



UNIVERSIDAD
SAN SEBASTIAN
VOCACIÓN POR LA EXCELENCIA

ICIFF004 - Databases

11 - Normal forms exercises

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Content

1. ICIFF004 - Databases

1. Previous lecture

Previous lecture

- Exam review
- Normalization
 - 1NF
 - 2NF
 - 3NF
- Mathematical properties of functional dependencies

What we will do today

We will do some exercises about normalization to 3NF

- Using Armstrong's axioms
- and from sample tables

Armstrong's Axioms

Let R be a relation schema and F a set of functional dependencies on R . The set of Armstrong's axioms is:

- **Reflexivity:** If $Y \subseteq X$, then $X \rightarrow Y$
- **Augmentation:** If $X \rightarrow Y$, then $XZ \rightarrow YZ$
- **Transitivity:** If $X \rightarrow Y$ and $Y \rightarrow Z$, then $X \rightarrow Z$
- **Union:** If $X \rightarrow Y$ and $X \rightarrow Z$, then $X \rightarrow jYZ$
- **Decomposition:** If $X \rightarrow YZ$, then $X \rightarrow Y$ and $X \rightarrow Z$
- **Pseudotransitivity:** If $X \rightarrow Y$ and $WY \rightarrow Z$, then $WX \rightarrow Z$
- **Combining:** If $X \rightarrow Y$ and $Z \rightarrow W$, then $XZ \rightarrow YW$

Example

Suppose a relational schema $R(A\ B\ C\ D\ E)$ and F the set of functional dependencies

$F: \{A \rightarrow B, B \rightarrow E, C \rightarrow D\}$

Then we can infer:

- $A \rightarrow E$

The minimal key for this schema is $\{A, C\}$. The reason is

- $A \rightarrow B \rightarrow E$
- $C \rightarrow D$

A and C are not related, and together they can determine all the attributes of the schema.

Exercise 1 (bonus 0.1)

Consider the relational schema $R(A\ B\ C\ D\ E\ F\ G)$ and the following set of functional dependencies:

$F: \{A \rightarrow B, ABCD \rightarrow E, EF \rightarrow G, EF \rightarrow H, ACDF \rightarrow EG\}$

Then:

- Determine the minimal key for the schema
- Determine in which normal form is the schema

Tip: First decompose the functional dependencies and later, remove the redundant ones.

Exercise 2 (bonus 0.1)

StudentID	City	Class	OfferingID	Term	Year	Grade	CourseID	CourseDescription
S1	SEATTLE	JUN	O1	FALL	2006	3.5	C1	Database
S1	SEATTLE	JUN	O2	FALL	2006	3.3	C2	Volleyball
S2	BOTHELL	JUN	O3	SPRING	2007	3.1	C3	Object-Oriented
S2	BOTHELL	JUN	O2	FALL	2006	3.4	C2	Volleyball

- Determine the set of functional dependencies
- Determine in which normal form is the schema
- Convert to NF3 if necessary

Thanks for your attention!