

Courses B0B36DBS, A7B36DBS: **Database Systems**

Practical Classes 10 and 11:

# **Functional Dependencies**

**Martin Svoboda**

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Faculty of Electrical Engineering, Czech Technical University in Prague

# Exercise 1

- Let us have the following relational schema
  - $A = \{A, B, C\}$  is a set of attributes
  - $F = \{A \rightarrow B\}$  is a set of functional dependencies
- Calculate the **closure** of  $F$

## Exercise 2

- Let us have a relational schema with attributes  $\{A, B, C, D, E\}$  and two different sets of functional dependencies
  - $F = \{A \rightarrow C, BC \rightarrow D, C \rightarrow E, E \rightarrow A\}$
  - $G = \{A \rightarrow CE, C \rightarrow A, E \rightarrow AE, AB \rightarrow D\}$
- Is  $F$  a **cover** of  $G$ ?
  - Use Armstrong's axioms only (not attribute closures)

# Exercise 3

- Assume we have a relational schema
  - $A = \{A, B, C, D, E\}$
  - $F = \{AC \rightarrow B, E \rightarrow B, D \rightarrow C, AC \rightarrow E, E \rightarrow AC\}$
- Are the following **dependencies redundant**?
  - $AC \rightarrow B$
  - $E \rightarrow B$
  - Use Armstrong's axioms only (not attribute closures)

# Exercise 4

- Let us have a relational schema
  - $A = \{A, B, C, D, E, F\}$
  - $F = \{AB \rightarrow D, A \rightarrow CE, F \rightarrow F, C \rightarrow A, E \rightarrow AE\}$
- Compute the following **attribute closures**
  - $\{A\}^+$
  - $\{F\}^+$
  - $\{B, C\}^+$
  - $\{A, B, F\}^+$

# Exercise 5

- Let us have two sets of functional dependencies for a schema with attributes  $\{A, B, C, D, E, F\}$ 
  - $F = \{A \rightarrow BEF, BC \rightarrow DE, BDE \rightarrow F, ADF \rightarrow CE, E \rightarrow CBD\}$
  - $G = \{A \rightarrow B, AB \rightarrow E, AD \rightarrow C, BC \rightarrow E, BCE \rightarrow FD, E \rightarrow C, CE \rightarrow B\}$
- 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 all **redundant dependencies**

# Exercise 7

- Let us have a relational schema
  - $A = \{A, B, C, D, E, F\}$
  - $F = \{AB \rightarrow D, A \rightarrow CE, C \rightarrow A, E \rightarrow AE, F \rightarrow B, BCEF \rightarrow A\}$
- Find **redundant attributes** within the following functional dependencies
  - $AB \rightarrow D$
  - $BCEF \rightarrow A$



# Exercise 8

- 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**

# Exercise 9

- Let us have a relational schema
  - $A = \{A, B, C, D, E\}$
  - $F = \{ABC \rightarrow DE, BC \rightarrow A, DE \rightarrow B, CE \rightarrow AB\}$
- Find a **minimal cover**

# Exercise 10

- Let us have a relational schema
  - $A = \{A, B, C, D, E, F, G\}$
  - $F = \{AB \rightarrow C, C \rightarrow A, BC \rightarrow D, ACD \rightarrow B, D \rightarrow EG, BE \rightarrow C, CG \rightarrow BD, CE \rightarrow AG\}$
- Find a **minimal cover**

# Exercise 11

- Let us have a relational schema
  - $A = \{A, B, C, D, E\}$
  - $F = \{BC \rightarrow DE, DE \rightarrow B, CE \rightarrow B\}$
- 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
  - $A = \{A, B, C, D, E, F\}$
  - $F = \{AB \rightarrow C, C \rightarrow D, DEF \rightarrow B, DA \rightarrow EB\}$
- 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