COMP 3005: Database Management Systems **(Due: Friday March 13, 2020 (11:59 PM))**

Assignment #3

Instructor: Ahmed El-Roby *Name: , ID:*

Instructions: Read all the instructions below carefully before you start working on the assignment, and before you make a submission.

- The accepted formats for your submission are: pdf and docx. More details below.
- If you use the tex file, make sure you edit line 28 to add your name and ID. Only write your solution and do not change anything else in the tex file. If you do, you will be penalized.
- Late submissions are allowed for 24 hours after the deadline above with a penalty of 10% of the total grade of the assignment. Submissions after more than 24 are not allowed.

Q 1: (4 points)

Consider the following proposed rule: If $A \rightarrow B$ and $C \rightarrow B$, then $A \rightarrow C$. Prove that this rule is not sound.

Q 2: (8 points)

Consider the following relation $R = \{A, B, C, D, E\}$ and the following set of functional dependencies
$F = \{$
$A \rightarrow BC$
$CD \rightarrow E$
$B \rightarrow D$
$E \rightarrow A\}$
Compute B^+. Is R in BCNF? If not, give a lossless decomposition of R into BCNF. Show your work for all previous questions.

Q 3: (4 points)

Give a lossless, dependency-preserving decomposition into 3NF of schema R in Q2.

Q 4: (4 points)

Assume the following decomposition of R in Q2: $R_1(A, B, C)$ and $R_2(C, D, E)$. Is this decomposition loassy or lossless? Why?

Q 5: (22 points)

Consider the following relation $R(A, B, C, D, E, G)$ and the set of functional dependencies
$F = \{$
$A \rightarrow BCD$
$BC \rightarrow DE$
$B \rightarrow D$
$D \rightarrow A\}$

Note: Show the steps for each answer.

(a) Compute B^+. (4 points)

(b) Prove (using Armstrong's axioms) that AG is superkey. (4 points)

(c) Compute F_c. (6 points)

(d) Give a 3NF decomposition of the given schema based on a canonical cover. (4 points)

(e) Give a BCNF decomposition of the given schema based on F. Use the first functional dependency as the violator of the BCNF condition. (4 points)

Q 6: (6 points)

Given the following set of functional dependencies:
$A \rightarrow BC$
$B \rightarrow AC$
$C \rightarrow AB$
Show that it is possible to find more than one unique canonical cover for this set.

Q 7: (7 points)

Consider the schema $R = (A, B, C, D, E, G)$ and the set F of functional dependencies:
$A \rightarrow BC$
$BD \rightarrow E$
$CD \rightarrow AB$
Use the BCNF decomposition algorithm to find a BCNF decomposition of R. Start with $A \rightarrow BC$. Explain your steps. Is this decomposition lossy or lossless? Is it dependency-preserving?