

B0B36DBS, BD6B36DBS: **Database Systems**

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Practical Classes 11 and 12

# Functional Dependencies

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# 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 two relational schemata with the same set of attributes  $A = \{A, B, C, D, E\}$  but two different sets of 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

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

Calculate 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  $A = \{A, B, C, D, E, F\}$

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

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

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

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

- $AB \rightarrow D$
- $BCEF \rightarrow A$



# Exercise 8

Let us have a relational schema

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

Find a **minimal cover** of  $F$

# Exercise 9

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** 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

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

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