$A \to\!\!\to HI$ in D^+

$A \to\!\!\to I$ in D_4.

So, not in 4NF

Decompose :

Trivial,

$R_5 = (A\ I)$; $P_5 = \{ A \twoheadrightarrow I \}$, In 4NF,

$R_6 = R_4 - \{I\} = (A, C, G)$ $P_6 = \{\}$

4NF

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DBMS :

Disk structure :