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Week 6 Lab

Database Normalization

[S23] Databases Course

Normalization 1NF

- **1NF criteria**
  - Primary key (no duplicate tuples)
  - No repeating groups
  - Atomic columns (each cell has a single value)
  - Values are of the same domain

1NF

Full Names	Physical Address	Movies Rented	Salutation
Janet Jones	First Street Plot No 4	Pirates of the Caribbean, Clash of the Titans	Ms.
Robert Phil	3rd Street 34	Forgetting Sarah Marshal, Daddy's Little Girls	Mr.
Robert Phil	5th Avenue	Clash of the Titans	Mr.

Full Names	Physical Address	Movies Rented	Salutation
Janet Jones	First Street Plot No 4	Pirates of the Caribbean	Ms.
Janet Jones	First Street Plot No 4	Clash of the Titans	Ms.
Robert Phil	3rd Street 34	Forgetting Sarah Marshal	Mr.
Robert Phil	3rd Street 34	Daddy's Little Girls	Mr.
Robert Phil	5th Avenue	Clash of the Titans	Mr.

Normalization 2NF

- **2NF criteria**
  - Relation in 1NF
  - No partial functional dependencies of non-prime attributes on candidate keys

2NF

Full Names	Physical Address	Movies Rented	Salutation
Janet Jones	First Street Plot No 4	Pirates of the Caribbean	Ms.
Janet Jones	First Street Plot No 4	Clash of the Titans	Ms.
Robert Phil	3rd Street 34	Forgetting Sarah Marshal	Mr.
Robert Phil	3rd Street 34	Daddy's Little Girls	Mr.
Robert Phil	5th Avenue	Clash of the Titans	Mr.

Membership ID	Full Names	Physical Address	Salutation
1	Janet Jones	First Street Plot No 4	Ms.
2	Robert Phil	3rd Street 34	Mr.
3	Robert Phil	5th Avenue	Mr.

Membership ID	Movies Rented
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans

Normalization 3NF

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- **3NF criteria**
  - Relation in 2NF
  - No transitive functional dependencies of non-prime attribute on candidate key

3NF

Membership ID	Movies Rented
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans

Membership ID	Full Names	Physical Address	Salutation
1	Janet Jones	First Street Plot No 4	Ms.
2	Robert Phil	3rd Street 34	Mr.
3	Robert Phil	5th Avenue	Mr.

Membership ID	Full Names	Physical Address	Salutation ID
1	Janet Jones	First Street Plot No 4	2
2	Robert Phil	3rd Street 34	1
3	Robert Phil	5th Avenue	1

Membership ID	Movies Rented
1	Pirates of the Caribbean
1	Clash of the Titans
2	Forgetting Sarah Marshal
2	Daddy's Little Girls
3	Clash of the Titans

Salutation ID	Salutation
1	Mr.
2	Ms.
3	Mrs.
4	Dr.

Normalization BCNF

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- **BCNF criteria**
  - Relation in 3NF
  - For any dependency X → Y, X must be a super key. In other words, for dependency X → Y, if Y is a prime attribute, X cannot be a non-prime attribute

Normalization 4NF

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- **4NF criteria**
  - Relation in BCNF
  - No multi-valued dependencies

Exercise 1

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a. Given the following relation, decompose it into 1NF, 2NF and 3NF. SQL queries for table creation and data insertion are attached on Moodle

orderId	date	customerId	customerName	city	itemId	itemName	quantity	price
2301	23/02/2011	101	Martin	Prague	3786	Net	3	$35,00
2301	23/02/2011	101	Martin	Prague	4011	Racket	6	$65,00
2301	23/02/2011	101	Martin	Prague	9132	Pack-3	8	$4,75
2302	25/02/2011	107	Herman	Madrid	5794	Pack-6	4	$5,00
2303	27/02/2011	110	Pedro	Moscow	4011	Racket	2	$65,00
2303	27/02/2011	110	Pedro	Moscow	3141	Cover	2	$10,00

Exercise 1: 1NF

All columns are atomic, no duplicate tuples and values are of the same domain. So, the relation is already in 1NF. And we can consider *orderId*, *customerId* and *itemId* as a candidate key.

orderId	date	customerId	customerName	city	itemId	itemName	quantity	price
2301	23/02/2011	101	Martin	Prague	3786	Net	3	$35,00
2301	23/02/2011	101	Martin	Prague	4011	Racket	6	$65,00
2301	23/02/2011	101	Martin	Prague	9132	Pack-3	8	$4,75
2302	25/02/2011	107	Herman	Madrid	5794	Pack-6	4	$5,00
2303	27/02/2011	110	Pedro	Moscow	4011	Racket	2	$65,00
2303	27/02/2011	110	Pedro	Moscow	3141	Cover	2	$10,00

Exercise 1: 2NF

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customerName and *city* depends only on *customerId; itemName* and *price* depends only on *itemId. customerId* and *date* and depends only on *orderId.* And the quantity is defined by *orderId* and *itemId*. Because of partial dependencies the relation is not in 2NF. Let us decompose

orderId	itemId	quantity
2301	3786	3
2301	4011	6
2301	9132	8
2302	5794	4
2303	4011	2
2303	3141	2

itemId	itemName	price
3786	Net	$35,00
4011	Racket	$65,00
9132	Pack-3	$4,75
5794	Pack-6	$5,00
3141	Cover	$10,00

customerId	customerName	city
101	Martin	Prague
107	Herman	Madrid
110	Pedro	Moscow

orderId	customerId	date
2301	101	23/02/2011
2302	107	25/02/2011
2303	110	27/02/2011

Exercise 1: 3NF

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The relations have no transitive functional dependencies. So, all the relations are already in 3NF

orderId	itemId	quantity
2301	3786	3
2301	4011	6
2301	9132	8
2302	5794	4
2303	4011	2
2303	3141	2

itemId	itemName	price
3786	Net	$35,00
4011	Racket	$65,00
9132	Pack-3	$4,75
5794	Pack-6	$5,00
3141	Cover	$10,00

customerId	customerName	city
101	Martin	Prague
107	Herman	Madrid
110	Pedro	Moscow

orderId	customerId	date
2301	101	23/02/2011
2302	107	25/02/2011
2303	110	27/02/2011

Exercise 1

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b. After normalization create next queries:

- Calculate the total number of items per order and the total amount to pay for the order
- Obtain the customer whose purchase in terms of money has been greater than the others

Exercise 2

a. Given the relationship *loan_books*, it is requested to apply the normalization rules 1NF, 2NF, 3NF, BCNF and 4NF. SQL queries for table creation and data insertion are attached on Moodle

school	teacher	course	room	grade	book	publisher	loanDate
Horizon Education Institute	Chad Russell	Logical Thinking	1.A01	1st grade	Learning and teaching in early childhood education	BOA Editions	09/09/2010
Horizon Education Institute	Chad Russell	Writing	1.A01	1st grade	Preschool N56	Taylor & Francis Publishing	05/05/2010
Horizon Education Institute	Chad Russell	Numerical Thinking	1.A01	1st grade	Learning and teaching in early childhood education	BOA Editions	05/05/2010
Horizon Education Institute	E.F.Codd	Spatial, Temporal and Causal Thinking	1.B01	1st grade	Early Childhood Education N9	Prentice Hall	06/05/2010
Horizon Education Institute	E.F.Codd	Numerical Thinking	1.B01	1st grade	Learning and teaching in early childhood education	BOA Editions	06/05/2010
Horizon Education Institute	Jones Smith	Writing	1.A01	2nd grade	Learning and teaching in early childhood education	BOA Editions	09/09/2010
Horizon Education Institute	Jones Smith	English	1.A01	2nd grade	Know how to educate: guide for Parents and Teachers	McGraw Hill	05/05/2010
Bright Institution	Adam Baker	Logical Thinking	2.B01	1st grade	Know how to educate: guide for Parents and Teachers	McGraw Hill	18/12/2010
Bright Institution	Adam Baker	Numerical Thinking	2.B01	1st grade	Learning and teaching in early childhood education	BOA Editions	06/05/2010

Exercise 2

b. After normalization create next queries:

- Obtain for each of the schools, the number of books that have been loaned to each publishers
- For each school, find the book that has been on loan the longest and the teacher in charge of it

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Thank you for attention

See you next week