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Level: 2 LMD
Module: DataBase

Directed Work 3

Objective:

The objective is to explore functional dependencies, Armstrong's axioms, elementary functional dependencies, transitive closure, attribute closure, keys, covers, and minimal covers.

Exercise 1

1. Consider the relational schema R(A, B, C, D, E) and the following set of functional dependencies:
   1. **A → BC**
   2. **B → C**
   3. **AC → D**
   4. **D → E**
   5. **A → D**

   Rewrite these functional dependencies to elementary functional dependencies

2. Consider the relational schema R(A, B, C, D, E) with the following functional dependencies:
   1. **A → BC**
   2. **B → D**
   3. **CD → E**

   Verify whether **A →** E holds using Armstrong's axioms. Justify your answer.

3. Let F be the following set of functional dependencies:
   F = { AB → C; B → D; CD → E; CE → GH; G → A }.

   Using **Armstrong's axioms** and the **attribute closure** method, demonstrate that the following functional dependencies can be deduced from F:

   1. **AB → E**
   2. **BG → C**
   3. **AB → G**

Exercise 2

Let us consider the schema of the following relation: R(A, B, C, D, E).
This relation is defined extensionally by the following tuples:

A	B	C	D	E
a1	b2	c2	d3	e2
a1	b2	c2	d1	e4
a2	b3	c2	d1	e5
a2	b4	c5	d1	e5

1. Among the following functional dependencies, which ones apply to the extension of R?
   E→D, E→A, {A,E}→C
   D→E, B→C, {A,E}→D
   E→B, B→A, {A,B}→A

2. Determine, among the following attribute groups, which ones are candidate keys or superkeys in R based on the given extension.

A	C	E	{A,B,E}	{B,E}
B	D	{A,D}	{C,D}	{A,B,C,D,E}

Exercise 3

Let's denote the set of functional dependencies as:
$F = \{ A \rightarrow B, \quad B \rightarrow C, \quad AC \rightarrow D, \quad D \rightarrow E \}$

1. Compute A^+, B^+, AC^+, D^+
2. Compute F^+ (transitive closure)

Exercice 4 :

Let R(A, B, C, D, E, F) be a relation with the following set of functional dependencies:
$F = \{ A \rightarrow B, B \rightarrow C, AC \rightarrow D, D \rightarrow E, CE \rightarrow F \}$

Questions:

1. Compute the closure of attribute A, A^+.
   Compute the closure of the set {A, C}, $(AC)^+$.
2. By applying Armstrong's axioms—particularly transitivity—derive all non-trivial functional dependencies from F, thereby identifying any additional dependencies that form part of F^+.
3. Determine whether the set AC is a key for relation R (i.e., whether $(AC)^+ = \{A, B, C, D, E, F\}$).
4. Based on your results, identify all possible minimal keys for R.

Exercise 5

Let R(A,B,C,D,E)) be a relational schema, and let the following sets of functional dependencies be given:

F1={A→B,B→C,A→C,C→D,AD→E}

F2={A→B,B→C,A→D,A→E}

Tasks:

1. Determine whether F1 is a cover of F2
2. Determine whether F2 is a cover of F1
3. Check if F1 and F2 are equivalent:

Exercise 6

Let the relation R(A,B,C,D,E,F) be given with the set of functional dependencies:

F={AC→D,B→AF,C→BE,F→EC}

Find an irreducible equivalent (Minimal Cover) of this set of functional dependencies.