

5 Databases (TGG)

(a) Define the concept of a *functional dependency*. [3 marks]

(b) Suppose that relation R has m attributes. Give an upper bound on the number of functional dependencies that R could satisfy (including trivial dependencies). [3 marks]

(c) Let $R(A, B, C, D, E)$ be a relational scheme with the following dependencies.

$$\begin{aligned} A &\rightarrow C \\ B, C &\rightarrow D \\ A &\rightarrow E \\ B, D &\rightarrow C \\ C &\rightarrow E \\ E &\rightarrow D \\ E &\rightarrow B \end{aligned}$$

Which, if any, of these dependencies are redundant? [4 marks]

(d) Suppose $R(A, B, C)$ is a relational schema with functional dependency $A \rightarrow B$. What can you deduce about the results of $\pi_{A,B}(R) \bowtie_A \pi_{A,C}(R)$? Justify your answer. [3 marks]

(e) Suppose $R(A, B, C)$ is a relational schema. In addition, you know that the following is always true in any correct database instance.

$$R = \pi_{A,B}(R) \bowtie_A \pi_{A,C}(R).$$

What can you deduce about the dependencies between attributes A , B , and C ? Prove any of your claims. [7 marks]