

Database Modeling

Normalization

1NF

1st Normal Form

Prerequisites

Tables, columns in place

All tables have a primary key

1NF

All cells should contain atomic data

A single cell can only contain 1 value

No repeating columns

Employee

EmployeeID	FirstName	LastName	Email	...
551	Les	Adams	ladams@	...
552	Jill	Baker	jbaker@	...
553	Stephen	Jackson	s.jackson@	...

Employee

EmployeeID	FirstName	LastName	Email	...	ComputerSerial
551	Les	Adams	ladams@	...	XP5435512
552	Jill	Baker	jbaker@	...	WA2324451
553	Stephen	Jackson	s.jackson@	...	BC32345412

Employee

EmployeeID	FirstName	LastName	Email	...	ComputerSerial
551	Les	Adams	ladams@	...	XP5435512 , XA5543231
552	Jill	Baker	jbaker@	...	WA2324451
553	Stephen	Jackson	s.jackson@	...	BC32345412 , ZZ87656, XX21312

Employee

EmployeeID	FirstName	LastName	Email	...	ComputerSerial
551	Les	Adams	ladams@	...	XP5435512, XAF543231
552	Jill	Baker	jbaker@	...	WA2324451
553	Stephen	Jackson	s.jackson@	...	BF32345412, ZZ87656, XX21312

violates 1NF

Employee

EmployeeID	FirstName	LastName	Email	...	ComputerSerial	ComputerSerial2	ComputerSerial3
551	Les	Adams	ladams@	...	XP5435512	XA5543231	
552	Jill	Baker	jbaker@	...	WA2324451		
553	Stephen	Jackson	s.jackson@	...	BC32345412	ZZ87656	XX21312

Solution

Employee

EmployeeID	FirstName	LastName	Email	...
551	Les	Adams	ladams@	...
552	Jill	Baker	jbaker@	...
553	Stephen	Jackson	s.jackson@	...

Computer

Serial	EmployeeID	Description	...
XP5435512	551	Dell Laptop	...
XA5543231	551	Apple MacBook	...
WA2324451	552	Acer Desktop	...
BC32345412	553	MacBook Pro	...
ZZ87656	553	HP Server	...
XX21312	553	iPad 3	...

Employee

EmployeeID	FirstName	LastName	Email	...
551	Les	Adams	ladams@	...
552	Jill	Baker	jbaker@	...
553	Stephen	Jackson	s.jackson@	...

Computer

Serial	EmployeeID	Description	...
XP5435512	551	Dell Laptop	...
XA5543231	551	Apple MacBook	...
WA2324451	552	Acer Desktop	...
BC32345412	553	MacBook Pro	...
ZZ87656	553	HP Server	...
XX21312	553	iPad 3	...

What about this?

id	name	last_name	address	zip
2	Claus	Bové	Victor Bendix Gade 6, 4.th	2100
3	Tove-Line Merete	Bitss	H.C Andersens vej 17	9210

What about this?

id	name	last_name	address	zip
2	Claus	Bové	Victor Bendix Gade 6, 4.th	2100
3	Tove-Line Merete	Bitss	H.C Andersens vej 17	9210

id	name	last_name	address	house_no	floor	zip
2	Claus	Bové	Victor Bendix Gade	6	4.th	2100
3	Tove-Line Merete	Bitss	H.C Andersens vej	17		9210

2NF

Second normal form:

"Any non-key field should be dependent on the entire primary key."

Events

Course	Date	CourseTitle	Room	Capacity	Available	...
SQL101	3/1/2013	SQL Fundamentals	4A	12	4	
DB202	3/1/2013	Database Design	7B	14	7	
SQL101	4/14/2013	SQL Fundamentals	7B	14	10	
SQL101	5/28/2013	SQL Fundamentals	12A	8	8	
CS200	4/15/2012	C Programming	4A	12	11	

Events

Course	Date	CourseTitle	Room	Capacity	Available	...
SQL101	3/1/2013	SQL Fundamentals	4A	12	4	
DB202	3/1/2013	Database Design	7B	14	7	
SQL101	4/14/2013	SQL Fundamentals	7B	14	10	
SQL101	5/28/2013	SQL Fundamentals	12A	8	8	
CS200	4/15/2012	C Programming	4A	12	11	

composite primary key

Events

Course	Date	CourseTitle	Room	Capacity	Available	...
SQL101	3/1/2013	SQL Fundamentals	4A	12	4	
DB202	3/1/2013	Database Design	7B	14	7	
SQL101	4/14/2013	SQL Fundamentals	7B	14	10	
SQL101	5/28/2013	SQL Fundamentals	12A	8	8	
CS200	4/15/2012	C Programming	4A	12	11	

composite primary key

Events

Course	Date	Room	Capacity	Available	...
SQL101	3/1/2013	4A	12	4	
DB202	3/1/2013	7B	14	7	
SQL101	4/14/2013	7B	14	10	
SQL101	5/28/2013	12A	8	8	
CS200	4/15/2012	4A	12	11	



Course

CourseID	Title	...
SQL101	SQL Fundamentals	...
DB202	Database Design	...
CS200	C Programming	...

3NF

Third normal form:

"No **non-key** field is dependent on
any other **non-key** field."

Events

Course	Date	Room	Capacity	Available	...
SQL101	3/1/2013	4A	12	4	
DB202	3/1/2013	7B	14	7	
SQL101	4/14/2013	7B	14	10	
SQL101	5/28/2013	12A	8	8	
CS200	4/15/2012	4A	12	11	

Course

CourseID	Title	...
SQL101	SQL Fundamentals	...
DB202	Database Design	...
CS200	C Programming	...

Events

Course	Date	Room	Capacity	Available	...
SQL101	3/1/2013	4A	12	4	
DB202	3/1/2013	7B	14	7	
SQL101	4/14/2013	7B	14	10	
SQL101	5/28/2013	12A	8	8	
CS200	4/15/2012	4A	12	11	

Course

CourseID	Title	...
SQL101	SQL Fundamentals	...
DB202	Database Design	...
CS200	C Programming	...

Events

Course	Date	Room	Available	...
SQL101	3/1/2013	4A	4	
DB202	3/1/2013	7B	7	
SQL101	4/14/2013	7B	10	
SQL101	5/28/2013	12A	8	
CS200	4/15/2012	4A	11	

Course

CourseID	Title	...
SQL101	SQL Fundamentals	...
DB202	Database Design	...
CS200	C Programming	...

Room

Room	Capacity
4A	12
7B	14
12A	8

OrderItem

ID	OrderID	ProductID	Quantity	UnitPrice	Total
10011	454	A43	4	\$10.00	\$40.00
10012	455	B56	2	\$5.00	\$10.00
10013	456	A22	1	\$9.99	\$9.99
10014	456	A43	55	\$10.00	\$550.00
10015	457	C77	10	\$75.00	\$750.00

OrderItem

ID	OrderID	ProductID	Quantity	UnitPrice	Total
10011	454	A43	4	\$10.00	\$40.00
10012	455	B56	2	\$5.00	\$10.00
10013	456	A22	1	\$9.99	\$9.99
10014	456	A43	55	\$10.00	\$550.00
10015	457	C77	10	\$75.00	\$750.00

OrderItem

ID	OrderID	ProductID	Quantity	UnitPrice	Total
10011	454	A43	4	\$10.00	\$40.00
10012	455	B56	2	\$5.00	\$10.00
10013	456	A22	1	\$9.99	\$9.99
10014	456	A43	55	\$10.00	\$550.00
10015	457	C77	10	\$75.00	\$750.00

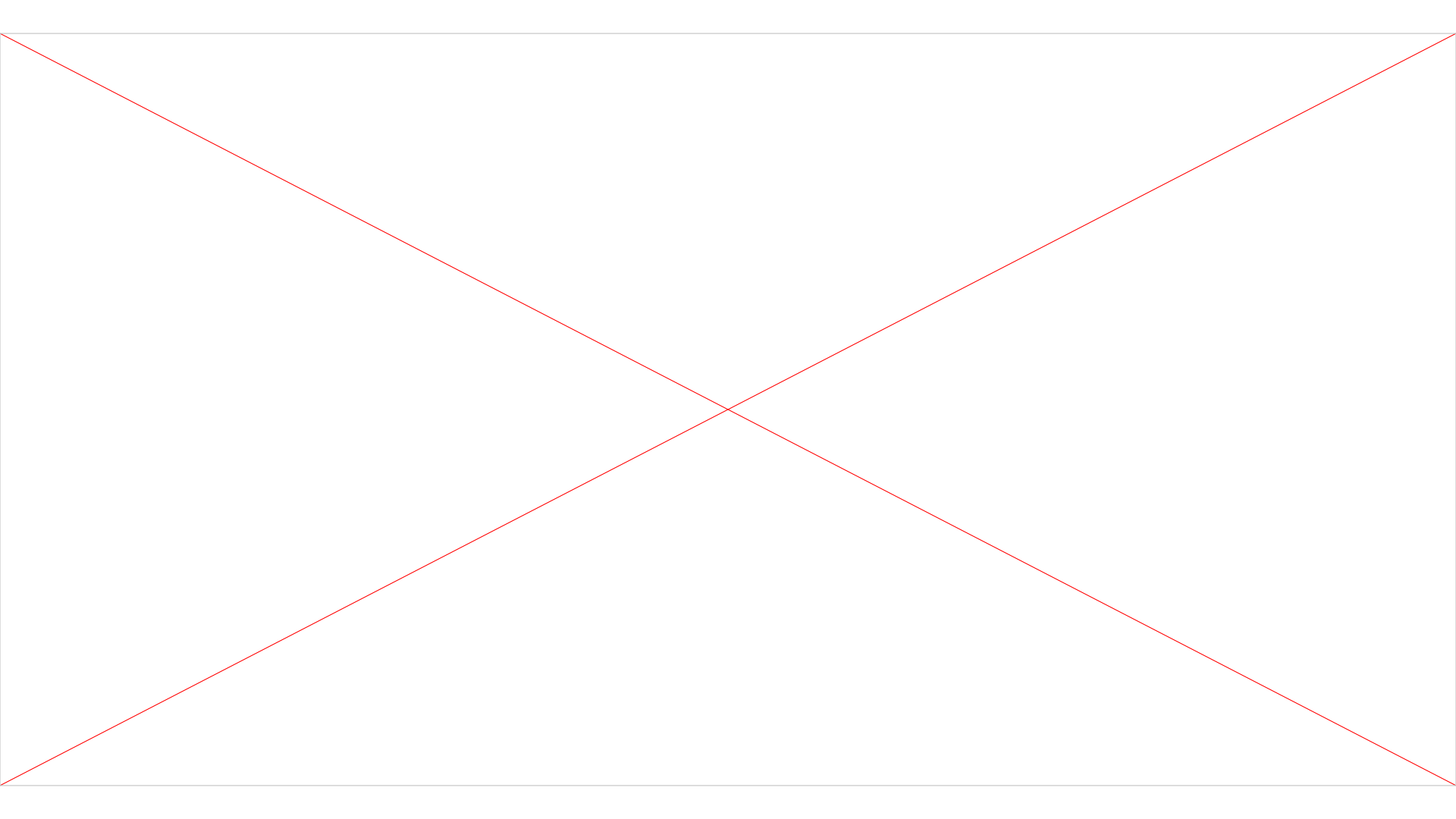
OrderItem

ID	OrderID	ProductID	Quantity	UnitPrice
10011	454	A43	4	\$10.00
10012	455	B56	2	\$5.00
10013	456	A22	1	\$9.99
10014	456	A43	55	\$10.00
10015	457	C77	10	\$75.00

OrderItem

ID	OrderID	ProductID	Quantity	UnitPrice	Total
10011	454	A43	4	\$10.00	\$40.00
10012	455	B56	2	\$5.00	\$10.00
10013	456	A22	1	\$9.99	\$9.99
10014	456	A43	55	\$10.00	\$550.00
10015	457	C77	10	\$75.00	\$750.00

if needed, a read-only
calculated column



Denormalization

Employee

EmployeeID	FirstName	LastName	Email	Phone	Email2	Phone2
551	Les	Adams	ladams@	555-555-1212	lesHome@...	
552	Jill	Baker	jbaker@	555-543-9876		555-543-7866
553	Stephen	Jackson	s.jackson@	555-101-2345	steve.j74@gm...	555-664-3168