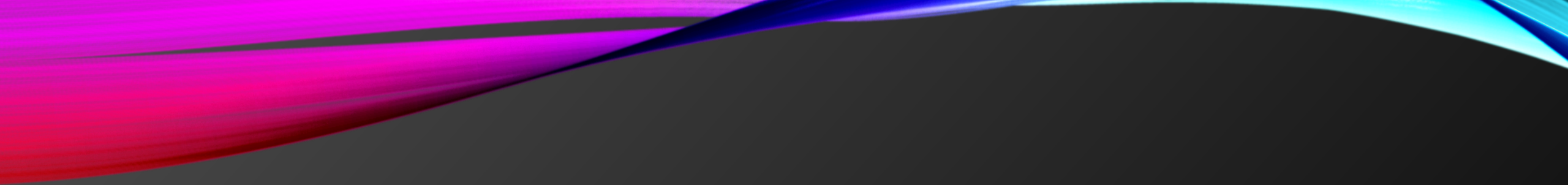




DATABASE DESIGN

Julie Allen 2024



DATABASE NORMALISATION

REMINDER...

1st Normal Form - a table is in 1NF if all the key attributes have been defined and:

- There are no repeating groups
- All data values are atomic
- Each field/attribute has a unique name
- Each table has a primary key

Tables in First Normal Form are still subject to the processing anomalies: (insert, update, delete), so we must carry on with normalisation.

SECOND & THIRD NORMAL FORM

2NF Conditions:

1. Tables are first in 1NF
2. All non-key attributes are dependent on ALL parts of the primary key

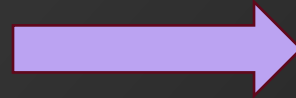
3NF Conditions:

1. Tables are first in 2NF
2. No non-key attributes are dependent on other non-key attributes.

DINOLAND GIFT SHOP IN 1NF

DinoLand Museum	
PK	Receipt Number

	DateOfSale
	TimeOfSale
	Item Name
	ItemDescription
	QtySold
	BuyingPrice
	SellingPrice
	DateLastBought
	QtyInStock
	StaffID
	StaffFirstName
	StaffSurname
	(more staff details)
	SupplierID
	SupplierName
	SupplierContactNo
	(more supplier details)



Sale	
PK	Receipt Number

	DateOfSale
	TimeOfSale
	StaffID
	StaffFirstName
	StaffSurname
	(more staff details)



Sale/Item		
PK	FK	Receipt Number
PK		ItemID

		ItemName
		ItemDescription
		QtySold
		BuyingPrice
		SellingPrice
		DateLastBought
		QtyInStock
		SupplierID
		SupplierName
		SupplierContactNo
		(more supplier details)

The repeating groups are the items on the receipt (sale). I have added a Receipt Number attribute for the primary key.

Note: I have also added an Item ID attribute as the products will have a product number to identify them.

THE JEWELLERS

Again, a Receipt ID attribute has been added and used as a primary key.

1052

MR-
MRS
MISS May REP 8693

ADDRESS 46 PR999D

Phone No. 0984808809

Nature Of Repair act fancy gate

blt.

Est to Rep -

Piece missing

Date Rec. 2/10 Price £37.50

Date Req. Phone/Calling



12a Chapel Street
Chorley, PR7 1BW
Tel: 01257 264125


JEWELLERS

Burns E-Commerce Ltd t/a Burns Jewellers
12a Chapel Street
Chorley PR7 1BW
Phone: 01257 264125
VAT Number: 221 2347 55

9001001
JEWELLERY REPAIRS
JEWELLERY REPAIRS
Q: Repair Reference
A: 8693
£37.50

9001001
JEWELLERY REPAIRS
JEWELLERY REPAIRS
Q: Repair Reference
A: 8694
£20.00

Total: £57.50

Paid By: Credit/Debit £57.50

No Change Due

Customer Information

Customer: 433840
Name: May

28/11/2015 12:59 004-01-17155
LIZ Items: 2



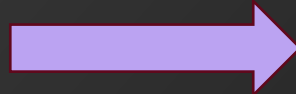
Thank You - Please Call Again

THANK YOU FOR YOUR CUSTOM
We offer an exchange or credit note
on most purchases within 30 days. This
does not affect your statutory rights.

Jewellers	
PK	ReceiptID
StoreName	
StoreAddress1	
StorePostcode	
(other store details)	
Date	
Time	
NoOfItems	
SalesAssistantFirstName	
SalesAssistantSurname	
(other sales assistant details)	
CustomerID	
CustomerFirstName	
CustomerSurname	
CustomerTelephoneNo	
(other customer details)	
RepairReference	
RepairItem	
RepairDescription	
RepairCost	
DateOfCollection	

Jewellers	
PK	ReceiptID

StoreName	
StoreAddress1	
StorePostcode	
(other store details)	
Date	
Time	
NoOfItems	
SalesAssistantFirstName	
SalesAssistantSurname	
(other sales assistant details)	
CustomerID	
CustomerFirstName	
CustomerSurname	
CustomerTelephoneNo	
(other customer details)	
RepairReference	
RepairItem	
RepairDescription	
RepairCost	
DateOfCollection	



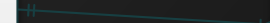
Receipt	
PK	ReceiptID

StoreName	
StoreAddress1	
StorePostcode	
(other store details)	
Date	
Time	
NoOfItems	
SalesAssistantFirstName	
SalesAssistantSurname	
(other sales assistant details)	
CustomerID	
CustomerFirstName	
CustomerSurname	
CustomerTelephoneNo	
(other customer details)	

THE JEWELLERS IN 1NF

Repair		
PK	FK	ReceiptID
PK		RepairReference

		RepairItem
		Repair Description
		RepairCost
		DateOfCollection



The repeating groups
are the repair items.

COLLEGE BATCH MARKING SYSTEM

Batch Number	Tutor Code	Assigns Marked	Date Sent	Date Returned	Student Code	Course Code	Assign Number
23	JS	87	12/4/07	07/5/07	20071230	PR007	3
					20078001	AB003	1
					20070239	PR009	7
24	GH	91	21/09/07	15/10/07	20078001	AB003	4
					20079851	GM201	3

Batch Number is the obvious primary key.

College	
PK	BatchNumber
	TutorCode
	TutorFirstName
	TutorSurname
	TutorAddressLine1
	(more tutor details)
	AssignmentsMarked
	DateSent
	DateReceived
	StudentCode
	StudentFirstName
	StudentSurname
	(other student details)
	CourseCode
	CourseName
	(other course details)
	AssignmentNo

COLLEGE BATCH MARKING SYSTEM IN 1NF

College	
PK	BatchNumber

	TutorCode
	TutorFirstName
	TutorSurname
	TutorAddressLine1
	(more tutor details)
	AssignmentsMarked
	DateSent
	DateReceived
	StudentCode
	StudentFirstName
	StudentSurname
	(other student details)
	CourseCode
	CourseName
	(other course details)
	AssignmentNo

The repeating group
are the assignments
within the batch.

Batch	
PK	Batch Number

	TutorCode
	TutorFirstName
	TutorSurname
	TutorAddressLine1
	(more tutor details)
	AssignmentsMarked
	DateSent
	DateReceived

BatchDetails	
PK	FK
	BatchNumber
PK	StudentCode
PK	CourseCode
PK	AssignmentNo

	StudentFirstName
	StudentSurname
	(other student details)
	CourseName
	(other course details)
	Grade

Note the composite primary key. Why do you think we have had to use so many attributes to guarantee each record is unique?

A WORKED EXAMPLE ONF – 3NF

Customer Purchasing System

Sales System - ONF	
PK	Customer No
	Title
	First Name
	Surname
	Street
	City
	Postcode
	Credit limit
	Balance
	Product No
	Product Description
	Product Price
	Qty Required
	Supplier No
	Supplier Name
	Other Supplier Details

ONF TO 1NF

Removes repeating groups...

If Customer No is the Primary key to the Customer, what are the repeating groups?

Sales System - ONF	
PK	Customer No

	Title
	First Name
	Surname
	Street
	City
	Postcode
	Credit limit
	Balance
	Product No
	Product Description
	Product Price
	Qty Required
	Supplier No
	Supplier Name
	Other Supplier Details

First Normal Form (1NF)

Removes repeating groups...

- There are no repeating groups
- All data values are atomic
- Each field/attribute has a unique name
- Each table has a primary key

Customer	
PK	Customer No

	Title
	First Name
	Surname
	Street
	City
	Postcode
	Credit limit
	Balance

Purchase	
PK	Customer No
FK	
PK	Product No

	Product Description
	Product Price
	Qty Required
	Supplier No
	Supplier Name
	Other Supplier Details



SECOND NORMAL FORM – 2NF

(Part Key Dependency)

1. Tables are first in 1NF
2. All non-key attributes are dependent on ALL parts of the primary key

In other words, we need to look at attributes in relation to the key, looking for part key dependencies...

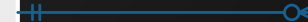
Second Normal Form (2NF)

Remove part key dependencies...

All non-key attributes must be dependent on the whole of the key

Customer	
PK	Customer No
	Title
	First Name
	Surname
	Street
	City
	Postcode
	Credit limit
	Balance

Purchase	
PK	Customer No
FK	
PK	Product No
	Product Description
	Product Price
	Qty Required
	Supplier No
	Supplier Name
	Other Supplier Details



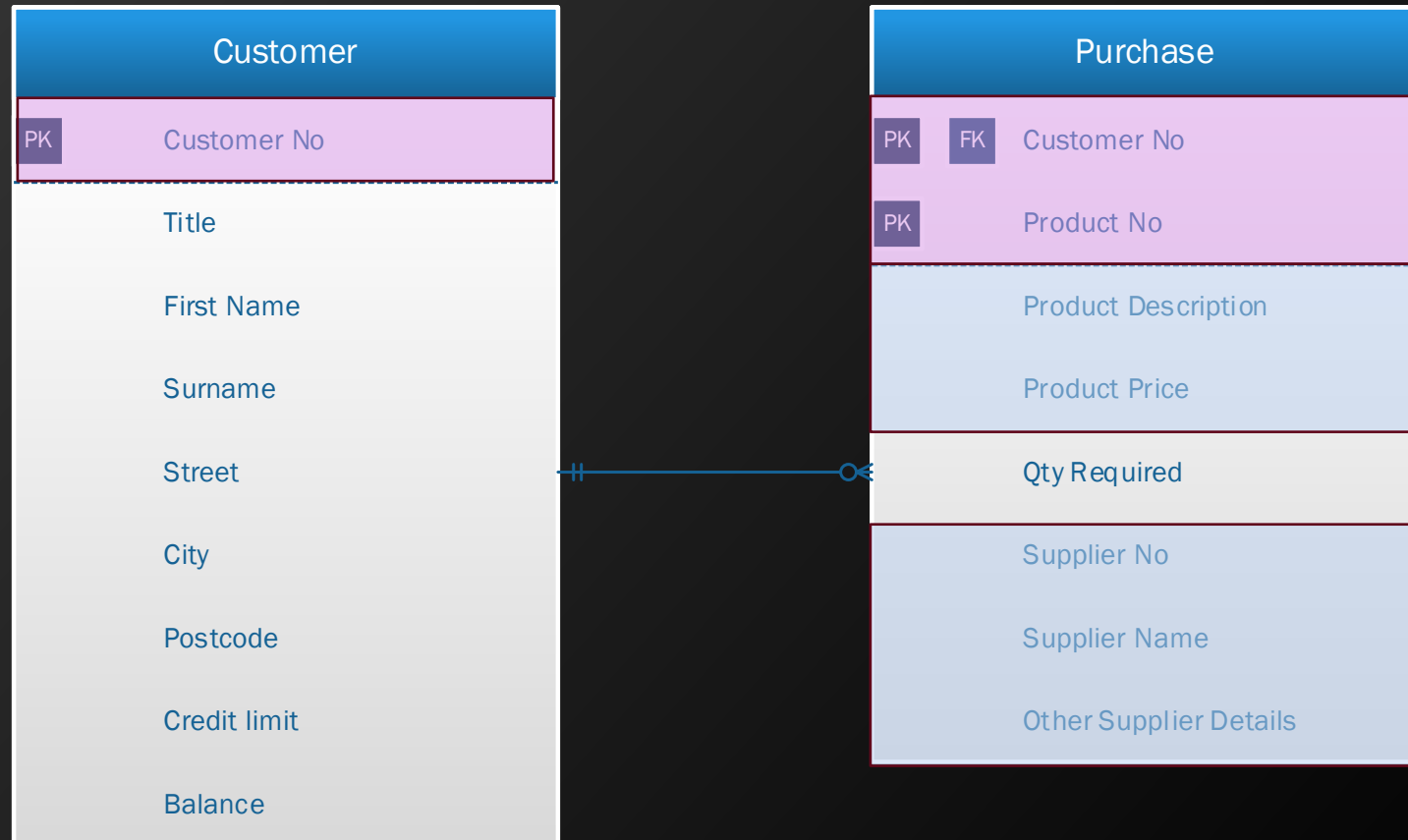
Transforming to Second Normal Form (2NF)...

Remove part key dependencies...

The Customer table is already in 2NF as key is only made up of one attribute.

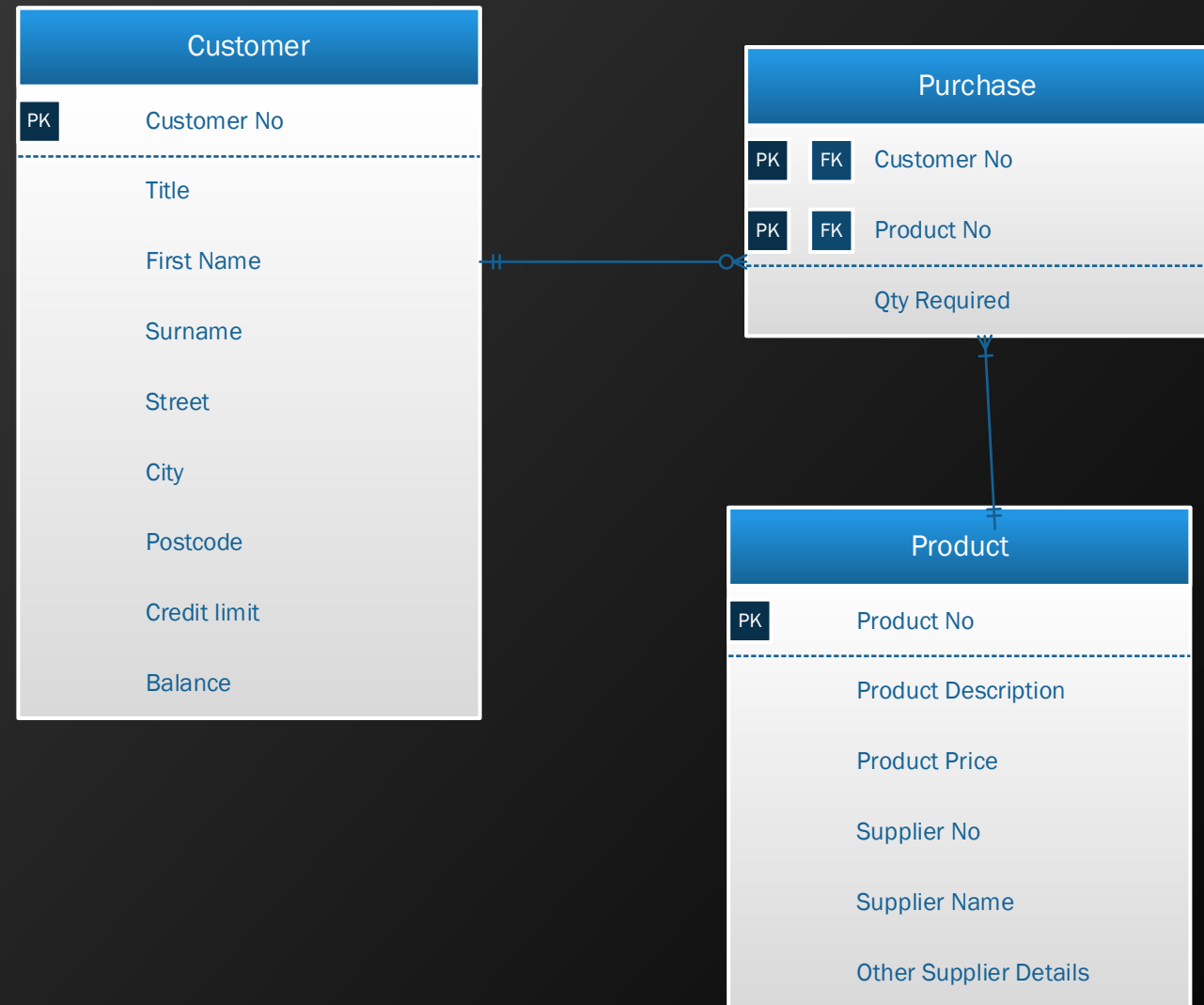
The Purchase table needs closer examination as the key is made up of two attributes.

Only QtyRequired is dependent on the whole of the key.



Second Normal Form (2NF)

There are now
no part-key
dependencies



THIRD NORMAL FORM – 3NF

(Transitive Dependencies)

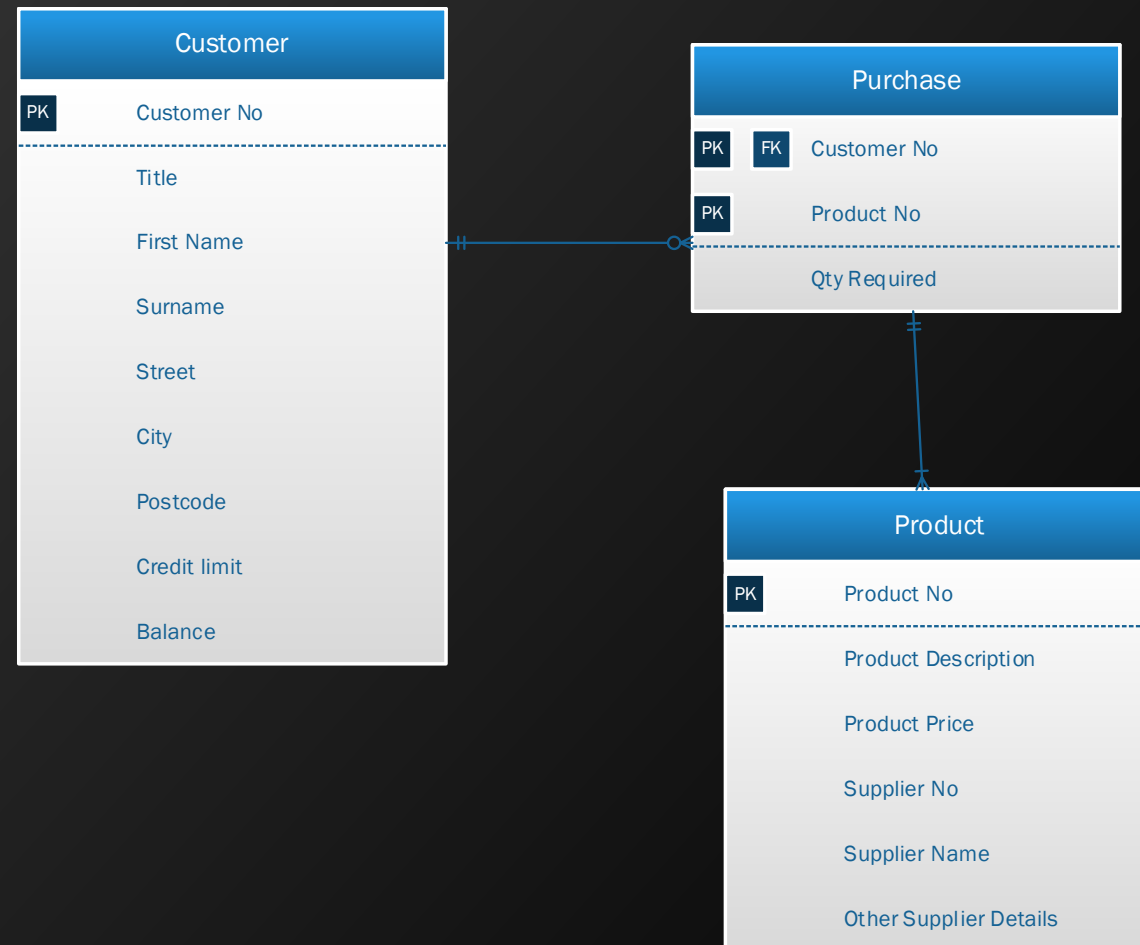
1. Tables are first in 2NF
2. No non-key attributes are dependent on other non-key attributes

In other words, every non key attribute must be dependent on the key, the whole key, and nothing but the key

Third Normal Form (3NF)

Remove transitive dependencies...

Every attribute must be dependent on the key, the whole key, and nothing but the key



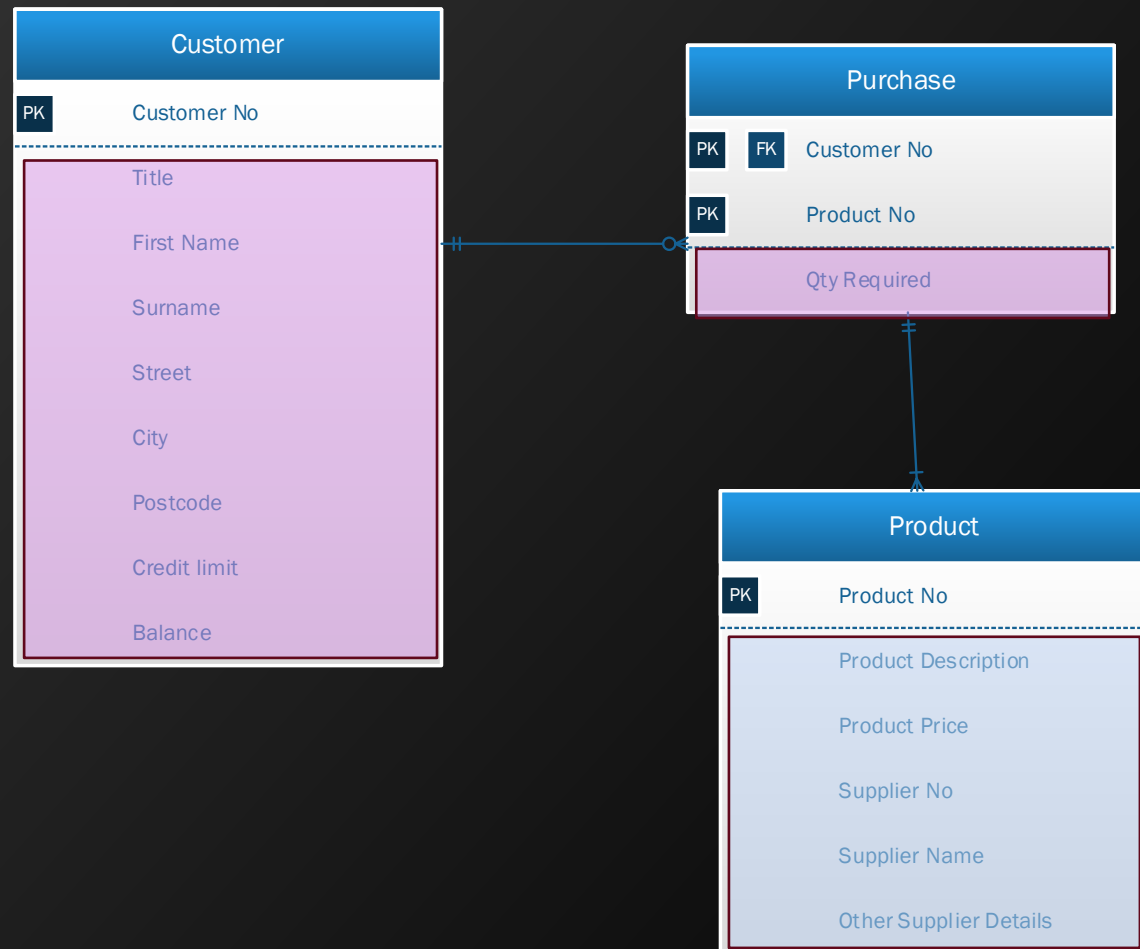
Transforming to Third Normal Form (3NF)...

Remove transitive Dependencies...

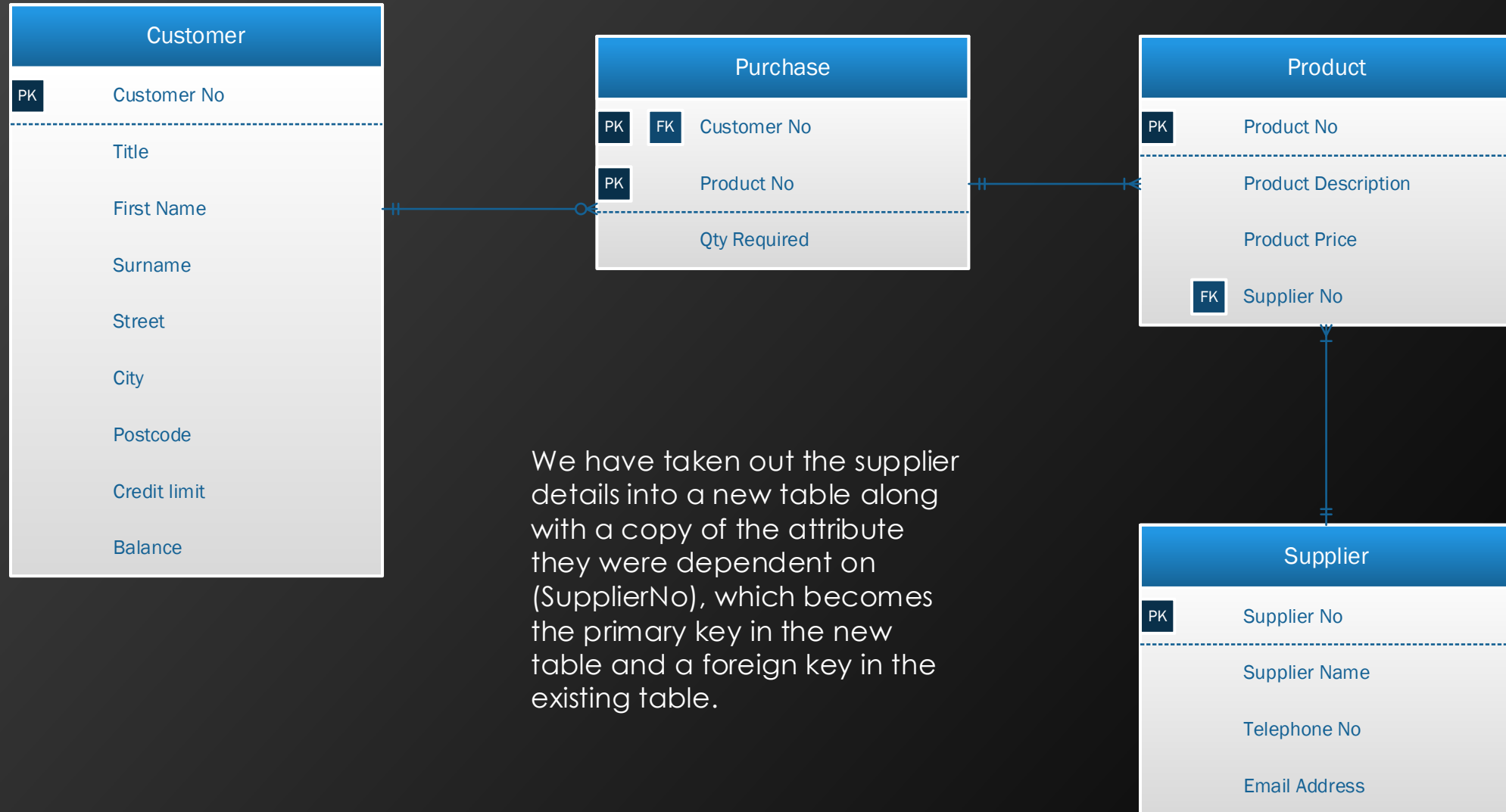
All attributes on the Customer table are wholly dependent on Customer No and not on other non-key attributes

In the Purchase table there is only one non-key attribute (QtyRequired), and this is wholly dependent on all parts of the primary key.

In the Product table the supplier details are dependent on a non-key attribute (SupplierNo)



Sales System in (3NF)



THE CIRCUS ONF – 3NF

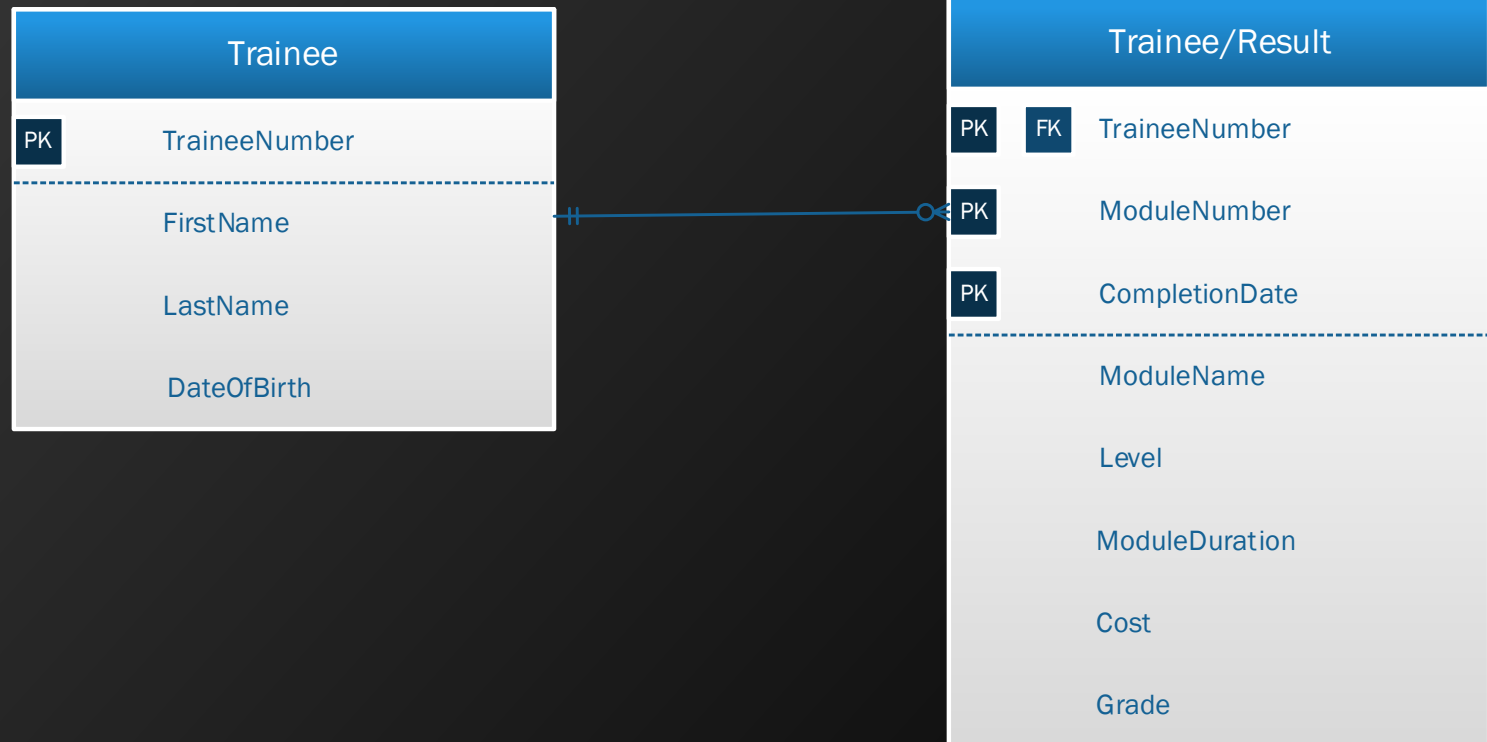


Circus Skills – Sample Data

Trainee Number	Title	First Name	Surname	Date of Birth	Address Line 1	Town/City	County	Postcode	Tel No	Module Number	Module Name	Level	Module Duration (days)	Cost	Assessment Date	Result
1235	Mr	Steve	Caswell	12/09/1985	32 Chestnut Close	Ramsgate	Cumbria	OL5 5DQ	01772 763425	250	Intermediate Static Trapeze	2	24	£50	21/02/2012	Distinction
1234	Rev	Brian	Broadgate	09/08/1980	Town Lane	Manchester	Greater Manchester	ML6 7FJ	01252 727 850	101	Learning to balance	1	15	£35	10/07/2012	Distinction
1235	Mr	Steve	Caswell	12/09/1985	32 Chestnut Close	Ramsgate	Cumbria	OL5 5DQ	01772 763425	102	Fire Eating for beginners	1	12	£30	11/07/2012	Distinction
1223	Miss	Clare	Croston	15/08/1998	15 Sure Street	Leyland	Lancashire	PR5 9GW	01772 678453	100	Learning to juggle	1	12	£25	14/07/2012	Pass
1222	Mrs	Lauren	Fazackerley	13/08/1978	21 Abbotts Road	London	Greater London	L56 7GH	0171 834 6337	200	Acrobatic Balancing	2	18	£48	22/07/2012	Pass
1223	Miss	Clare	Croston	15/08/1998	15 Sure Street	Leyland	Lancashire	PR5 9GW	01772 678453	100	Learning to juggle	1	12	£25	23/07/2012	Fail
1222	Mrs	Lauren	Fazackerley	13/08/1978	21 Abbotts Road	London	Greater London	L56 7GH	0171 834 6337	252	Intermediate fire eating	2	18	£45	29/07/2012	Merit
1234	Rev	Brian	Broadgate	09/08/1980	Town Lane	Manchester	Greater Manchester	ML6 7FJ	01252 727 850	210	Flying Trapeze	2	20	£58	25/08/2012	Pass
1259	Miss	Patricia	Smithies	14/09/1966	27 Croston Road	Preston	Lancashire	PR5 3JL	01772 567685	330	Advanced Juggling	3	24	£75	25/08/2012	Merit
1234	Rev	Brian	Broadgate	09/08/1980	Town Lane	Manchester	Greater Manchester	ML6 7FJ	01252 727 850	252	Intermediate fire eating	2	18	£45	01/09/2012	Pass
1254	Mr	Steven	Buchanan	13/08/1986	14 Garrett Hill	London	Greater London	SW1 8JR	0171 5554848	252	Intermediate fire eating	2	18	£45	20/09/2012	Pass
1235	Mr	Steve	Caswell	12/09/1985	32 Chestnut Close	Ramsgate	Cumbria	OL5 5DQ	01772 763425	330	Advanced Juggling	3	24	£75	30/11/2012	Distinction

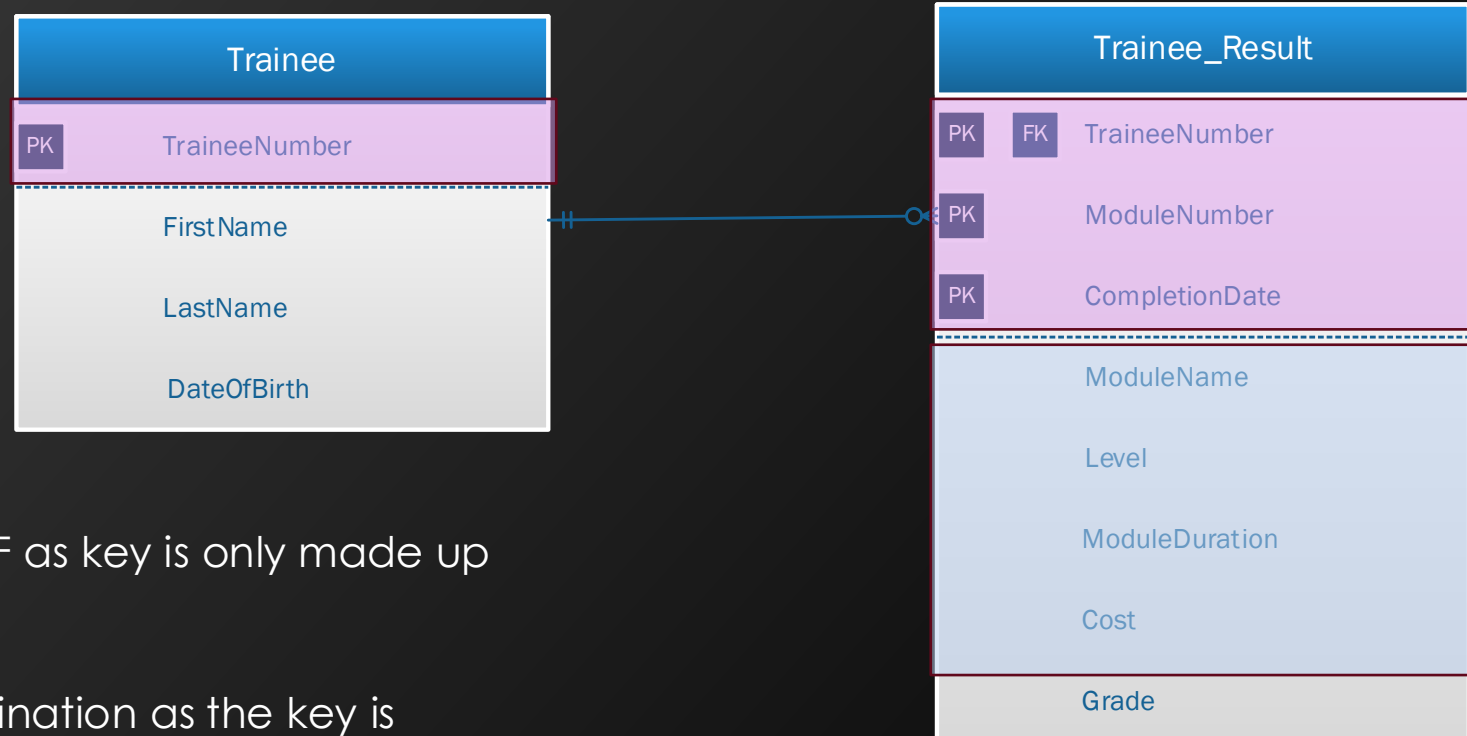
First Normal Form (1NF)...

- There are no repeating groups
- All data values are atomic
- Each field/attribute has a unique name
- Each table has a primary key



Transforming to Second Normal Form (2NF)...

(Part Key Dependency)

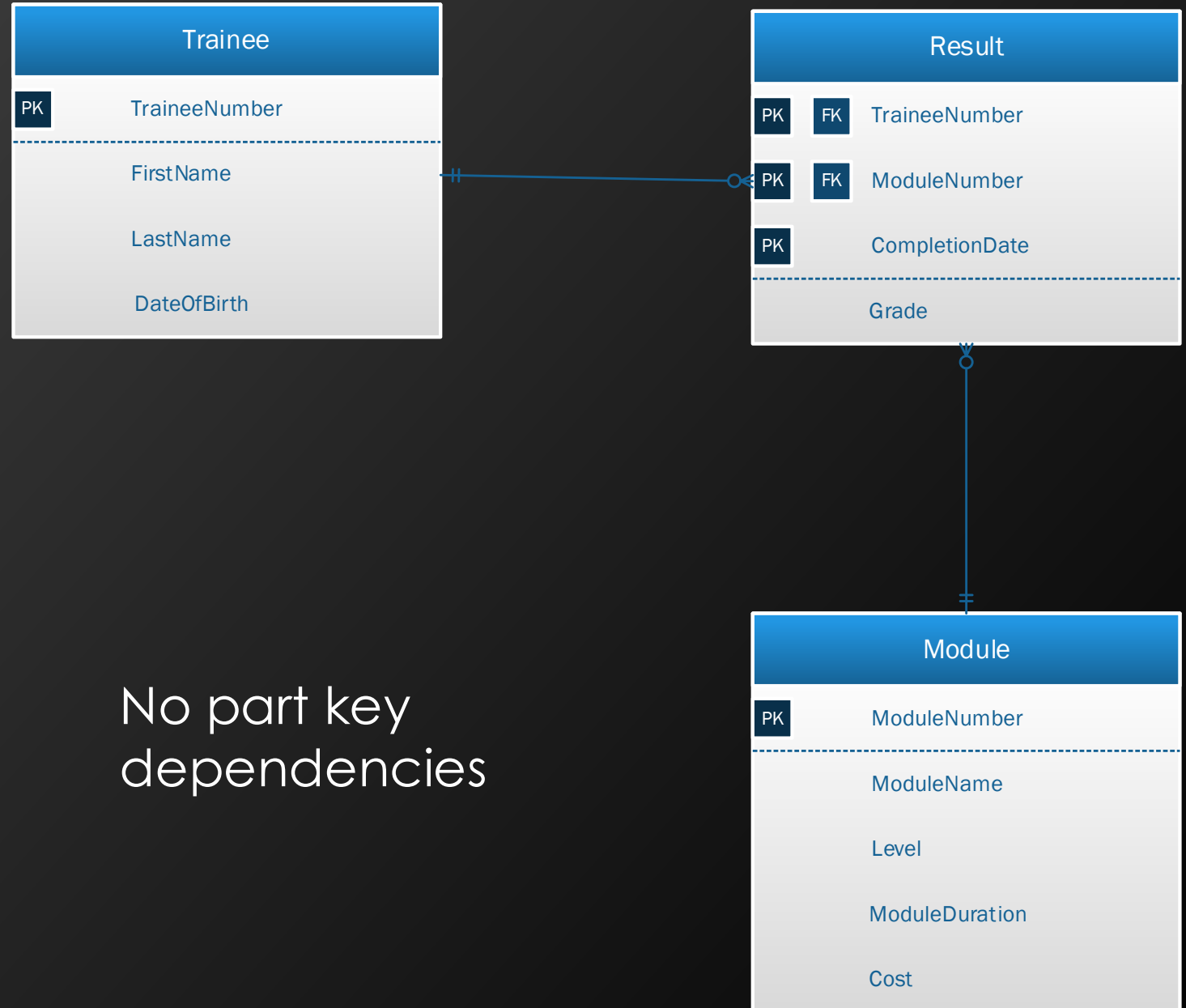


The Trainee table is already in 2NF as key is only made up of one attribute.

Trainee Result needs closer examination as the key is made up of three attributes.

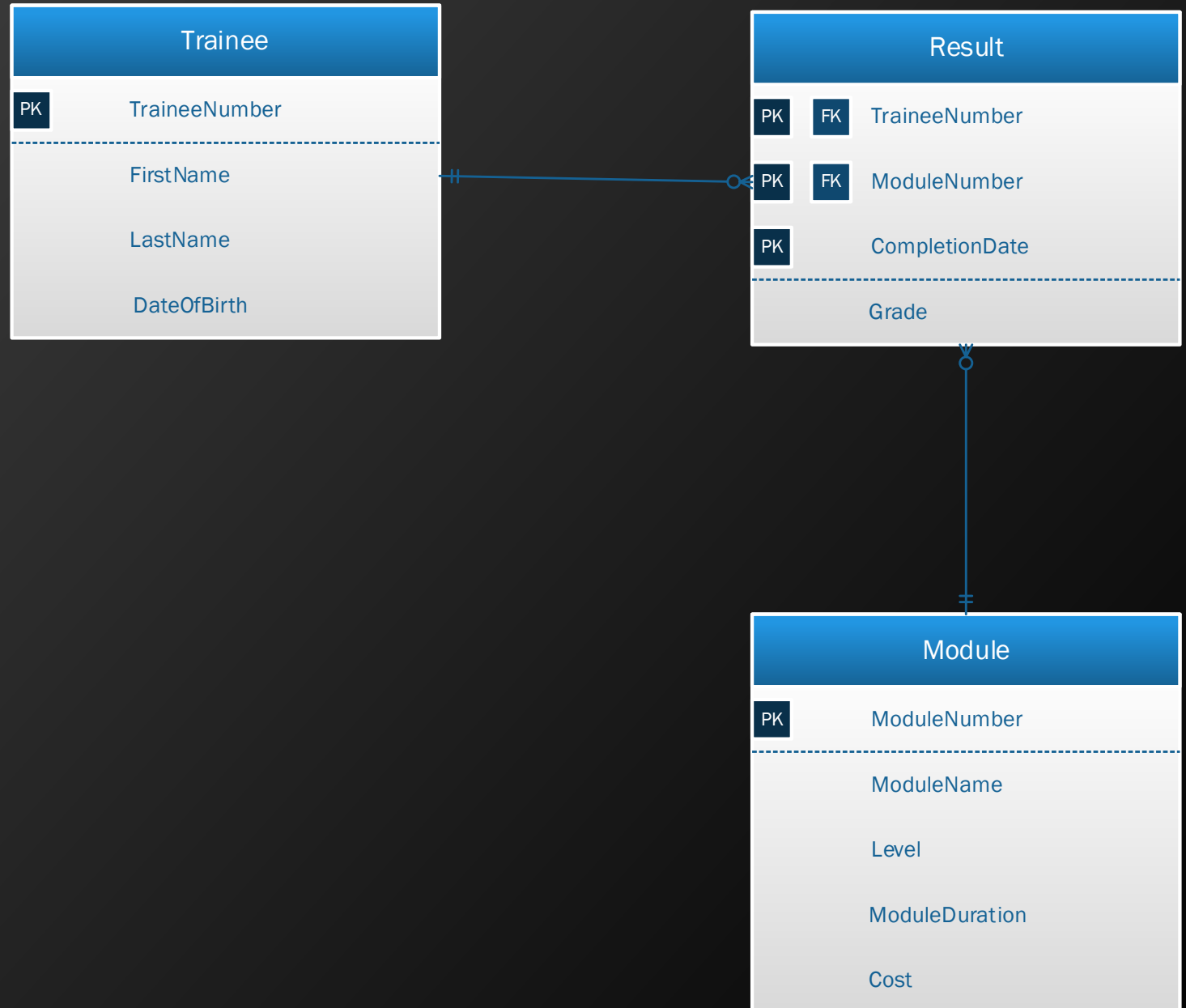
The Circus in Second Normal Form (2NF)

No part key
dependencies

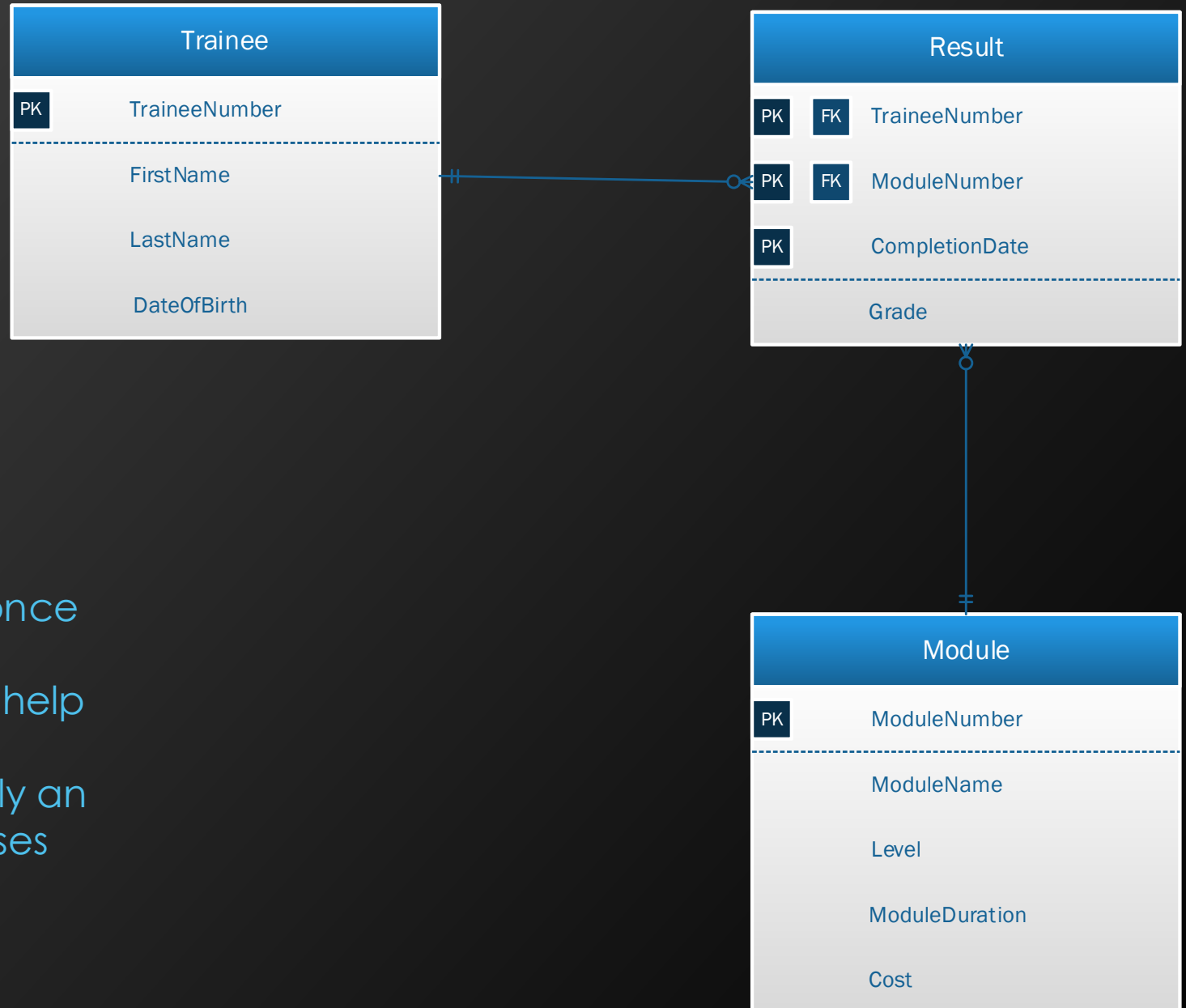


Third Normal Form (3NF)

All three tables are already in 3NF, as all non-key attributes depend on the primary key (no transitive dependencies).



Normalisation



- Each item of data is only held once within a database.
- Various stages of normalization help databases do this.
- Third Normal Form (3NF) is usually an adequate structure for databases

DE-NORMALISATION

De-normalisation is the process of undoing the normalisation process to allow redundant data in the database. In other words, we have fewer tables with fewer joins.

- Increases performance.
- Reduces the read time of queries.
- Reduces the complexity of the code.
- Should be carried out with care to ensure it doesn't have a negative effect on the integrity of the data. The benefits should outweigh the negatives.

SUMMARY

- Normalisation is a set of procedures that aid in the design of databases.
- Normalisation is used as part of the database design process and complements the ERD design technique.
- Normalisation removes unnecessary redundancy from a database.
- Normalisation can identify potential anomalies in the database.
- Normalisation is a multi-stage process where the product of each stage is referred to as a Normal Form.
- Normal Forms 1NF, 2NF, 3NF and Boyce-Codd are the most significant.

RESOURCES

- Richie, C. (2008). *Database Principles and Design*. 3rd Ed. Thompson Learning
- [Normalisation 1NF: Understanding and applying First Normal Form \(youtube.com\)](#)
- [Normalisation 1NF: First Normal Form Example \(youtube.com\)](#)
- [Normalisation 2NF: Understanding and Applying Second Normal Form \(youtube.com\)](#)
- [Normalisation 2NF: Second Normal Form Example \(youtube.com\)](#)
- [Normalisation 3NF: Understanding Third Normal Form \(youtube.com\)](#)
- [Normalisation 3NF: Third Normal Form Example \(youtube.com\)](#)