

## COMP5112. Tutorial 11: Database normalization

*The following questions are adapted from “Database System Concepts”.*

### Question 1.

You are given the following set  $F$  of functional dependencies for relation schema  $R = (A, B, C, D, E)$ .

- $A \rightarrow BC$
- $CD \rightarrow E$
- $B \rightarrow D$
- $E \rightarrow A$

**1.1. Compute** the attribute set closures  $A^+$ ,  $B^+$ ,  $C^+$ ,  $D^+$ ,  $E^+$ .

**1.2. Check** whether  $BC$  is a candidate key for  $R$ .

**1.3. Find** all the candidate keys for  $R$ .

### Solution of 1.1:

<i>Attribute set</i>	<i>Steps for computing the attribute set closure</i>	<i>Attribute set closure</i>
A		$A^+ =$
B		$B^+ =$
C		$C^+ =$
D		$D^+ =$
E		$E^+ =$

### Solution of 1.2:

### **Solution of 1.3:**

First, we consider size-1 keys.

[ *Hint*: consider the solution of 1.1 ]

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Next, we consider size-2 keys.

[ *Hint*: What kind of size-2 keys cannot be candidate keys?

For the remaining size-2 keys, how to check whether they are candidate keys? ]

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Next, we consider size-3 keys.

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In summary, the candidate keys are .....

**Question 2.**

Suppose that the relation schema  $R=(A, B, C, D, E)$  satisfies the following functional dependencies:

- $A \rightarrow BC$
- $CD \rightarrow E$
- $B \rightarrow D$
- $E \rightarrow A$

**2.1. Show** that the decomposition of  $R=(A, B, C, D, E)$  into  $R_1=(A,B,C)$  and  $R_2=(A,D,E)$  is a lossless-join decomposition.

**2.2. Show** that the decomposition of  $R=(A, B, C, D, E)$  into  $R_1=(A,B,C)$  and  $R_2=(A,D,E)$  is not a dependency-preserving decomposition.

**Solution of 2.1:**

**Solution of 2.2:**