Normalization

1. Given the relation shown below
   a. List all non-trivial functional dependencies satisfied by the relation shown below.
   b. Give all candidate keys of this relation.

A	B	C
a1	b1	c1
a1	b1	c2
a2	b1	c3
a2	b1	c4

2. Consider the following relation:
   CAR_SALE(Car#, Date_sold, Salesman#, Commission%, Discount_amt)
   Assume that a car may be sold by multiple salesmen, and hence {Car#, Salesman#} is the primary key. Additional dependencies are

   Date_sold→ Discount_amt
   Car# → Data_sold
   Salesman# → Commission%

   a) Based on the given primary key, is this relation in 1NF, 2NF, or 3NF? Why or why not?

   b) How would you successfully normalize it completely? Show and explain each decomposition step and verify the decomposition is lossless or not.

3. Consider the relation R (A,B,C,D,E, F, G, H, I, J) with the following FDs:
   AB→ C, BD→ EF, AD→ GH, A→I, H→ J
   a) What is the candidate key of R?
   b) Explain why the relation is not in 2NF.
   c) Normalize it to 2NF, 3NF, and BCNF. Show and explain each decomposition step and verify the decomposition is lossless or not.

4. Consider the following relation for published books:
   BOOK (Book_title, Author_name, Book_type, List_price, Author_affil, Publisher).
   Suppose the following dependencies exist:
   Book_title→ Publisher, Book_type
   Book_type → List_price
   Author_name → Author_affil

   a. What normal form is the relation in? Explain your answer.
   b. Apply normalization until you cannot decompose the relations further. Show and explain each decomposition step and verify the decomposition is lossless or not.