CS 353 Spring 2022
Homework 5
Due: 15 April, Friday till midnight
You will use the Moodle course page for submission of this assignment

Q.1 [25 pts, 5 pts each] Given an instance of the relation R(A, B, C, D)

A	B	C	D
a1	b1	c1	d1
a1	b2	c1	d1
a2	b3	c1	d3
a2	b3	c2	d3
a3	b3	c2	d3
a4	b4	c2	d4

a. Does A $\rightarrow$ C hold on R? If not, explain why.
b. Does B $\rightarrow$ D hold on R? If not, explain why.
c. Does BCD $\rightarrow$ A hold on R? If not, explain why.
d. Find the attribute closures of A and B.
e. Is AB a candidate key and/or a super key of this relation? Explain your answer.

Q.2 [15 pts, 5 pts each]
Consider a relation R(A,B,C, D, E, F) with the following set of functional dependencies: {AB $\rightarrow$ C, A $\rightarrow$ D, F $\rightarrow$ A, D $\rightarrow$ E, BE $\rightarrow$ F, AC $\rightarrow$ B}.

a. Find the attribute closure of A.
b. Find the attribute closure of CF.
c. Using only Armstrong's axioms, show that DB $\rightarrow$ C holds on R.

Q.3 [15 pts, 5 pts each]
Given a relation R (A, B, C, D) with F = {A $\rightarrow$ D, B $\rightarrow$ C, A $\rightarrow$ BD and D $\rightarrow$ B}

a. What is the candidate key of this relation?
b. Does this relation satisfy BCNF? Explain your answer.
c. Does this relation satisfy 3NF? Explain your answer.

Q.4 [25 pts, 5 pts each]
Given a relation R (A, B, C, D, E, F) with F = {A $\rightarrow$ D, BC $\rightarrow$ E, and AF $\rightarrow$ BC}

a. Show that R does not satisfy BCNF.
b. Give a lossless decomposition of R into BCNF.
c. Is your decomposition dependency preserving? Explain your answer.
d. Suppose that the following decomposition is given: R1(A, B, C, D) and R2(D, E, F). Is this decomposition lossless?
e. Is the decomposition in part (d) dependency preserving? Explain your answer.

Q.5 [20 pts]
Given R(A, B, C, D, E) with F = {A $\rightarrow$ BC, B $\rightarrow$ E, BD $\rightarrow$ C, AD $\rightarrow$ CE, E $\rightarrow$ AD}.

a. [5 pts] Check if D is extraneous in BD $\rightarrow$ C.

b. [5 pts] Check if C is extraneous in $A \rightarrow BC$.
c. [10 pts] Find the canonical cover of F.