

## Understanding how to get to 3NF stage in Normalization process

Unnormalized Data

### EXAMPLE DATA VIEW

Order Table			
Column Name	Data Type	Domain	Key
OrderNmbr	int	OrderNmbr	Yes
OrderDate	datetime	BusinessDate	
DeliveryDate	datetime	AnyDay	
CustomerNmbr	int	CustomerNmbr	Yes
CustomerName	nvarchar(50)	PeopleNames	
CustomerAddr	nvarchar(50)	StreetAddr	
CustomerCity	nvarchar(25)	CityName	
CustomerState	char(2)	USStateCode	
CustomerZip	char(5)	USZipCode5	
CustomerPhone	char(10)	USPhoneNmbr	
PartNmbr	nchar(6)	PartNmbr	Yes
PartDescription	nvarchar(30)	PartDescription	
PartColor	nvarchar(20)	Colors	
PartWeight	numeric(5,2)	USOunces	
PartCost	smallmoney	USCurrency	
OrderPartQty	smallint	Quantity	
OrderPartCost	smallmoney	USCurrency	
Subtotal	smallmoney	USCurrency	
Tax	smallmoney	USCurrency	
OrderTotal	smallmoney	USCurrency	

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### DATA VIEWS TO 1<sup>ST</sup> NORMAL FORM

- Split columns that are not atomic into separate columns for each part of the original column.
- Remove repeating groups
  - Place repeating groups in a new table
  - The key of the new table is built by combining the source table key and the repeating group key.

### 1<sup>ST</sup> NORMAL FORM EXAMPLE

Order Table			
Column Name	Data Type	Domain	Key
OrderNmbr	int	OrderNmbr	Yes
OrderDate	datetime	BusinessDate	
DeliveryDate	datetime	AnyDay	
CustNmbr	int	CustomerNmbr	Yes
CustFirstName	nvarchar(35)	FirstNames	
CustSurname	nvarchar(35)	Surnames	
CustAddrNmbr	nvarchar(10)	ValidStreetNmbr	
CustStreetName	nvarchar(25)	ValidStreetName	
CustAptNmbr	nvarchar(8)	ValidAptNmbr	
CustCity	nvarchar(25)	CityName	
CustState	char(2)	USStateCode	
CustZip	char(5)	USZipCode5	
CustPhone	char(10)	USPhoneNmbr	
Subtotal	smallmoney	USCurrency	
Tax	smallmoney	USCurrency	
OrderTotal	smallmoney	USCurrency	

OrderPart Table			
Column Name	Data Type	Domain	Key
OrderNmbr	int	OrderNmbr	Yes
PartNmbr	nchar(6)	PartNmbr	Yes
PartDescription	nvarchar(30)	PartDescription	
PartColor	nvarchar(20)	Colors	
PartWeight	numeric(5,2)	USOunces	
PartCost	smallmoney	USCurrency	
OrderPartQty	smallint	Quantity	
OrderPartCost	smallmoney	USCurrency	

Problem: some OrderPart columns only depend on the PartNmbr key.

### 1<sup>ST</sup> NORMAL FORM TO 2<sup>ND</sup> NORMAL FORM

- Remove partial key dependencies
  - Place columns that depend only on part of a primary key in a new table whose key is the key part that the columns depend on.

## Understanding how to get to 3NF stage in Normalization process

### 2<sup>ND</sup> NORMAL FORM EXAMPLE

Order Table			
Column Name	Data Type	Domain	Key
OrderNmbr	int	OrderNmbr	Yes
OrderDate	datetime	BusinessDate	
DeliveryDate	datetime	AnyDay	
CustNmbr	int	CustomerNmbr	Yes
CustFirstName	nvarchar(35)	FirstNames	
CustSurname	nvarchar(35)	Surnames	
CustAddrNmbr	nvarchar(10)	ValidStreetNmbr	
CustStreetName	nvarchar(25)	ValidStreetName	
CustAptNmbr	nvarchar(8)	ValidAptNmbr	
CustCity	nvarchar(25)	CityName	
CustState	char(2)	USStateCode	
CustZip	char(5)	USZipCode5	
CustPhone	char(10)	USPhoneNmbr	
Subtotal	smallmoney	USCurrency	
Tax	smallmoney	USCurrency	
OrderTotal	smallmoney	USCurrency	

OrderPart Table			
Column Name	Data Type	Domain	Key
OrderNmbr	int	OrderNmbr	Yes
PartNmbr	nchar(6)	PartNmbr	Yes
OrderPartQty	smallint	Quantity	
OrderPartCost	smallmoney	USCurrency	

Part Table			
Column Name	Data Type	Domain	Key
PartNmbr	nchar(6)	PartNmbr	Yes
PartDescription	nvarchar(30)	PartDescription	
PartColor	nvarchar(20)	Colors	
PartWeight	numeric(5,2)	USOunces	
PartCost	smallmoney	USCurrency	

Problem: the customer columns do not depend on OrderNmbr

### 2<sup>ND</sup> NORMAL FORM TO 3<sup>RD</sup> NORMAL FORM

- Remove non-key dependencies
  - Move columns that depend on a key that is not the primary key to a new table.
  - The primary key of the new table is the key on which all the moved columns depend.
  - The column(s) forming the key for the new table are left in the source table as a foreign key.

## Understanding how to get to 3NF stage in Normalization process

### 3<sup>RD</sup> NORMAL FORM EXAMPLE

Order Table			
Column Name	Data Type	Domain	Key
OrderNmbr	int	OrderNmbr	PK
OrderDate	datetime	BusinessDate	
DeliveryDate	datetime	AnyDay	
CustNmbr	int	CustomerNmbr	FK
Subtotal	smallmoney	USCurrency	
Tax	smallmoney	USCurrency	
OrderTotal	smallmoney	USCurrency	

OrderPart Table			
Column Name	Data Type	Domain	Key
OrderNmbr	int	OrderNmbr	PK, FK
PartNmbr	nchar(6)	PartNmbr	PK,FK
OrderPartQty	smallint	Quantity	
OrderPartCost	smallmoney	USCurrency	

Customer Table			
Column Name	Data Type	Domain	Key
CustNmbr	int	CustomerNmbr	PK
CustFirstName	nvarchar(35)	FirstNames	
CustSurname	nvarchar(35)	Surnames	
CustAddrNmbr	nvarchar(10)	ValidStreetNmbr	
CustStreetName	nvarchar(25)	ValidStreetName	
CustAptNmbr	nvarchar(8)	ValidAptNmbr	
CustCity	nvarchar(25)	CityName	
CustState	char(2)	USStateCode	
CustZip	char(5)	USZipCode5	
CustPhone	char(10)	USPhoneNmbr	

Part Table			
Column Name	Data Type	Domain	Key
PartNmbr	nchar(6)	PartNmbr	PK
PartDescr	Introduction to DB Design  r(30)	PartDescription	
PartColor	nvarchar(20)	Colors	
PartWeight	numeric(5,2)	USOunces	
PartCost	smallmoney	USCurrency	

Does this meet all business requirements?

### NORMALIZATION: FINAL STEPS

- Go through the normalization process against all of the forms, screens, and reports identified in the initial requirements gathering, along with all the data processing requirements.
- Merge tables
  - Combine the columns from all tables that share the same primary key.
- Validate against processing requirements
  - Ensure all organizational activities are modeled in the tables.

# Understanding how to get to 3NF stage in Normalization process

## TABLES WITH ORDER DATA

Order Table						
OrderNmbr	OrderDate	DeliveryDate	CustomerNmbr	Subtotal	Tax	Total
12345	16-Sep-11	20-Sep-11	34576	\$195.58	\$15.65	\$211.23

Customer Table									
CustNmbr	CustFirstName	CustSurname	CustAddrNmbr	CustStreetName	CustAptNmbr	CustCity	CustState	CustZip	CustPhone
34576	Daneel	Olivaw	3	Asimov Way	NULL	Aurora	WA	98099	(425)999-1232

Part Table				
PartNmbr	PartDescription	PartColor	PartWeight	PartCost
AB123BU	Widget	Blue	1.00	\$49.99
CD456RD	Thingy	Red	8.00	\$0.05
EF789GR	Dohickey	Green	9.25	\$1.25
GH012OR	Thingamabob	Orange	8.00	\$10.15

OrderPart Table			
OrderNmbr	PartNmbr	OrderPartQty	OrderPartCost
12345	AB123BU	2	\$99.98
12345	CD456RD	100	\$5.00
12345	EF789GR	40	\$50.00
12345	GH012OR	4	\$40.60

## 4<sup>TH</sup> NORMAL FORM

- A table should be in 3<sup>rd</sup> Normal Form, and also not contain multiple independent, multi-valued facts about an entity.

### Problematic

Class Table	
Column	Key
ClassID	PK
CourseID	PK,FK
InstructorID	PK,FK
RoomID	PK,FK
PeriodID	PK,FK
StudentID	PK,FK

### Better

Class Table	
Column	Key
ClassID	PK

ClassCourse Table	
Column	Key
ClassID	PK, FK
CourseID	PK, FK

ClassInstructor Table	
Column	Key
ClassID	PK, FK
InstructorID	PK, FK

ClassStudent Table	
Column	Key
ClassID	PK, FK
StudentID	PK, FK

ClassPeriod Table	
Column	Key
ClassID	PK, FK
PeriodID	PK, FK

ClassRoom Table	
Column	Key
ClassID	PK, FK
RoomID	PK, FK

Now, the normalized logical model whether it is 3NF or 4NF can be implemented on any RDBMS.

## **Understanding how to get to 3NF stage in Normalization process**

Source: [Introduction to DB Design on Normalization](#)