

Exercise 7

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1 Functional Dependencies and Normal Forms

1. Consider the relation schema program(showID, showName, date, time, genre), where all attributes are atomic, and the functional dependencies are:

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 \begin{array}{lll} \mathcal{F}_{program} \; = \; \{ & & \\ & showID & \rightarrow & showID, \; date, \; time, \\ & showName & \rightarrow & genre, \\ & date, \; time & \rightarrow & showName \\ & \} & \end{array}
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- a) Determine the set of all candidate keys $S_{program}$ for relation schema program.
- b) For each normal form (1NF, 2NF, 3NF, BCNF) check if the relation schema program is in that normal form. Explain your answer.
- c) Decomposition to next normal form:
 - (i) Show the minimal basis for the set of functional dependencies $\mathcal{F}_{program}$.
 - (ii) Decompose the relation schema into new relation schemas.
 - (iii) List the candidate keys of the decomposed relation schemas.
- d) We saw from the slide that output of 3NF synthesis algorithm guarantees recoverability and dependency preservation. Here, please check if the decomposition in (c) has recoverability by applying the condition we saw in slide p.296.
- 2. Consider $\mathcal{R}(A,B,C,D)$ and the following functional dependencies:

$$\mathcal{F}_{\mathcal{R}} = \{A \to BD, \ B \to C, \ C \to C, \ AB \to C, \ B \to D\}$$

Determine the minimal basis for the set of functional dependencies $\mathcal{F}_{\mathcal{R}}$.

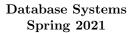
2 Multi-valued Dependencies and 4NF

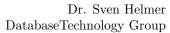
Consider the following relation instance R with the schema $\mathcal{R}(A,B,C,D)$.

R				
	A	В	С	D
c_1	Migros	Bern	Pasta	20
c_2	Coop	St. Gallen	Bratwurst & mustard	15
c_3	Migros	Zürich	Steak	30
c_4	Migros	Luzern	Pizza	22
c_4	Coop	Aarau	Lasagne	25
c_6	Manor	Bahnhofstr.	Rösti	26

The minimal basis for the set of functional dependencies $\mathcal{F}_{\mathcal{R}}$ of relation R is **empty** (i.e. $\mathcal{F}_{\mathcal{R}} = \{\}$).

a) Assume there is in addition to $\mathcal{F}_{\mathcal{R}}$ the multi-valued dependency (MVD) $A \rightarrow B$.







- (i) Which tuples must be added to the relation R such that the multi-valued dependency (MVD) $A \twoheadrightarrow B$ holds?
- (ii) Is the relation schema \mathcal{R} in 4NF? Explain your answer.
- b) Assume there is in addition to $\mathcal{F}_{\mathcal{R}}$ the multi-valued dependency (MVD) $AB \twoheadrightarrow CD$.
 - (i) Which tuples must be added to the relation R such that the multi-valued dependency (MVD) $AB \twoheadrightarrow CD$ holds?
 - (ii) Is the relation schema $\mathcal R$ in 4NF? Explain your answer.