

# Exam 3

Your name:

1. *Question 1 - 20 pts* Convert the ER diagram below to a set of relations.

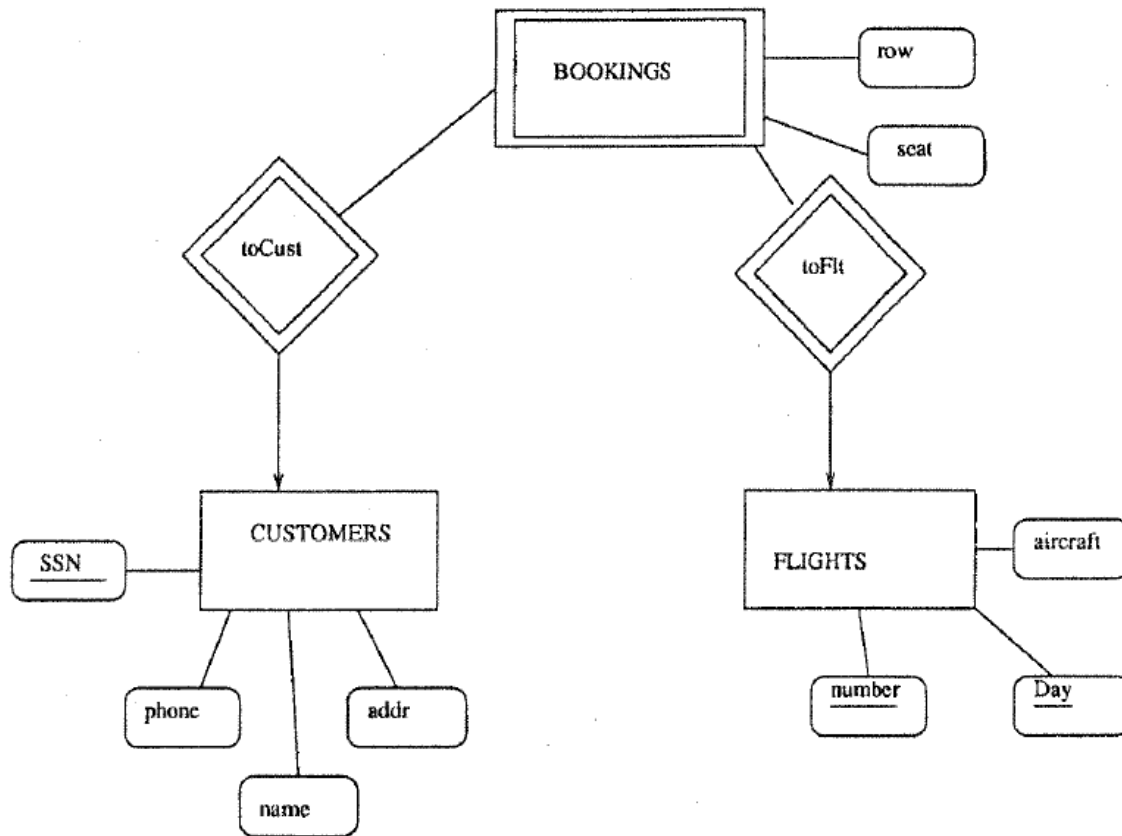


Figure 1: ER Diagram

BOOKINGS (SSN, number, Day, row, seat)

CUSTOMERS (SSN, phone, name, addr)

FLIGHTS (number, Day, aircraft)

2. *Question 2 - 20 pts* Consider relation  $R$  with attributes  $A_1, A_2, \dots, A_n$ . As a function of  $n$  how many superkeys  $R$  has if  $A_1$  is the only candidate key

The number of superkey:  $2^{(n-1)}$ .

3. *Question 3* Consider the following set  $FD$  of functional dependencies

$AB \rightarrow C$

$C \rightarrow A$

$BC \rightarrow D$

$ACD \rightarrow B$

$D \rightarrow E$

$BE \rightarrow C$

$CE \rightarrow A$

(a) Find all candidate keys of  $R(A, B, C, D, E)$  (20pts).

AB, BC, BD, BE, CD

(b) Find a canonical cover of  $FD$  (10pts).

$AB \rightarrow C$

$C \rightarrow A$

$BC \rightarrow D$

$CD \rightarrow B$

$D \rightarrow E$

$BE \rightarrow C$

(c) Is decomposition  $R_1(A, B, C, D)$  and  $R_2(C, D, E)$  lossless? dependency-preserving? Justify your answer. (20 pts).

Yes, it is lossless. Because  $R_1 \cap R_2 = \{C, D\}$  and  $CD$  is candidate key.

No, it is not dependency-preserving. Because we can not check  $CE \rightarrow A$  without joining  $R_1$  and  $R_2$ .

(d) Decompose  $R$  into a set of relations each of which is in BCNF. Is your decomposition dependency-preserving? (20 pts).

BCNF Decomposition

R1(A,C) R2(D, E) R3(B, C, E)

No, it is not dependency preserving. Because we can not check  $CE \rightarrow A$  without join operation on R1 and R3.

(e) Decompose  $R$  into a set of relations each of which is in 3d normal form. (10 pts).

3<sup>rd</sup> Normal Form Decomposition

R1(A, B, C) R2(D, E) R3(B, C, D) R4(B, C, E)