



# Assignment 1

## CMPUT 391 sections B1 & B2

### Winter 2004

Assignment due in class on *January 23, 2004*.

Penalties for late submission: 20% off per late day. Assignment counts for 5% overall

---

#### Question 1

- A) The definition of functional dependencies does not preclude the case in which the left-hand side is empty—that is, it allows FDs of the form  $\{\} \rightarrow A$ . Explain the meaning of such dependencies. Give an example of such a table.
- B) Assume a table with only one attribute  $A$  and the functional dependency  $\{\} \rightarrow A$ , what would be the key of such a relation? Give a concrete example of such a table.

#### Question 2

Prove the following generalized transitivity rule: If  $Z \subseteq Y$ , then  $(X \rightarrow Y \text{ and } Z \rightarrow W)$  entail  $X \rightarrow W$ . Prove this rule in two ways:

- Using the argument that directly appeals to the definition of FDs, as in Section 8.4
- By deriving  $X \rightarrow W$  from  $X \rightarrow Y$  and  $Z \rightarrow W$  via a series of steps using Armstrong's axioms.

#### Question 3

Given the relation  $R$  with attributes  $A, B, C, D$ , and  $E$ , and given the following functional dependencies:  $F = \{A \rightarrow CD, BC \rightarrow E, C \rightarrow A\}$ , Find all the candidate keys. Justify that they are candidate keys and the only candidate keys.

#### Question 4

Consider a database schema with attributes  $A, B, C, D$ , and  $E$  and functional dependencies  $B \rightarrow E, E \rightarrow A, A \rightarrow D$ , and  $D \rightarrow E$ . Prove that the decomposition of this schema into  $AB, BCD$ , and  $ADE$  is lossless. Is it dependency preserving?

#### Question 5

Consider the following functional dependencies over the attribute set  $ABCDEFGH$ :

$A \rightarrow E$	$BE \rightarrow D$
$AD \rightarrow BE$	$BDH \rightarrow E$
$AC \rightarrow E$	$F \rightarrow A$
$E \rightarrow B$	$D \rightarrow H$
$BG \rightarrow F$	$CD \rightarrow A$

Find a minimal cover, then decompose into lossless 3NF. After that, check if all the resulting relations are in BCNF. If you find a schema that is not, decompose it into a lossless BCNF. Explain all steps.