DBMS Digital Assignment 1

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The Questions:

The purpose of this digital Assignment is to get understanding of the different normal forms and of the problems that can be prevented by normalization.
The city library of Uppsala has a database to keep track of its books, the people who borrow books, and who has borrowed which books. The tables, with the data, are included be low in section 2 and 3. (For well known reasons, there are very few books in the library.) Unfortunately, the design of the database is not very good. Your mission is to analyze the problems with the design, and suggest a better one. The output of your work should be a report that addresses all the faults you find regarding normalization along with a description of why they are problematic. Furthermore you should develop an alternative design that is in BCNF.

Section 1:

Exercises
1) Specify all functional dependencies without redundancies for each table of the library database. Then state which normal form (1NF, 2NF, 3NF or BCNF) each of the existing tables is, and why.
2) For each table that doesn't fulfill the requirements for BCNF, explain the problems that this lack of normalization has and their potential consequences. Give some examples.
3) Design a new database, with different tables, where all the tables fulfill BCNF without losing any information.
Hints:
− consider dates as atomic (there is a type 'date' in SQL);
− assume that there is one telephone number per address;
− you can choose any of the approaches for relational database design:

top-down (starting with ER modeling) or bottom-up (starting with specification of all functional dependencies and applying a normalization algorithm).

THE ANSWER:

Let the attributes be denoted as follows:

A	TitleNr
B	ISBN
C	CopyNr
D	Title
E	PublYear
F	Author
G	AuthorNat
H	CustomerNr
I	PersonNr
J	Name
K	Address
L	Tel
M	NrBooks
N	Date
P	BorrowerName

1) BOOK

The tables look like this:

BOOK

TitleNr	ISBN	CopyNr	Title	PublYear	Author	AuthorNat
1	0071148108	1	Database	1997	Silberschatz	USA
1	0071148108	1	Database	1997	Korth	USA
1	0071148108	1	Database	1997	Sudarshan	India
2	0805317538	1	Fundamentals	1994	Elmasri	USA
2	0805317538	1	Fundamentals	1994	Navathe	USA
2	0805317538	2	Fundamentals	1994	Elmasri	USA
2	0805317538	2	Fundamentals	1994	Navathe	USA
3	0198642253	1	Mord	1995	Guillou	Sweden
3	0198642253	2	Mord	1995	Guillou	Sweden
4	3411021764	1	Våld	1998	Guillou	Sweden

Functional dependencies for table BOOK

F → G

AC → DEF

BE → C

2) CUSTOMER

CUSTOMER

CustomerNr	PersonNr	Name	Address	Tel	NrBooks
1	6312111658	Padron-McCarthy	Vägen 7	282677	1
2	4403149901	Silberschatz	Gatan 6	146000	1
3	4010229910	Elmasri	Gatan 8	241000	1
4	4501129921	Schwarzenegger	Vägen 3	174590	0

Functional dependencies for table CUSTOMER

HJ → M

H → J

I → KL

3) LOAN

LOAN

TitleNr	CopyNr	CustomerNr	Date	BorrowerName
1	1	3	7/1 98	Elmasri
3	2	1	1/9 98	Padron-McCarthy
2	1	2	7/1 98	Silberschatz

Functional dependencies for table LOAN

$H \rightarrow NP$

$AC \rightarrow H$

(a) Table BOOK is in 2NF

Reason: Transitive dependency of {Author, AuthorNat} and {Title, PublYear} still exists in the table

(b) Table CUSTOMER is in 1NF

Reason: Partial dependency of {CustomerNr, Name, Address, Tel} exists.

(c) Table LOAN is in 2NF

Reason: Transitive dependency of {CustomerNr, Date, BorrowerName} exists.

Section -2: The schema of the existing database

There are three tables:

- A table called **BOOK**, which contains data about the books. It has the attributes **TitleNr** (a number that this library assigns), **ISBN**, **CopyNr** (which is used to separate different copies of the same book), **Title**, **PublYear**, **Author**, and **AuthorNat**. The primary key consists of **TitleNr**, **CopyNr** and **Author**. An alternative key is formed by **ISBN**, **CopyNr** and **Author**.
- A table called **CUSTOMER**, which contains data about the persons who can borrow books. It has the attributes **CustomerNr** (a unique number identifying a person, assigned by the library), **PersonNr** (which is a unique number identifying a person, assigned by the Swedish state), **Name**, **Address**, **Tel**, and **NrBooks** (the number of books that this person has borrowed at the moment). **CustomerNr** is the primary key. **PersonNr** is an alternative key.
- A table called **LOAN**, where the loans are stored. It has the attributes **TitleNr**, **CopyNr**, **CustomerNr**, **Date** (which is the date when the book was borrowed), and **BorrowerName** (which is the name of the customer who borrowed the book). The primary key consists of **TitleNr** and **CopyNr**.

THE ANSWER:

Table BOOK

{TitleNr, CopyNr, Title} all have repetitive values. Updating any of the fields would cause entire database to be modified.

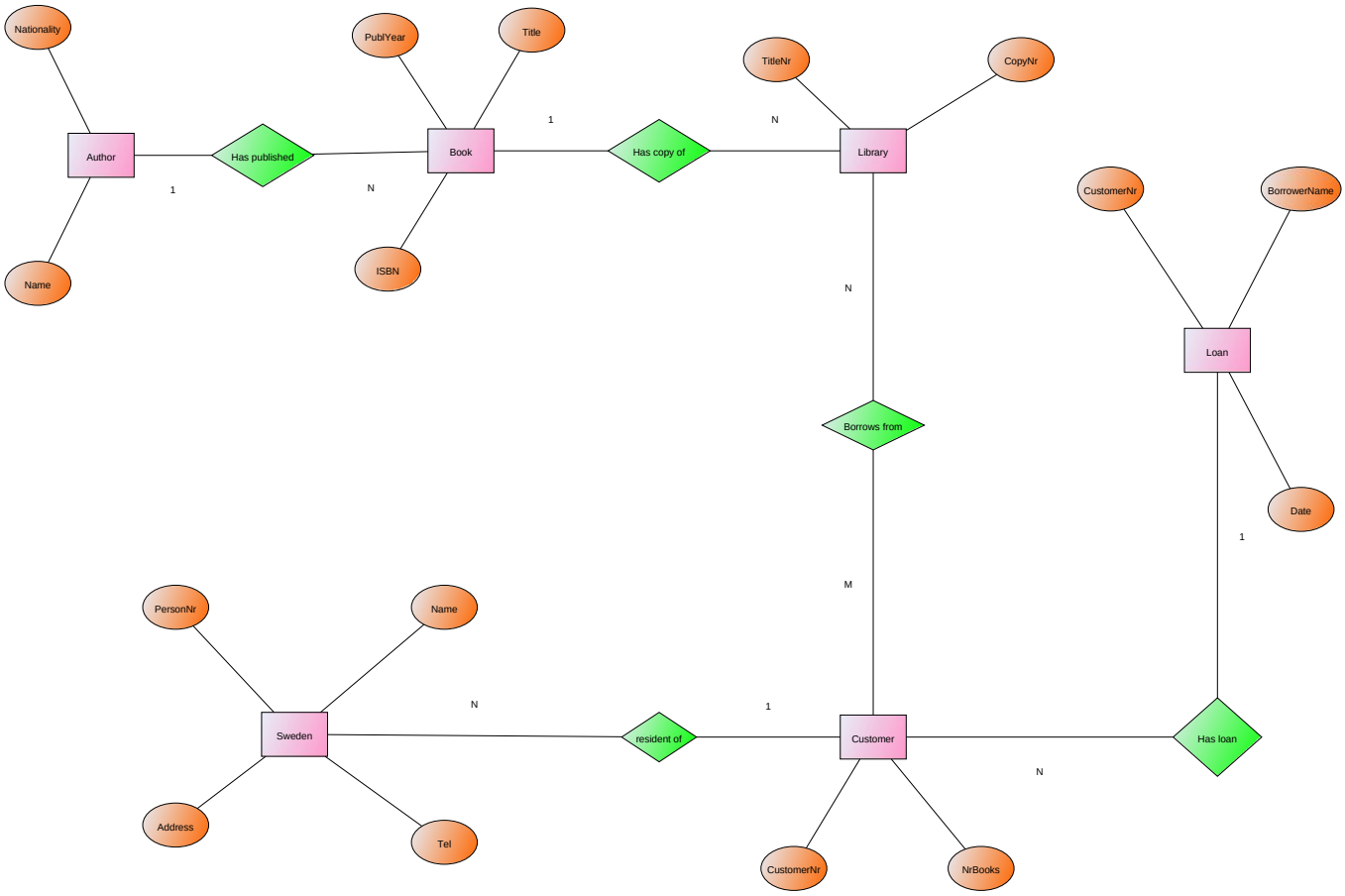
Table CUSTOMER

{PersonNr, Address, Tel} should be clubbed together as they are collection of separate entity assigned by Swedish State. {CustomerNr, Name} should be treated separately for being relevant only to the library.

Table LOAN

Full functional dependency of {TitleNr, CopyNr} on CustomerNr is a must as they collectively decide the customer and subsequently the borrower.

The ER Daigram



Section -3: The contents of the existing database:

Your report should contain your answers to the questions in section 1. The database design in exercise 1.3 should be presented as both ER diagram and the corresponding relational tables in format table_name (column1, column2,...). Motivate why your relations are in BCNF by specifying all functional dependencies.

THE ANSWER:

ER Model

Author	
Name	Nationality

Book		
ISBN	Title	PublYear

Library	
TitleNr	CopyNr

Customer	
CustomerNr	Nrbooks

Loan		
CustomerNr	Date	BorrowerName

Sweden			
Name	**PersonNr**	Address	Tel

THANK YOU