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