CPSC 304 Winter2, 2006-2007

Tutorial 3 - BCNF & 3NF

Feb. 1, 2007

Abstract

Now it's time that we make a careful consideration on our schemas derived from the E-R diagram. What are candidate keys for each relation? Are we choosing the correct primary keys? What normal form does each relation belong to? How could we decompose relations so that after a serial of actions all relations are in 3NF or BCNF, while the semantics are precisely preserved?

Question 1

(1) Consider relation R=(A,B,C,D) with the following FDs:

AB -> C, C-> D, and D-> A

a.   List all candidate keys of R.

b.   Is R in 3NF? BCNF?

(2) Consider relation S=(A,B,C,D) with the following FDs:

A->B, B->C, C->D, and D->A

a.   List all candidate keys of S.

b.   Is S in 3NF? In BCNF?

(3) Given relation R=(A,B,C,D), find if R is in 3NF or BCNF with respect to the following FDs

i.   B->C, C->A, C->D

ii.   ABC->D,D->A

iii.   A->C,B->D

Question 2

Create Table r1

(a1 INTEGER, a2 INTEGER, a3 INTEGER, a4, INTEGER, a5 INTEGER,

  Primary Key (a1, a2),

  Unique (a3, a4),

  Foreign Key (a5) references r2 (a5))

1) List **all** the non-trivial functional dependencies pertaining to the attributes of r1 that can be inferred from the create table statement.
2) Is r1 in BCNF? Give a brief explanation.
3) Is r1 in 3NF? Give a brief explanation.

Question 3

Normalization:

- Consider a schema with attributes $A_1, A_2, A_3, A_4, A_5, A_6$ and FDs

$A_1 \rightarrow A_3$, $A_1 A_2 \rightarrow A_3$, $A_3 \rightarrow A_4 A_6$, $A_3 A_4 \rightarrow A_6$, $A_3 A_5 \rightarrow A_1 A_2$, $A_5 A_6 \rightarrow A_3$.

(a) Find a minimum cover for this set of FDs.

- Consider <u>another</u> set of FDs on $A_1 \ldots A_6$:

$A_3 \rightarrow A_6$ (FD1), $A_5 \rightarrow A_1$ (FD2), $A_3 A_5 \rightarrow A_4$ (FD3), $A_1 \rightarrow A_2$ (FD4).
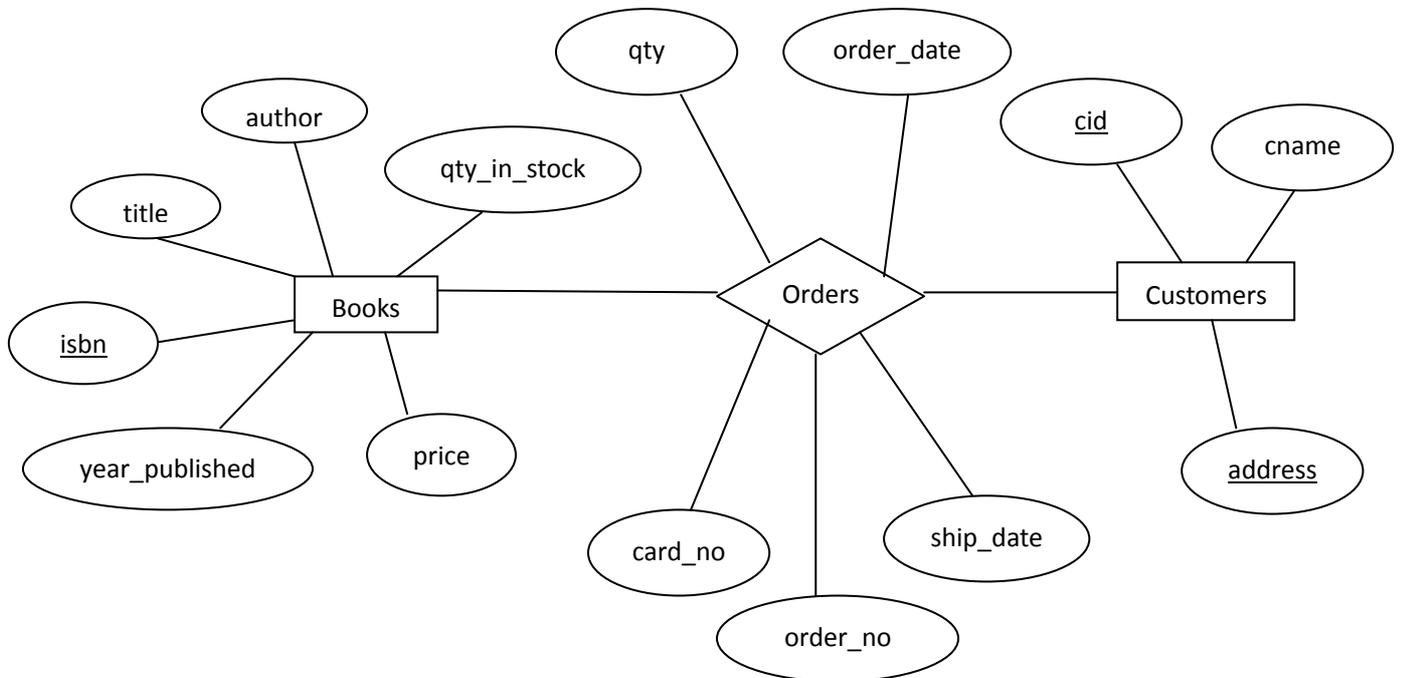
(b) How many candidate keys does it have? Explain your answer.
(c) Find a lossless BCNF decomposition of the schema. Is it dependency-preserving? Explain why.

Question 4

[RG 3rd P640. 19.9] Case Study: The Internet shop
The case study is sketched as follows:
A design for an online book store with the following E-R diagram:

And a possible relational schema:

Books (isbn, title, author, qty_in_stock, price, year_published)
Customers (cid, cname, address)
Orders (order_no, isbn, cid, card_no, qty, order_date, ship_date)

Tasks:
   1) Examine this schema and suggest *reasonable* functional dependencies;

   Note: your answers to the next two parts will depend on your answer to 1)
   2) Decompose the relations into BCNF;
   3) Draw the E-R diagram reflecting the final design.