

2NF

- A table is in second normal form if:
 - ✓ It is already in 1NF
 - ✓ **All non key attributes** are **dependent on ALL PARTS** of the primary key

A key attribute is one which is a primary key or part of a composite primary key.

Non key attributes are the attributes that are not a primary key or part of a composite primary key.

2NF Example

Student No.	First Name	Last Name	Address 1	Town	Post code	Gender
TR4678D	Joseph	Harvey	214 Aston Road	Birmingham	B57YH	M
YU7423O	Maria	Woods	47 West Bridge St.	Birmingham	B47UH	F

Key
Attribute

Already in 1NF, not in 2NF

Student No.	Course Code	Course Name	Teacher ID	Teacher Initial	Teacher Lastname	Date Completed	Grade
TR4678D	72846	German	12	H	Strausse	12-06-2011	B
TR4678D	20194	ICT	37	D	Barton	06-07-2011	B
YU7423O	20194	ICT	37	D	Barton	05-05-2011	C
YU7423O	56490	Geography	23	A	Revell	17-06-2011	D
YU7423O	72846	German	12	H	Strausse	13-06-2010	C

Already in 1NF, not in 2NF

In the top table, all non key attributes are dependent on primary key "Student No." (any 1NF table with a primary key that is just one field is already in 2NF)

Student No.	First Name	Last Name	Address 1	Town	Post code	Gender
TR4678D	Joseph	Harvey	214 Aston Road	Birmingham	B57YH	M
YU7423O	Maria	Woods	47 West Bridge St.	Birmingham	B47UH	F

Key
Attribute

Student No.	Course Code	Course Name	Teacher ID	Teacher Initial	Teacher Lastname	Date Completed	Grade
TR4678D	72846	German	12	H	Strausse	12-06-2011	B
TR4678D	20194	ICT	37	D	Barton	06-07-2011	B
YU7423O	20194	ICT	37	D	Barton	05-05-2011	C
YU7423O	56490	Geography	23	A	Revell	17-06-2011	D
YU7423O	72846	German	12	H	Strausse	13-06-2010	C

Already in 1NF, not in 2NF

In the bottom table
(1) "Course name" is dependent on "Course Code"
(2) Other non key attributes are dependent on both "Student No." and "Course Code"

Student No.	First Name	Last Name	Address 1	Town	Post code	Gender
TR4678D	Joseph	Harvey	214 Aston Road	Birmingham	B57YH	M
YU7423O	Maria	Woods	47 West Bridge St.	Birmingham	B47UH	F

Key
Attribute

Student No.	Course Code	Course Name	Teacher ID	Teacher Initial	Teacher Lastname	Date Completed	Grade
TR4678D	72846	German	12	H	Strausse	12-06-2011	B
TR4678D	20194	ICT	37	D	Barton	06-07-2011	B
YU7423O	20194	ICT	37	D	Barton	05-05-2011	C
YU7423O	56490	Geography	23	A	Revell	17-06-2011	D
YU7423O	72846	German	12	H	Strausse	13-06-2010	C

Student No.	First Name	Last Name	Address 1	Town	Post code	Gender
TR4678D	Joseph	Harvey	214 Aston Road	Birmingham	B57YH	M
YU7423O	Maria	Woods	47 West Bridge St.	Birmingham	B47UH	F

Course Code	Course Name
72846	German
20194	ICT
56490	Geography

Student No.	Course Code	Teacher ID	Teacher Initial	Teacher Lastname	Date Completed	Grade
TR4678D	72846	12	H	Strausse	12-06-2011	B
TR4678D	20194	37	D	Barton	06-07-2011	B
YU7423O	20194	37	D	Barton	05-05-2011	C
YU7423O	56490	23	A	Revell	17-06-2011	D
YU7423O	72846	12	H	Strausse	13-06-2010	C

In 2NF

2NF Exercise

Order No.	Order Date	Customer ID	Customer First Name	Customer Last Name	Customer Address 1	Town	Post Code	Total Price
1250	12/11/2012	AAC45	Barry	Baker	42 New St.	Birmingham	B27YH	\$22.5
1251	13/11/2012	ABD67	Joanne	Harris	13 Corporation St.	Birmingham	BS10 4QT	\$34

Order No.	Pizza Code	Pizza Name	Quantity	Price
1250	P	Pepperoni	1	\$5
1250	MF	Meat Feast	1	\$6.5
1250	V	Vegetarian	2	\$5.5
1251	HM	Ham& Mushroom	3	\$5
1251	MF	Meat Feast	2	\$6.5
1251	THO	The Hot One	1	\$6

How to normalize
these tables to
2NF?

Order No.	Order Date	Customer ID	Customer First Name	Customer Last Name	Customer Address 1	Town	Post Code	Total Price
1250	12/11/2012	AAC45	Barry	Baker	42 New St.	Birmingham	B27YH	\$22.5
1251	13/11/2012	ABD67	Joanne	Harris	13 Corporation St.	Birmingham	BS10 4QT	\$34

Order No.	Pizza Code	Quantity
1250	P	1
1250	MF	1
1250	V	2
1251	HM	3
1251	MF	2
1251	THO	1

Pizza Code	Pizza Name	Price
P	Pepperoni	\$5
MF	Meat Feast	\$6.5
V	Vegetarian	\$5.5
HM	Ham & Mushroom	\$5
THO	The Hot One	\$6

In 2NF

3NF

- A table is in third normal form if:
 - ✓ It is already in 2NF
 - ✓ All non key attributes are NOT dependent on any other non key attributes

Student No.	First Name	Last Name	Address 1	Town	Post code	Gender
TR4678D	Joseph	Harvey	214 Aston Road	Birmingham	B57YH	M
YU7423O	Maria	Woods	47 West Bridge St.	Birmingham	B47UH	F

3NF Example

Student No.	Course Code	Teacher ID	Teacher Initial	Teacher Lastname	Date Completed	Grade
TR4678D	72846	12	H	Strausse	12-06-2011	B
TR4678D	20194	37	D	Barton	06-07-2011	B
YU7423O	20194	37	D	Barton	05-05-2011	C
YU7423O	56490	23	A	Revell	17-06-2011	D
YU7423O	72846	12	H	Strausse	13-06-2010	C

Course Code	Course Name
72846	German
20194	ICT
56490	Geography

Already in 2NF, not in 3NF

Student No.	First Name	Last Name	Address 1	Town	Post code	Gender
TR4678D	Joseph	Harvey	214 Aston Road	Birmingham	B57YH	M
YU7423O	Maria	Woods	47 West Bridge St.	Birmingham	B47UH	F

Course Code	Course Name
72846	German
20194	ICT
56490	Geography

Student No.	Course Code	Teacher ID	Date Completed	Grade
TR4678D	72846	12	12-06-2011	B
TR4678D	20194	37	06-07-2011	B
YU7423O	20194	37	05-05-2011	C
YU7423O	56490	23	17-06-2011	D
YU7423O	72846	12	13-06-2010	C

Teacher ID	Teacher Initial	Teacher Lastname
12	H	Strausse
37	D	Barton
23	A	Revell

in 3NF

Order No.	Pizza Code	Quantity
1250	P	1
1250	MF	1
1250	V	2
1251	HM	3
1251	MF	2
1251	THO	1

Pizza Code	Pizza Name	Price
P	Pepperoni	\$5
MF	Meat Feast	\$6.5
V	Vegetarian	\$5.5
HM	Ham& Mushroom	\$5
THO	The Hot One	\$6

3NF Exercise

How to
normalize
these tables
to 3NF?

Order No.	Order Date	Customer ID	Customer First Name	Customer Last Name	Customer Address 1	Town	Post Code	Total Price
1250	12/11/2012	AAC45	Barry	Baker	42 New St.	Birmingham	B27YH	\$22.5
1251	13/11/2012	ABD67	Joanne	Harris	13 Corporation St.	Birmingham	BS10 4QT	\$34

Order No.	Order Date	Customer ID	Total Price
1250	12/11/2012	AAC45	\$22.5
1251	13/11/2012	ABD67	\$34

Order No.	Pizza Code	Quantity
1250	P	1
1250	MF	1
1250	V	2
1251	HM	3
1251	MF	2
1251	THO	1

Pizza Code	Pizza Name	Price
P	Pepperoni	\$5
MF	Meat Feast	\$6.5
V	Vegetarian	\$5.5
HM	Ham& Mushroom	\$5
THO	The Hot One	\$6

in 3NF

Customer ID	Customer First Name	Customer Last Name	Customer Address 1	Town	Post Code
AAC45	Barry	Baker	42 New St.	Birmingham	B27YH
ABD67	Joanne	Harris	13 Corporation St.	Birmingham	BS10 4QT

Normalization Exercise 1

- **Exercise:** Consider the table schema below. How to normalize it to 1NF, 2NF, 3NF?

Grade_report(StudentNo, StudentName, Major, AdvisorID, CourseNo, CourseTitle, InstructorID, InstructorOffice, Grade)

1NF:

Student (StudentNo, StudentFirstName, StudentLastName)

StudMajor(StudentNo, AdvisorID, Major)

StudCourse(StudentNo, CourseNo, CourseTitle, InstructorID, InstructorOffice, Grade)

Normalization Exercise 1(Cont.)

1NF:

Student (StudentNo, StudentFirstName, StudentLastName)

StudMajor(StudentNo, AdvisorID, Major)

StudCourse(StudentNo, CourseNo, CourseTitle, InstructorID, InstructorOffice, Grade)



2NF:

Student (StudentNo, StudentFirstName, StudentLastName)

StudAdvisor(StudentNo, AdvisorID)

AdvisorMajor(AdvisorID, Major)

StudCourse(StudentNo, CourseNo, Grade)

Course (CourseNo, CourseTitle, InstructorID, InstructorOffice)

Normalization Exercise 1(Cont.)

2NF:

Student (StudentNo, StudentFirstName, StudentLastName)

StudAdvisor(StudentNo, AdvisorID)

AdvisorMajor(AdvisorID, Major)

StudCourse(StudentNo, CourseNo, Grade)

Course (CourseNo, CourseTitle, InstructorID, InstructorOffice)



3NF:

Student (StudentNo, StudentFirstName, StudentLastName)

StudAdvisor(StudentNo, AdvisorID)

AdvisorMajor(AdvisorID, Major)

StudCourse(StudentNo, CourseNo, Grade)

Course (CourseNo, CourseTitle, InstructorID)

Instructor (InstructorID, InstructorOffice)

Exercise 2

DreamHome Customer Rental Details						
Customer Name		John Kay	Customer Number		CR76	
Property Number	Property Address	Rent Start	Rent Finish	Rent	Owner Number	Owner Name
PG4	6 Lawrence St, Glasgow	1-Jul-2014	31-Aug-2015	1500	CO40	Tina Murphy
PG16	5 Novar Dr, Glasgow	1-June-2013	30-June-2014	1350	CO93	Tony Shaw

Exercise 2 – Original Table

Customer_Rental Table Normalize this table to 3NF

Customer_No	Customer_Name	Property_No	Property_Address	RentStart	RentFinish	Rent	Owner_No	Owner_Name
CR76	John Kay	PG4	6 Lawrence St., Glasgow	1-Jul-2014	31-Aug-2015	1500	CO40	Tina Murphy
CR76	John Kay	PG16	5 Novar Dr, Glasgow	1-June-2013	30-June-2014	1350	CO93	Tony Shaw
CR56	Aline Stewart	PG4	6 Lawrence St, Glasgow	1-Oct-2012	30-Sep-2013	1500	CO40	Tina Murphy
CR56	Aline Stewart	PG36	2 Manor Rd, Glasgow	1-Dec-2013	1-Dec-2014	1100	CO93	Tony Shaw
CR56	Aline Stewart	PG16	5 Novar Dr, Glasgow	1-June-2015	1-June-2016	1350	CO93	Tony Shaw

Prop_Rental_Owner Table

Exercise 2 – Solution

Customer_No	Property_No	Property_Address	RentStart	RentFinish	Rent	Owner_No	Owner_Name
CR76	PG4	6 Lawrence St., Glasgow	1-Jul-2014	31-Aug-2015	1500	CO40	Tina Murphy
CR76	PG16	5 Novar Dr, Glasgow	1-June-2013	30-June-2014	1350	CO93	Tony Shaw
CR56	PG4	6 Lawrence St, Glasgow	1-Oct-2012	30-Sep-2013	1500	CO40	Tina Murphy
CR56	PG36	2 Manor Rd, Glasgow	1-Dec-2013	1-Dec-2014	1100	CO93	Tony Shaw
CR56	PG16	5 Novar Dr, Glasgow	1-June-2015	1-June-2016	1350	CO93	Tony Shaw

Customer Table

Customer_No	Customer_Name
CR76	John Kay
CR56	Aline Stewart

1NF

You can further split “Property-Address”, “Owner_Name”, “Customer_Name” into atomic attributes.

Customer Table

Customer_ No	Customer_ Name
CR76	John Kay
CR56	Aline Stewart

Property_Owner Table

Property_ No	Property_ Address	Rent	Owner_ No	Owner_ Name
PG4	6 Lawrence St., Glasgow	1500	CO40	Tina Murphy
PG16	5 Novar Dr, Glasgow	1350	CO93	Tony Shaw
PG36	2 Manor Rd, Glasgow	1100	CO93	Tony Shaw

Rental Table

Customer_ No	Property_ No	RentStart	RentFinish
CR76	PG4	1-Jul-2014	31-Aug-2015
CR76	PG16	1-June-2013	30-June-2014
CR56	PG4	1-Oct-2012	30-Sep-2013
CR56	PG36	1-Dec-2013	1-Dec-2014
CR56	PG16	1-June-2015	1-June-2016

2NF

Exercise 2 – Solution

Exercise 2 – Solution

Customer Table

Customer_ No	Customer_ Name
CR76	John Kay
CR56	Aline Stewart

Property_for_Rent Table

Property_ No	Property_ Address	Rent	Owner_ No
PG4	6 Lawrence St., Glasgow	1500	CO40
PG16	5 Novar Dr, Glasgow	1350	CO93
PG36	2 Manor Rd, Glasgow	1100	CO93

3NF

Rental Table

Customer_ No	Property_ No	RentStart	RentFinish
CR76	PG4	1-Jul-2014	31-Aug-2015
CR76	PG16	1-June-2013	30-June-2014
CR56	PG4	1-Oct-2012	30-Sep-2013
CR56	PG36	1-Dec-2013	1-Dec-2014
CR56	PG16	1-June-2015	1-June-2016

Owner Table

Owner_ No	Owner_ Name
CO40	Tina Murphy
CO93	Tony Shaw