

School of Engineering and Computer Science

SWEN304 Database System Engineering

Assignment 3

Due date: 23:59, **Monday 20 May**

The objective of this assignment is to test your understanding of functional dependencies, normal forms, database normalization, The assignment is worth **8%** of your final grade. It will be marked out of 100.

Submission instructions:

- Submit your assignment in **pdf** via the submission system

Note: Assignments not in **pdf** will incur a deduction of 3 marks.

Question 1. Normal Forms

[16 marks]

Consider a relation schema $N(R, F)$ where $R = \{A, B, C, D\}$. For each of the following sets F of functional dependencies, determine which normal form (1NF, 2NF, 3NF, BCNF) the relation schema N is in. Justify your answer.

Hint: Note that in all four cases AB is the only key for N .

1) $F = \{AB \rightarrow C, C \rightarrow D\}$

2) $F = \{AB \rightarrow D, B \rightarrow C\}$

3) $F = \{AB \rightarrow C, AB \rightarrow D\}$

4) $F = \{AB \rightarrow CD, C \rightarrow B\}$

ANSWER

Question 2. Functional Dependency

[9 marks]

Consider a relation schema $N(R, F)$ where $R = \{A, B, C, D, E\}$ with the set of functional dependencies

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

Show that $AB \rightarrow D$ can be inferred from F using Armstrong's inference rules.

ANSWER

Question 3. Minimal Cover of a set of Functional Dependencies

[20 marks]

Consider the set of functional dependencies $F = \{A \rightarrow B, B \rightarrow CD, D \rightarrow A, AC \rightarrow D\}$. Compute a minimal cover of F . Justify your answer.

ANSWER

Question 4. 3NF Normalization

[25 marks]

Consider a relation schema $N(R, F)$ where $R = \{A, B, C, D\}$ and $F = \{A \rightarrow B, C \rightarrow D\}$. Perform the following tasks. Justify your answers.

- 1) [5 marks] Identify all keys for N . Show your process.
- 2) [5 marks] Identify the highest normal form (1NF, 2NF, 3NF, BCNF) that N satisfies.
- 3) [10 marks] If N is not in 3NF, compute a lossless transformation into a set of 3NF relation schemas using the Synthesis algorithm.
- 4) [5 marks] Verify explicitly that your result has the lossless property, satisfies 3NF, and that all functional dependencies are preserved.

ANSWER

Question 5. BCNF Normalization

[30 marks]

Consider a relation schema $N(R, F)$, where $R = \{A, B, C, D\}$ and $F = \{A \rightarrow C, D \rightarrow B, BC \rightarrow A, BC \rightarrow D\}$. Perform the following tasks. Justify your answers.

- 1) [5 marks] Identify all keys for N . Show process.
- 2) [4 marks] Identify the highest normal form (1NF, 2NF, 3NF, BCNF) that N satisfies.
- 3) [16 marks] If N is not in BCNF, compute a lossless decomposition into a set of BCNF relation schemas using the BCNF decomposition algorithm.
- 4) [5 marks] Verify explicitly whether your result satisfies BCNF, and all functional dependencies are preserved.

ANSWER
