5 Databases (TGG)

(a) The relational schema \( R(A, B, C, D, E) \) has the following functional dependencies.

\[
\begin{align*}
A & \rightarrow E \\
B & \rightarrow D \\
A, B & \rightarrow C
\end{align*}
\]

Decompose this into a set of relations in BCNF. Show your working. [5 marks]

(b) By inspecting your answer to (a), describe a possible interpretation in the language of Entity-Relationship modelling. [5 marks]

(c) Heath’s Rule tells us that if \( R(A, B, C) \) is a relational schema with functional dependency \( A \rightarrow B \), then

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

This rule is often applied in the relational decomposition process that seeks to arrive at relations in a particular normal form. For example, we might decompose \( R \) into two implemented relations \( R_1(A, B) \) and \( R_2(A, C) \). Some people have been very critical of this approach since it ignores the fact that the implementation of such a decomposition is normally associated with foreign key constraints between tables.

What is missing? Can you express, in the relational algebra, what such a missing constraint might look like for the decomposition described above using Heath’s rule? Justify your answer. [5 marks]

(d) Using your answer to (c), discuss which constraints might be missing from your decomposition in question (a). [5 marks]