CS 353 Fall 2022
Homework 5
Due: November 24, Thursday till midnight
You will use the Moodle course page for submission of this assignment

Q.1 [10 pts] Consider the following instance of relation R(A, B, C):

A	B	C
a1	b1	c1
a1	b2	c2
a2	b3	c1
a3	b3	c1
a2	b1	c1

Which of the following functional dependencies are **violated** by this instance?

(a) A → B
(b) B → C
(c) C → A
(d) AB → C
(e) AC → B
(f) BC → A

Q.2 [20 pts, 10 pts each] Given a relation R(A, B, C) with the following functional dependencies:
A → B, C → AB

(a) Is the decomposition of R into R1(A, B) and R2(A, C) lossless? Explain why or why not. If it is not lossless, show this through an example instance of R.
(b) Is the decomposition of R into R1(A, B) and R2(B, C) lossless? Explain why or why not. If it is not lossless, show this through an example instance of R.

Q.3 [24 pts, 8 pts each] Given a relation R(A, B, C, D, E) and its functional dependencies:

A → D, BC → E, D → AB

(a) Find the candidate key(s) of R. Show how you derived the key(s).
(b) Check if R is in BCNF. If not, find a violation.
(c) Check if R is in 3NF. If not, find a violation.

Q.4 [22 pts] Given the following functional dependency sets F and G:

F = {A → B, AB→ C, D →AC, D → E}
G = {A → BC, D→ AE, E → B}

(a) [10 pts] Show that all the functional dependencies in F can be inferred from G (i.e., G covers F).

(b) [6 pts] Does F cover G?
(c) [6 pts] Are F and G equivalent?

Q.5 [24 pts, 12 pts each] Given the relation schema R(A, B, C, D) with the functional dependency set

F = {A → BD, CD → B, C→D, B → D}.

(a) Find a canonical cover Fc of F.
Show all your work.
(b) Check if R is in 3NF. If not, decompose it into 3NF relations using the lossless and dependency preserving decomposition algorithm.