Course: Database management
Unit: Database Design. Normalization
Material: Normalization exercises
Teamwork: Groups of two or three

To do the exercises remember that:

- 1NF: The domain of each attribute contains only atomic (indivisible) values, and the value of each attribute contains only a single value from that domain.
- 2NF: 1NF + any attribute that is not part of the primary key depends fully functionally on the entire primary key.
- 3NF: 2NF + each non-key attribute depends only on the primary key.

1.- For the example below we have one big table. Put the table in normalized form.

SID = Student ID, S_Name= Student Name,

CID = Course ID, C_Name = Course Name, Grade = Student's Grade in Course

Faculty = Faculty Name, F_Phone = Faculty Phone

Functional Dependencies are:

SID→S_name   SID and CID→Grade   CID→C_name

CID→Faculty   Faculty →F_phone

The primary key of the table is SID.

SID	CID	S_name	C_name	Grade	Faculty	F_phone
1	IS318, IS301	Adams	Database, EC	A,B	Howser, Langley	60192, 45869
2	IS318	Jones	Database	A	Howser	60192
3	IS318	Smith	Database	B	Howser	60192
4	IS301, IS318	Baker	EC, Database	A,B	Langley, Howser	45869, 60192

Put the above table in 1NF Tables:

Put the above table in 2NF:

Put the above table in 3NF Tables:

Final set of Tables with meaningful names and PKs and FKs:

2.- For the example below we have one big table. Put the table in normalized form.

OID = Order ID, O_Date= Order Date,

CID = Customer ID, C_Name = Customer Name, C_State = Customer's State,

PID = product id, P_Desc =Product Name, P_Price = Product Price, Qty = Quantity Purchased Note: 7, 5, 4 means three Product IDs. Similarly, 1, 1, 5 means three Quantities.

Functional Dependencies are:

OID→O_Date   CID→C_Name   PID→P_Desc   PID→P_Price

OID→CID   CID→C_State   PID and OID→Qty

OID	O_Date	CID	C_Name	C_State	PID	P_Desc	P_Price	Qty
1006	10/24/09	2	Apex	NC	7, 5, 4	Table, Desk, Chair	800, 325, 200	1, 1, 5
1007	10/25/09	6	Acme	GA	11, 4	Dresser, Chair	500, 200	4, 6

The primary key of the table is OID.

Put the above table in 1NF Tables:

Put the above table in 2NF:

Put the above table in 3NF Tables:

Final set of Tables with meaningful names and PKs and FKs:

3.- For the example below we have one big table representing a company's data on their projects and employees. Put the table in normalized form.

DID = Department ID, Dname = Department Name

EID = Employee ID, Ename = Employee Name, Btime = Budgeted Time

PID = Project ID, Pname = Project Name

Functional Dependencies are:

DID → Dname   EID → Ename   EID and PID → Btime

EID → DID   PID → Pname

DID	Dname	EID	Ename	PID	Pname	Btime
10	Finance	1, 5, 11	Huey, Dewey, Louie	27, 25, 22	Alpha, Beta, Gamma	4.5, 3, 7
14	R&D	2, 4,	Jack, Jill	26, 21	Pail, Hill	8, 9

Put the above table in 1NF Tables:

Put the above table in 2NF:

Put the above table in 3NF Tables:

Final set of Tables with meaningful names and PKs and FKs:

4.-
Produce the Third Normal Form of this document by normalization.

Order Form

Order number: 1234   Date: 11/04/98

Customer number: 9876

Customer name: Billy

Customer address: 456 HighTower Street

City-Country: Hong Kong, China

ProductNo	Desscription	Quantity	Unit Price
A123	Pencil	100	$3.00
B234	Eraser	200	$1.50
C345	Sharpener	5	$8.00

Order number = OID, Customer number = CID, Customer name = C_name, Customer address = C_address, ProductNo = PID, Description = P_desc, Quantity = Qty, Unit Price = P_Price

Functional Dependencies are:

$OID \rightarrow Date$ $CID \rightarrow C\_Name$ $CID \rightarrow City$ $CID \rightarrow C\_address$

$PID \rightarrow P\_Desc$ $PID \rightarrow P\_Price$ $OID \rightarrow CID$ $City \rightarrow Country$

PID and $OID \rightarrow Qty$

Put the above table in 1NF Tables:

Put the above table in 2NF:

Put the above table in 3NF Tables:

Final set of Tables with meaningful names and PKs and FKs:

5.- Do the relational model in 3NF:

PET ID	PET NAME	PET TYPE	PET AGE	OWNER	VISIT DATE	PROCEDURE
246	ROVER	DOG	12	SAM COOK	JAN 13/2002	01 - RABIES VACCINATION
					MAR 27/2002	10 - EXAMINE and TREAT WOUND
					APR 02/2002	05 - HEART WORM TEST
298	SPOT	DOG	2	TERRY KIM	JAN 21/2002	08 - TETANUS VACCINATION
					MAR 10/2002	05 - HEART WORM TEST
341	MORRIS	CAT	4	SAM COOK	JAN 23/2001	01 - RABIES VACCINATION
					JAN 13/2002	01 - RABIES VACCINATION
519	TWEEDY	BIRD	2	TERRY KIM	APR 30/2002	20 - ANNUAL CHECK UP
					APR 30/2002	12 - EYE WASH

6.- Do the relational model in 3NF:

INVOICE

HILLTOP ANIMAL HOSPITAL   DATE: JAN 13/2002
INVOICE # 987

MR. RICHARD COOK
123 THIS STREET
MY CITY, ONTARIO
Z5Z 6G6

PET	PROCEDURE	AMOUNT
ROVER	RABIES VACCINATION	30.00
MORRIS	RABIES VACCINATION	24.00

	TOTAL	54.00
	TAX (8%)	4.32
	AMOUNT OWING	58.32

7.- Do the relational model in 3NF:

Gallery Customer History Form

Gallery Customer History Form

Customer Name

Jackson, Elizabeth   Phone (206) 284-6783
123 – 4ᵗʰ Avenue
Fonthill, ON
L3J 4S4

Purchases Made

Artist	Title	Purchase Date	Sales Price
03 - Carol Channing	Laugh with Teeth	09/17/2000	7000.00
15 - Dennis Frings	South toward Emerald Sea	05/11/2000	1800.00
03 - Carol Channing	At the Movies	02/14/2002	5550.00
15 - Dennis Frings	South toward Emerald Sea	07/15/2003	2200.00

The Gill Art Gallery wishes to maintain data on their customers, artists and paintings. They may have several paintings by each artist in the gallery at one time. Paintings may be bought and sold several times. In other words, the gallery may sell a painting, then buy it back at a later date and sell it to another customer.

8.- Do the relational model in 3NF:

Good News Grocers

User View 1 - Price Update List

Department	Product Code	Aisle[1] Number	Price	Unit of Measure
Produce	4081	1	0.35	lb
Produce	4027	1	0.90	ea
Produce	4108	1	1.99	lb
Butcher	331100	5	1.50	lb
Butcher	331105	5	2.40	lb

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[1] http://www.wordreference.com/es/translation.asp?tranword=aisle

Butcher	332110	5	5.00	lb
Freezer	411100	6	1.00	ea
Freezer	521101	6	1.00	ea
Freezer	866503	6	5.00	ea
Freezer	866504	6	5.00	ea

This report is used by the department managers to update the prices that are displayed in the grocery store for these products.

9.- IESFBMOLL Computing wants to computerize their invoice system:

IESFBMOLL Computing		
INVOICE	Number: 1254	
	Date: 3/10/2018	

Customer NIF:	11111111-A
Customer name:	Sergio González Rubio
Address:	Caracas Street, 6
Postal Code:	07006
Town:	Palma
Phone:	634216316

Item List

Category	Code	Description	Price/Unit	Quantity	Price
RAM memmories	123	Samsung DDR3-1066 SO-DIMM (4 GB, 204 pines, PC3-8500)	34,95 €	2	69,90 €
RAM memmories	124	Crucial CT102464BF160B - Memoria RAM de 8 GB (DDR3L, 1600 MT/s, PC3L-12800, SODIMM, 204-Pin)	54,99 €	3	164,97 €
RAM memmories	215	Kingston KVR13N9S8K2/8 - Memoria RA	67,50 €	1	67,50 €
Processors	1012	AMD RYZEN 7 1700- Processor de 3.7 (	199,90 €	2	399,80 €
Motherboards	2003	Dell motherboard for OptiPlex GX170L 1	83,50 €	2	167,00 €
				Total:	869,17 €

Do the relational model in 3NF.

10.- Normalize up to 3NF the relation R (A, B, C, D, E, F) in which the following functional dependencies are given:
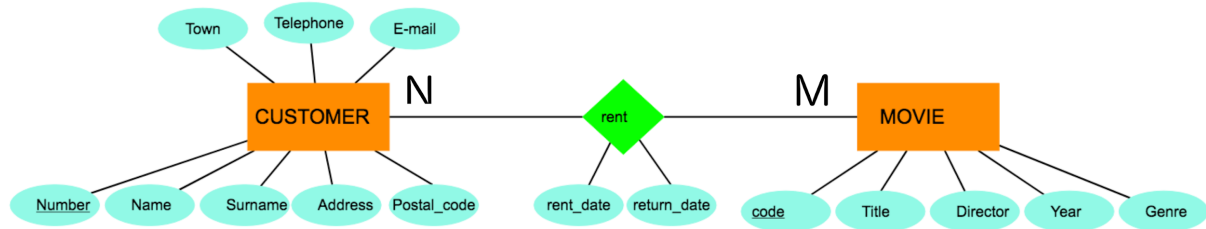- E → B
- C → A
- C, E ⇒ F
- A → D

11.- Normalize up to 3NF the relation R (A, B, C, D, E) in which the following functional dependencies are given:

- C, E ⇒ D
- D → B
- C → A

12.- Do the relational model in 3NF.
Entity-relationship model:

13.- Normalize up to 3NF.
R(Course, Teacher, Hour, Classroom, Student, Mark)
In which:
- Each course is done by a teacher.
- At one hour, in a classroom, a single course is done.
- At one hour, a teacher is only in a single classroom.
- Each student has a single mark for each course that he/she is enrolled.
- At one hour, a student is only in a single classroom.

14.- Normalize up to 3NF.
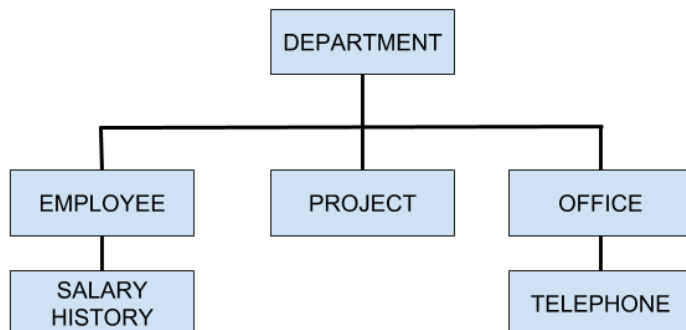
It is interesting to keep the following information:
- For each department: department number (unique), budget, and the number of the employee who is the department manager (unique).
- For each employee: employee number (unique), current project number, office number, personal telephone number, name of each job that has been held, description of each job, and amount and range of dates of each salary which he has received for each of these works.
- For each project: project number (unique) and budget.
- For each office: office number (unique), area in m^2, and numbers (unique) of all the phones in this office.

15.- Indicate the normal form of the following relationships and normalize them if necessary:
TRIPS (id_trip, departure_time, date, vehicle_plate, driver_id_card, driver_surname)
With the next functional dependencies:

- FD1: {id_trip, departure_time} → {vehicle_plate} → {driver_surname}
- FD1: {driver_id_card} → {driver_surname}

16.- An enterprise works with the following sheet:

Customer id	Name	Surname	Phone	Address
1	Brad	Pitt	90000001 60012312 61132199	504 Avenue, 23
2	Jennifer	Lawrence	97100012 97100013	525 Avenue, 3
3	George	Clooney	60012345	104 Avenue, 53
4	Jane	Fonda	97111111 97122222	14 Avenue, 2
...				

Customers (Customer id, Name, Surname, {Phone}, Address)

Translate to the 1NF, 2NF, and, finally, to the 3NF.

17.- An enterprise works with the following sheet:

Customer id	Name	Surname	Project	Budget	In charge	State
1	Brad	Pitt	Website12	12500	SGR	1
2	Jane	Fonda	DigiATM	50000	DGF	3
3	George	Clooney		49000		
1	Brad	Pitt	App15	25000	SGR	5

As you can see, a project can have many customers and a customer can have many projects. Every project has a single person in charge (and obviously that employee may be in charge of many projects).

CustomerProjects (Customer id, Name, Surname, Project, Budget, In charge, State)

Translate to the 1NF, 2NF, and, finally, to the 3NF.

18.- A shop rents video games. They work with a sheet with the following fields:

RENT (Videogame id, Title, Copy number, Customer num, Customer name, Customer phone number, rent date, rent number days)

Translate to the 1NF, 2NF, and, finally, to the 3NF.

19.- A college keeps data from students, professors, studies and subjects (inside those studies). The following considerations are assumed:

- A student must be enrolled in a single career (and maybe he/she is not enrolled in all the subjects of that career).
- There are subjects shared in different studies.
- A professor teaches a concrete subject (and he/she can teach many subjects).

They work with a sheet like this ones:

Student Id	Student Name	Student Surname	Subject Code	Subject Name	Professor Id	Professor Name	Studies Id	Studies Name
1001	Sergio	González	201	Databases	23	Michael Mann	2	Computer engineering
1001	Sergio	González	98	Programming I	12	Jane Smith	2	Computer engineering
1002	Laura	Palmer	98	Programming I	12	Jane Smith	1	Mathematics
...								

Translate to the 1NF, 2NF, and, finally, to the 3NF.

20.- A library is working with the following sheets:

Book Id	Title	Author	Editorial Id	Editorial Name	Reader Id	Reader Name	Start Date	End Date
12	Programming in C++	John Smith	12	Ra-Ma	23	Sergi González	12/1/17	19/1/17
23	Databases	Helen Furlong	14	McGraw Hill	28	Ana Ramis	15/2/18	22/2/18
12	Programming in C++	John Smith	12	Ra-Ma	23	Sergi González	1/3/17	8/3/17
...								

Translate to the 1NF, 2NF, and, finally, to the 3NF.