

Assignment 3

Due: DUE DATE Wednesday, December 5, 2018, 11:59pm

Database Design

1. Consider relation $R(A, B, C, D, E, F, G, H)$ and the set of functional dependencies $\{A \rightarrow E, AD \rightarrow BE, AC \rightarrow E, E \rightarrow B, BG \rightarrow F, BE \rightarrow D, BDH \rightarrow E, F \rightarrow A, D \rightarrow H, CD \rightarrow A\}$
 - (a) Find the candidate keys of this schema.
 - (b) Find a 3NF decomposition of this schema (list both the relations and the corresponding set of functional dependencies). Show the details of your work.
 - (c) Find a BCNF decomposition of this schema (list both the relations and the corresponding set of functional dependencies). Show the details of your work. Is your decomposition dependency preserving? Explain.
2. Let $S(A_1, A_2, \dots, A_n)$ be a relation and X_1, X_2, \dots, X_n be subsets of $\{A_1, A_2, \dots, A_n\}$ such that $X_1 \cup X_2 \cup \dots \cup X_n = \{A_1, A_2, \dots, A_n\}$. An instance s of S satisfies a join dependency constraint of the form $S = X_1 \bowtie X_2 \bowtie \dots \bowtie X_n$ if and only if $s = \pi_{X_1}(s) \bowtie \pi_{X_2}(s) \bowtie \dots \bowtie \pi_{X_n}(s)$.

Multivalued dependencies are a special case of join dependency: if $\{A_1, A_2, \dots, A_n\} = X_1 \cup X_2 \cup X_3$, a instance s of S satisfies a multivalued dependency $X_1 \twoheadrightarrow X_2$ if and only if $s = \pi_{X_1 X_2}(s) \bowtie \pi_{X_1 X_3}(s)$.

 - (a) Let X, Y, Z be sets of attributes in $\{A_1, A_2, \dots, A_n\}$ such that $X \cup Y = \{A_1, A_2, \dots, A_n\}$ and $X \cap Y$ is a subset of Z . Let s be a instance over S that satisfies the nontrivial dependency $S = X \bowtie Y$ (neither X nor Y is a subset of the other). Prove that the projection of s on the attributes of Z satisfies the join dependency $S = (Z \cap X) \bowtie (Z \cap Y)$.
 - (b) Let X, Y, Z be sets of attributes in $\{A_1, A_2, \dots, A_n\}$ such that $X \cup Y = \{A_1, A_2, \dots, A_n\}$ and $X \cap Y$ is not a subset of Z . For $n = 6$, give an example of a database instance s over S that satisfies the nontrivial dependency $S = X \bowtie Y$ (neither X or Y is a subset of the other), but does not satisfy $S = (Z \cap X) \bowtie (Z \cap Y)$.
3. Let $R(A_1, A_2, \dots, A_n)$ be a relation with n attributes. Assume that the only keys are $\{A_1, A_2, A_3\}$ and $\{A_1, A_3, A_4\}$. Express as a function of n the total number of superkeys in R .
4. Prove or disprove that:
 1. If $A \rightarrow B$ then $B \rightarrow C$
 2. If $AB \rightarrow C$ then $A \rightarrow C$ and $B \rightarrow C$

Submission instructions

Your assignment must be typed; handwritten assignments will not be marked. Whatever you choose to use, you need to produce a final document in pdf format.

You must declare your team and hand in your work electronically using the MarkUs online system. Well before the due date, you should declare your team and try submitting with MarkUs. You can submit an empty file as a placeholder, and then submit a new version of the file later (before the deadline, of course); For this assignment, hand in just one file: A3.pdf. If you are working in a team, only one of you should hand it in.