B0B36DBS: **Database Systems**

Practical Class
Functional Dependencies

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Exercise 1

Let us have the following relational schema

- $A = \{\mathtt{A}, \mathtt{B}, \mathtt{C}\}$ is a set of attributes
- $F = \{\mathtt{A} \to \mathtt{B}\}$ is a set of functional dependencies

Calculate the **closure** of F

Exercise 2

Let us have two relational schemata with the same set of attributes $A = \{\texttt{A}, \texttt{B}, \texttt{C}, \texttt{D}, \texttt{E}\}$ but two different sets of dependencies

- $F = \{\texttt{A} \rightarrow \texttt{C}, \texttt{BC} \rightarrow \texttt{D}, \texttt{C} \rightarrow \texttt{E}, \texttt{E} \rightarrow \texttt{A}\}$
- $G = \{\texttt{A} \rightarrow \texttt{CE}, \texttt{C} \rightarrow \texttt{A}, \texttt{E} \rightarrow \texttt{AE}, \texttt{AB} \rightarrow \texttt{D}\}$

Is F a **cover** of G?

- Use Armstrong's axioms only (not attribute closures)

Exercise 3

Assume we have a relational schema

- $A = \{\texttt{A}, \texttt{B}, \texttt{C}, \texttt{D}, \texttt{E}\}$
- $F = \{\texttt{AC} \rightarrow \texttt{B}, \texttt{E} \rightarrow \texttt{B}, \texttt{D} \rightarrow \texttt{C}, \texttt{AC} \rightarrow \texttt{E}, \texttt{E} \rightarrow \texttt{AC}\}$

Are the following **dependencies redundant**?

- $\texttt{AC} \rightarrow \texttt{B}$
- $\texttt{E} \rightarrow \texttt{B}$
- Use Armstrong's axioms only (not attribute closures)

Exercise 4

Let us have a relational schema

- $A = \{\texttt{A}, \texttt{B}, \texttt{C}, \texttt{D}, \texttt{E}, \texttt{F}\}$
- $F = \{\texttt{AB} \rightarrow \texttt{D}, \texttt{A} \rightarrow \texttt{CE}, \texttt{F} \rightarrow \texttt{F}, \texttt{C} \rightarrow \texttt{A}, \texttt{E} \rightarrow \texttt{AE}\}$

Calculate the following **attribute closures**

- $\{\texttt{A}\}^+$
- $\{\texttt{F}\}^+$
- $\{\texttt{B}, \texttt{C}\}^+$
- $\{\texttt{A}, \texttt{B}, \texttt{F}\}^+$

Exercise 5

Let us have two sets of functional dependencies for a schema with attributes $A = \{A, B, C, D, E, F\}$

- $F = \{A \rightarrow BEF, BC \rightarrow DE, BDE \rightarrow F, ADF \rightarrow CE, E \rightarrow CBD\}$
- $G = \{A \rightarrow B, AB \rightarrow E, AD \rightarrow C, BC \rightarrow E, BCE \rightarrow FD,$
  $E \rightarrow C, CE \rightarrow B\}$

Is F a **cover** of G?

Exercise 6

Let us have a relational schema

- $A = \{A, B, C, D\}$
- $F = \{A \rightarrow C, B \rightarrow A, D \rightarrow AB, B \rightarrow C, D \rightarrow C\}$

Find and remove all **redundant dependencies**

Exercise 7

Let us have a relational schema

- $A = \{\mathtt{A}, \mathtt{B}, \mathtt{C}, \mathtt{D}, \mathtt{E}, \mathtt{F}\}$
- $F = \{\mathtt{AB} \rightarrow \mathtt{D}, \mathtt{A} \rightarrow \mathtt{CE}, \mathtt{C} \rightarrow \mathtt{A}, \mathtt{E} \rightarrow \mathtt{AE}, \mathtt{F} \rightarrow \mathtt{B}, \mathtt{BCEF} \rightarrow \mathtt{A}\}$

Find and remove **redundant attributes** in the following functional dependencies

- $\mathtt{AB} \rightarrow \mathtt{D}$
- $\mathtt{BCEF} \rightarrow \mathtt{A}$

Exercise 8

Let us have a relational schema

- $A = \{\texttt{A}, \texttt{B}, \texttt{C}, \texttt{D}, \texttt{E}\}$
- $F = \{\texttt{ABC} \rightarrow \texttt{DE}, \texttt{BC} \rightarrow \texttt{A}, \texttt{DE} \rightarrow \texttt{B}, \texttt{CE} \rightarrow \texttt{AB}\}$

Find a **minimal cover** of F

Exercise 9

Let us have a relational schema

- $A = \{\texttt{A}, \texttt{B}, \texttt{C}, \texttt{D}, \texttt{E}, \texttt{F}, \texttt{G}\}$
- $F = \{\texttt{AB} \rightarrow \texttt{C}, \texttt{C} \rightarrow \texttt{A}, \texttt{BC} \rightarrow \texttt{D}, \texttt{ACD} \rightarrow \texttt{B}, \texttt{D} \rightarrow \texttt{EG},$
  $\texttt{BE} \rightarrow \texttt{C}, \texttt{CG} \rightarrow \texttt{BD}, \texttt{CE} \rightarrow \texttt{AG}\}$

Find a **minimal cover** of F

Exercise 10

Let us have a relational schema

- $A = \{A, B, C, D, E, F, G, H\}$
- $F = \{AB \rightarrow H, EB \rightarrow C, CB \rightarrow A, C \rightarrow F, F \rightarrow G, A \rightarrow EC, E \rightarrow D\}$

Find a **minimal cover** of F

Exercise 11

Let us have a relational schema

- $A = \{\mathtt{A}, \mathtt{B}, \mathtt{C}, \mathtt{D}, \mathtt{E}\}$
- $F = \{\mathtt{BC} \rightarrow \mathtt{DE}, \mathtt{DE} \rightarrow \mathtt{B}, \mathtt{CE} \rightarrow \mathtt{B}\}$

Find any **key**

Exercise 12

Find **all keys** for the previous schema, i.e. for a schema

- $A = \{A, B, C, D, E\}$
- $F = \{BC \rightarrow DE, DE \rightarrow B, CE \rightarrow B\}$

Exercise 13

Let us have a relational schema

- $A = \{\texttt{A}, \texttt{B}, \texttt{C}, \texttt{D}, \texttt{E}, \texttt{F}\}$
- $F = \{\texttt{AB} \rightarrow \texttt{C}, \texttt{C} \rightarrow \texttt{D}, \texttt{DEF} \rightarrow \texttt{B}, \texttt{DA} \rightarrow \texttt{EB}\}$

Find **all keys**

Exercise 14

Let us have a relational schema

- $A = \{B, C, D, E\}$
- $F = \{BC \rightarrow DE, DE \rightarrow B, CE \rightarrow B\}$
- Keys are CE and BC

Determine a **normal form** of this schema