

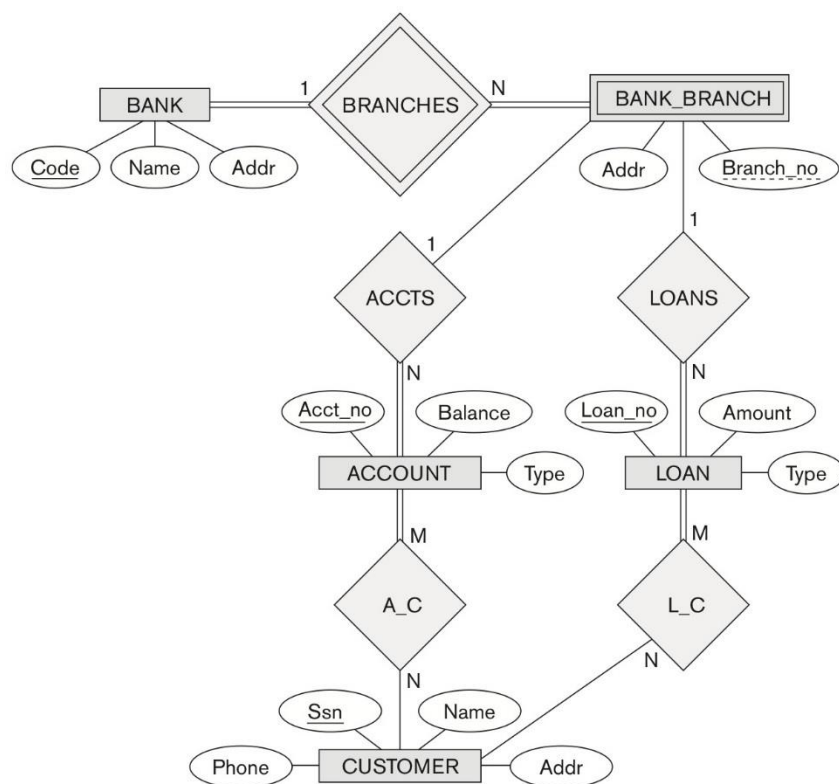
Introduction to Databases, Spring 2019

Homework #2 (30 Pts, Apr 17, 2019)

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Name 이 준 혁

(1) [9 pts] Consider the following ER diagram for the BANK database. Each bank can have multiple branches, and each branch can have multiple accounts and loans.



(a) [1 pt] List the regular entity types in the ER diagram.

Answer: BANK, ACCTS, CUSTOMER, LOAN

(b) [1 pt] Is there a weak entity type? If so, specify the primary key for the weak entity type?

Answer: Yes, BANK_BRANCH is the weak entity type. So, it does not have its own primary key.

However, combining BCode, which is foreign key referencing 'code' attribute of the bank can construct the primary key.

BCode and branch_no are the primary key of BANK_BRANCH

(c) [7 pts] Map the BANK diagram into a relational model. For each relation, specify all primary keys and foreign keys.

Answer: Primary keys are bold and underlined, and foreign keys are colored as gray, with the referring attribute name and arrow

BANK

<u>Code</u>	Name	Addr
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BANK_BRANCH

<u>BCode</u> (Code of BANK)	<u>Branch_No</u>	Addr
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ACCOUNT

<u>AcctNo</u>	Balance	Type	BCode	Branch_No (Branch_No of BANK_BRANCH)
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Customer

<u>SSN</u>	Name	Phone	Addr
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LOAN

<u>LoanNo</u>	Amount	Type	BCode	Branch_No (Branch_No of BANK_BRANCH)
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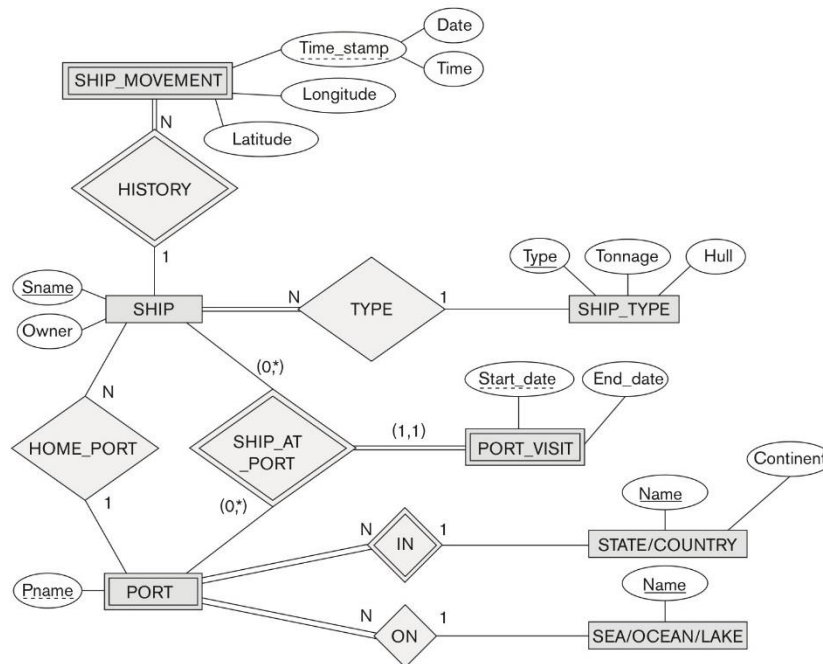
A_C

<u>SSN</u> (SSN of Customer)	<u>AcctNo</u> (AcctNo of ACCOUNT)
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L_C

<u>SSN</u> (SSN of Customer)	<u>LoanNo</u> (LoanNo of LOAN)
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(2) [7 pts] Consider the ER diagram for SHIP_TRACKING database to keep track of transport ships and their locations for maritime authorities. Map this diagram to a relational schema (SHIP, SHIP TYPE, PORT, PORT_VISIT, SHIP_MOVEMENT, STATE_COUNTRY, SEA_OCEAN_LAKE), and specify all primary keys and foreign keys for each relation.



Answer:

Relation	Primary key	Foreign Key
SHIP	Sname	Stype (Type of SHIP_TYPE) HPname (Pname of PORT)
SHIP TYPE	Type	
PORT	Pname, Placename(Name of STATE/Country)	Placename (Name of STATE/Country), Watename (Name of SEA/OCAEN/LAKE)
PORT_VISIT	Sname (Sname of SHIP), Pname (Pname of PORT), Start_date	Sname(Sname of SHIP) Pname(Pname of PORT)
SHIP_MOVEMENT	Time_stamp, Sname (Sname of SHIP)	Sname(Sname of SHIP)
STATE_COUNTRY	Name	
SEA_OCEAN_LAKE	Name	

(3) [6 pts] Consider the relation $R = \{A, B, C, D, E, F, G, H, I, J\}$ and the set of functional dependencies $F = \{ \{A, B\} \rightarrow \{C\}, \{A\} \rightarrow \{D, E\}, \{B\} \rightarrow \{F\}, \{F\} \rightarrow \{G, H\}, \{D\} \rightarrow \{I, J\} \}$ (2 pts each).

(a) What is the key for R?

Answer: $\{A, B\}$

Since $\{A, B\}^+ = \{A, B, C, D, E, F, G, H, I, J\}$, $\{A, B\}$ is the superkey of R.

Furthermore, $\{A\}^+ = \{A, D, E, I, J\}$, $\{B\}^+ = \{B, F, G, H\}$. So $\{A, B\}$ is the minimal superkey.

(b) Decompose R into 2NF relations.

Answer: Bold means the primary key

<u>A</u>	<u>B</u>	C
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<u>A</u>	D	E	I	J
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<u>B</u>	F	G	H
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(c) Decompose R into 3NF relations.

Answer: Underline means the primary key

<u>A</u>	<u>B</u>	C
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<u>A</u>	D	E
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<u>B</u>	F
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<u>D</u>	I	J
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<u>F</u>	G	H
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(4) [4 pts] What is the problem of this table? And how can you fix it?

Customer ID	First Name	Surname	Tel. No. 1	Tel. No. 2	Tel. No. 3
123	Robert	Ingram	555-861-2025		
456	Jane	Wright	555-403-1659	555-776-4100	555-403-1659
789	Maria	Fernandez	555-808-9633		

Answer: The telephone number attribute is too many, so it seems like repeating groups. Furthermore, the 1st and 3rd telephone number of “Jane” is same, but this kind of model can’t figure out such problems.

So, making by telephone attribute as one, and using several tuples, we can reduce the redundancy. Since 1st and 3rd telephone number of the Jane are same, those are same tuples. Therefore, we can omit duplicate tuple

Customer ID	First Name	Surname	Tel. No
123	Robert	Ingram	555-861-2025
456	Jane	Wright	555-403-1659
456	Jane	Wright	555-776-4100
789	Maria	Fernandez	555-808-9633

(5) [4 pts] The following set of data represents a sample of the types of data used by a clerk in a library. Suppose every author who wrote the books in the library has a different name.: (2 pts each)

<u>Borrower Number</u>	<u>Borrower Name</u>	<u>Book Number</u>	<u>Out Date</u>	<u>Book Title</u>	<u>Book Returned</u>	<u>Authors Name</u>	<u>Author Living</u>
3652	Smith	HG18	9/12/97	Clouds	Yes	D. Drone	Yes
2854	Jones	LB87	9/15/97	I See	Yes	C. Clay	No
4723	Brown	XR22	9/18/97	Birds	No	D. Drone	Yes
3652	Smith	HG18	9/23/97	Clouds	No	D. Drone	Yes
4723	Brown	LA07	9/25/97	Zen	Yes	M. Bush	Yes
3113	Jones	LB87	9/28/97	I See	No	C. Clay	No

(a) Which normal forms are violated?

Answer: 2NF, 3NF

Arrange all the functional dependency of this relation(table)

{Borrower Number} -> {Borrower Name}

{Book Number} -> {Book Title, Authors Name, Author Living}

{Book Number, Out Date, Borrower Number} -> {Book Returned}

{Author Name} -> {Author Living}

1. Note that primary keys are Borrower Number, Book Number, Out Date. Since non-prime attributes are not fully functionally dependent, it violates the 2NF

2. There are transitively dependent functional dependency exist:

{Book Number} -> {Author Name, Author Living}

{Author Name} -> {Author Living}

So, it violates 3NF

(b) Apply normalization until you cannot decompose the relations further.

Answer: Underline means the primary key.

<u>Book Number</u>	Book Title	Authors Name
HG18	Clouds	D. Drone
LB87	I See	C. Clay
XR22	Birds	D. Drone
HG18	Clouds	D. Drone
LA07	Zen	M. Bush
LB87	I See	C. Clay

<u>Authors Name</u>	Author Living
D. Drone	Yes
C. Clay	No
D. Drone	Yes
D. Drone	Yes
M. Bush	Yes
C. Clay	No

<u>Borrower Number</u>	Borrower Name
3652	Smith
2854	Jones
4723	Brown

3652	Smith
4723	Brown
3113	Jones

<u>Book Number</u>	<u>Borrower Number</u>	<u>Out Date</u>	Book Returned
HG18	3652	9/12/97	Yes
LB87	2854	9/15/97	Yes
XR22	4723	9/18/97	No
HG18	3652	9/23/97	No
LA07	4723	9/25/97	Yes
LB87	3113	9/28/97	No