

WELCOME

C0558 Database Design

About me: kompel.campion@bucks.ac.uk

- Career: IS & Service Manager for a well known telecommunications retailer
- Education: MSc Information Technology (Bucks) and Fellow of Higher Education Academy
- Teaching Experience: Bucks University & Open University
- Specialization: Databases, IT Service Management and Project Management

About you

- Introduce yourself
- What are you expecting from this module
- Your experience of databases

Learning outcomes

Learning about the fundamental theories of relational database design and management.

1. General grounding in the fundamental theories of relational database design and management
2. Relational **data analysis and entity relationship modelling**
3. Techniques of data: **Normalization to 3NF**
4. The use of **SQL**: DML (Structured Query Language : Data Manipulation Language) to query a relational database
5. Explain use of **transaction processing and concurrency control and database recovery** in a large-scale database environment

Module content

Week by Week Guide:	
Week 1: beginning 01/10/2018	<p>Introduction to CO558 Dabase Design</p> <p>Module plan</p> <p>Reading list</p> <p>Assessment schedule</p> <p>Lesson: Tables (flat files) & Normalization</p> <p>Learning Objectives</p> <p>Understand the importance of data</p> <p>Understand the beginnings of databases – flat files</p> <p>Understand how data can suffer from anomalies</p> <p>Why we normalize</p> <p>Apply First Normal Form (1NF)</p> <p>Read: Chapter 13 - Database Systems by Thomas Connolly and Carolyn Begg</p>
Week 2: beginning 08/10/2018	<p>Lesson: Normalization</p> <p>Learning Objectives</p> <p>Apply First (1NF), second (2NF) and third (3NF).</p>

Reading list

FIND a book that you are comfortable reading!

- Core text: Modern database management - McFadden, Hoffer & Prescott
- Fundamentals of Database Systems – Elmasri & Navathe
- Databases illuminated – Ricardo & Urban
- Database Systems: A Practical Approach to Design, Implementation, and Management – Connolly & Begg
- Database Systems - Beynon-Davies

Assessment

Currently undergoing quality control - to be confirmed!

TCA 1 – Normalization 15/10/2018 (adjustment date 22/10/2018) - 30%

TCA 2 – Requirements analysis and Entity Relationship Modelling 05/11/2018
(adjustment date 12/11/2018) - 30%

TCA 3 – SQL 03/12/18 (adjustment date 10/12/2018) - 25%

TCA 4 – Transactions, Concurrency Control and Database recovery 21/01/2019 - 15%

Resit capped at 40% - Exam week 28/01/2018



Any questions before we begin the lesson?

Lesson: Data, Tables & Normalization



Learning outcomes

- Understand data – what is data, types of data
- Understand how data can suffer from anomalies
- Why we normalize
- Apply First Normal Form (1NF)

In small groups discuss...

- What is data?
- Find three examples of data?

Be prepared to share your thoughts with the rest of the class...

Read the following paper in your groups:

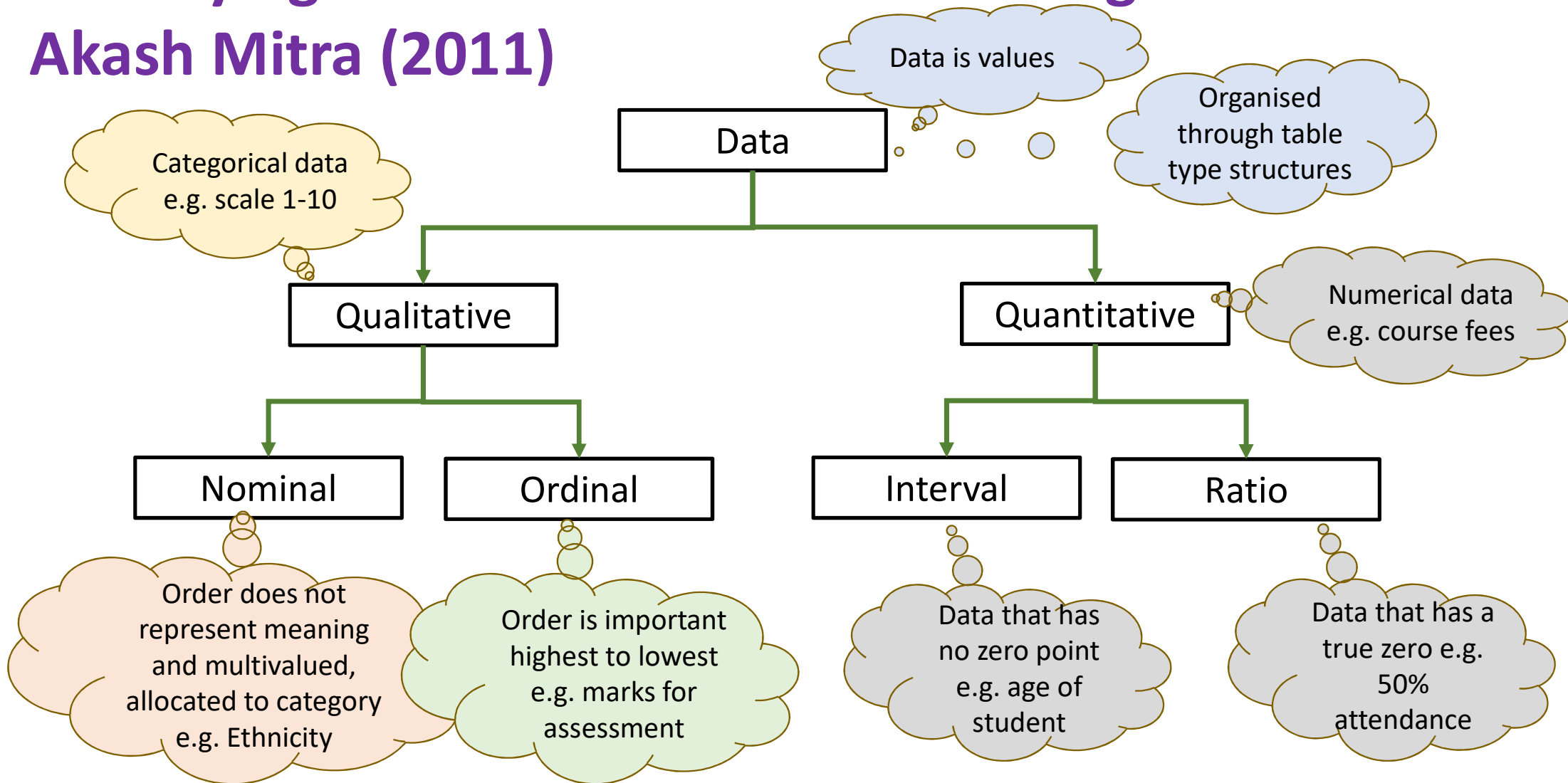
Classifying data for successful modelling

Akash Mitra (2011)

Summarise the main points presented in the paper

Be prepared to share you thoughts with the rest of the class...

Classifying data for successful modelling: Akash Mitra (2011)



What is Data? Text book definition...

“Facts that can be recorded that have implicit meaning...”

Elmasri & Navathe (2017)

“Facts text, graphics, images, sound... segments that have meaning to users in an environment...” Mcfadden et al (1999)

“Refers to bare facts recorded in a database...processed data is useful for making decisions...” Ricardo & Urban (2017)

Data in context – organised data

Data organised into rows
and columns - flat file

StudentID	LastName	DOB	Attendance	AcademicYear	CourseFee
324917628	Doyle	18/03/2000	45%	2017-2018	£9000.00
324917629	Hussain	14/02/1999	55%	2017-2018	£9000.00
324917630	McFarran	19/09/1998	100%	2017-2018	£9000.00
324917631	Adams	29/05/2001	30%	2017-2018	£9000.00
324917632	Tingle	02/12/1997	75%	2017-2018	£9000.00

Can you classify the data – quantitative or qualitative?

Data in context – organised data

Quantitative

StudentID	LastName	DOB	Attendance	AcademicYear	CourseFee
324917628	Doyle	18/03/2000	45%	2017-2018	£9000.00
324917629	Hussain	14/02/1999	55%	2017-2018	£9000.00
324917630	McFarran	19/09/1998	100%	2017-2018	£9000.00
324917631	Adams	29/05/2001	30%	2017-2018	£9000.00
324917632	Tingle	02/12/1997	75%	2017-2018	£9000.00

Qualitative

Understand the data in order to classify in modelling and make decisions

Types of data

Exact numeric	Bigint, smallint, decimal, int
Approximate numeric	Float, real
Date and time	Date, time
Character strings	Char, varchar, text

“In SQL Server, each column has a related data type. A data type is an attribute that specifies the type of data that the object can hold: integer data, character data, monetary data, date and time data, binary strings, and so on...”

<https://docs.microsoft.com/en-us/sql/t-sql/data-types/data-types-transact-sql?view=sql-server-2017>

For defining the data types when drawing ERD's

Data in context – organised data

StudentID	LastName	DOB	Attendance	AcademicYear	CourseFee
324917628	Doyle	18/03/2000	45%	2017-2018	£9000.00
324917629	Hussain	14/02/1999	55%	2017-2018	£9000.00
324917630	McFarran	19/09/1998	100%	2017-2018	£9000.00
324917631	Adams	29/05/2001	30%	2017-2018	£9000.00
324917632	Tingle	02/12/1997	75%	2017-2018	£9000.00

What data types would you assign to the data?

Data in context – organised data



StudentID	LastName	DOB	Attendance	AcademicYear	CourseFee
324917628	Doyle	18/03/2000	45%	2017-2018	£9000.00
324917629	Hussain	14/02/1999	55%	2017-2018	£9000.00
324917630	McFarran	19/09/1998	100%	2017-2018	£9000.00
324917631	Adams	29/05/2001	30%	2017-2018	£9000.00
324917632	Tingle	02/12/1997	75%	2017-2018	£9000.00

Integer

Text

Date

Calculated
Field

Derived
Date

Decimal

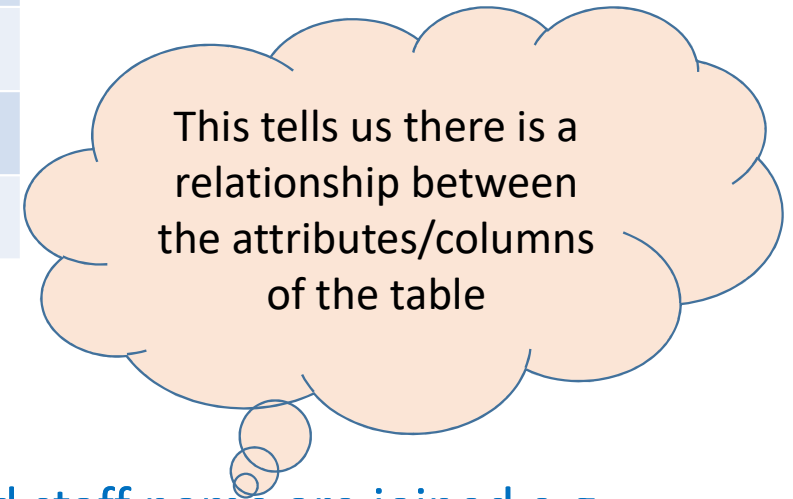
Database fundamentals

Table: Relation
Employee Contact

Column: Attribute

EmployeeID	EmpName	TelephoneNumber
324917628	Doyle	01494 522141
324917629	Adams	01494 522142
324917630	McFarran	01494 522143
324917631	Adams	01494 522144

Row: Tuple



PK is unique identifier for each tuple

Record: employee details and contact information

Meaning: Contact staff members

Decision: becomes information when employee id and staff name are joined e.g. 324917629 Adams is a different person to 324917631 Adams and therefore each has a different phone number – we can make a decision on which Adams we want to call!

Functional Dependency

Functional dependency textbook meaning



- “Is a type of relationship between columns (attributes)”

Ricardo and Urban, 2017, p.260

- “A constraint between two columns (attributes)...

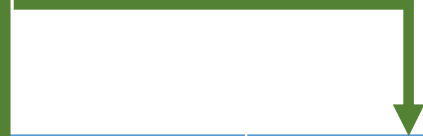
McFadden et al, 2015, p.239

- “Describes the relationship between columns (attributes) in a table (relation)...”

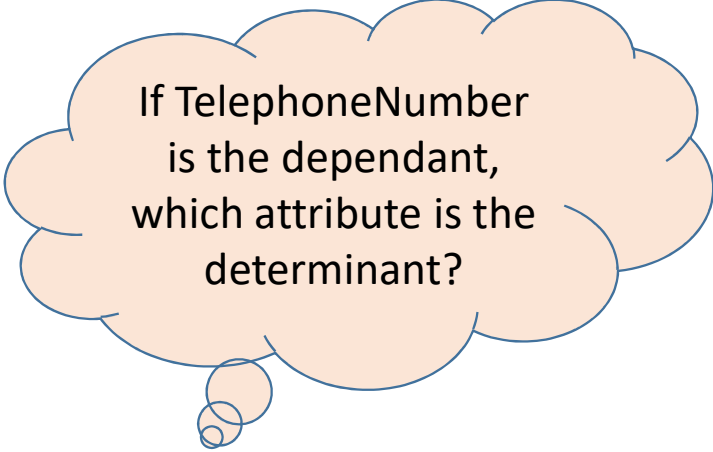
Connolly and Begg, 2005, p.391

Functional Dependency

EmployeeID \rightarrow EmplName



EmployeeID	EmplName	TelephoneNumber
324917628	Doyle	01494 522141
324917629	Adams	01494 522142
324917630	McFarran	01494 522143
324917631	Adams	01494 522144



If TelephoneNumber is the dependant, which attribute is the determinant?

The employee ID is unique for each employee

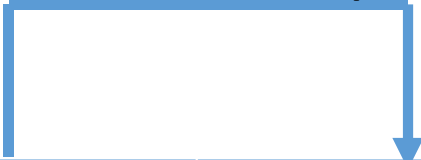
There is a relationship between EmployeeID and EmplName

To distinguish between Adams (321917**629**) and Adams (324917**631**)

EmployeeID is the determinant and EmplName is the dependant

Functional Dependency

EmpName → TelephoneNumber



EmployeeID	EmpName	TelephoneNumber
324917628	Doyle	01494 522141
324917629	Adams	01494 522142
324917630	McFarran	01494 522143
324917631	Adams	01494 522144

An employee has to exist to have a telephone number

You assign telephone numbers to people

It is joined to the real world – we call this cardinality or constraints

How would we represent the functional dependency?

VIN	Make	Model	AssemLocation
1FMCU9H90DUB12493	BMW	X5	Dagenham
5YJSA1DN8CFS49959	BMW	X6	Southampton
1HGEM22652L173765	BMW	i8	Crowley

Representing functional dependency

VIN	Make	Model	Assemblylocation
1FMCU9H90DUB12493	BMW	X5	Dagenham
5YJSA1DN8CFS49959	BMW	X6	Southampton
1HGEM22652L173765	BMW	i8	Crowley



VIN → make, model, assemblylocation

The make, model and assemloction are functionally dependant on the Vin number

How would you represent this functional dependency?

ISBN	Title	Author	Edition	Format
978-3-16-148410-0	Computing Illustrated	Jobs	1 st	Hardcopy
569-5-17-179511-0	IT Systems	Gates	2 nd	E-book

Representing functional dependency

ISBN	Title	Author	Edition	Format
978-3-16-148410-0	Computing Illustrated	Jobs	1 st	Hardcopy
569-5-17-179511-0	IT Systems	Gates	2 nd	E-book



ISBN → title, author, edition, format

The title of the book, the author and the edition is functionally dependant on the ISBN

“An ISBN is used by publishers, booksellers and libraries for ordering, listing and stock control activities. An ISBN enables the identification of a specific edition of a specific title and the specific format used for that particular book” <https://www.isbn-international.org/content/what-isbn>


How would we represent this functional dependency?

VIN	Make	Model	FuelType	ManuDate
1FMCU9H90DUB12493	BMW	X5	Diesel	1999
5YJSA1DN8CFS49959	BMW	X6	Petrol	2008
1HGEM22652L173765	BMW	i8	Electric	2014

Representing functional dependency


VIN \rightarrow make, model, ManuDate

The make, model and FuelType are functionally dependant on the Vin number



VIN	Make	Model	FuelType	ManuDate
1FMCU9H90DUB12493	BMW	X5	Diesel	1999
5YJSA1DN8CFS49959	BMW	X6	Petrol	2008
1HGEM22652L173765	BMW	i8	Electric	2014

Multiple functional dependencies



Model \rightarrow FuelType

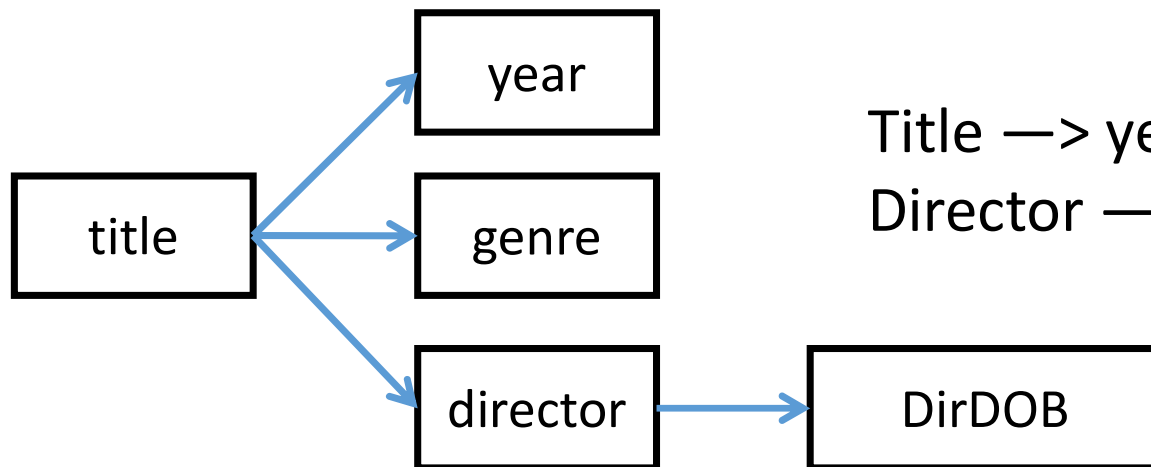
The FuelType is determined by the model of car

How would we represent this functional dependency?

Title	Year	Genre	Director	DirectorDOB
The Dark Knight	2008	Crime/Thriller	Christopher Nolan	30 July 1970
Wonder Woman	2017	Fantasy/Science fiction	Patty Jenkins	July 24 1971

Representing functional dependency

Title	Year	Genre	Director	DirDOB
The Dark Knight	2008	Crime/Thriller	Christopher Nolan	30 July 1970



Title \rightarrow year, genre, director

Director \rightarrow DirDOB

BREAK TIME



After the break
problems with tables
and solving with
Normalization

Problems with updating large flat files – update anomalies

What are anomalies?

- “Inconsistent, incomplete or contradictory state...”

Ricardo and Urban, 2017, p.260

- “Errors or inconsistencies that may result when a user attempts to update a table...”

McFadden et al, 2015, p.239

- “Relations that may have redundant data...”

Connolly and Begg, 2005, p.391

Error situation that occurs when we try to perform a process on the table

Three types of anomalies



When certain attributes cannot be inserted into the table(s) without the presence of other attributes.



When certain attributes are deleted by the process of deletion to another attribute.



When attributes are updated, but because there is duplication of data this causes certain attributes to be missed from the update process.

Insertion anomalies

The table represents the customer account that is managed by the sales person and the sales person's selling region.

CustID	CustName	SalesID	SalesPerson	Region
8023	J Anderson	SM003	Smith	South
9167	A Bancroft	HK001	Hicks	West
7924	D Hobbs	SM003	Smith	South
6837	G Tucker	HD005	Hernandez	East
8596	W Eckersley	HK001	Hicks	West
7018	C Arnold	FB009	Faulb	North
(New)				

We want to create a new entry for White (a new salesperson). White has no customers to manage at present.

Why can this update not be completed?

Deletion anomalies

Customer Tucker has moved his business elsewhere we need to delete the record.

What would be the affect if customer Tucker tuple was removed?

CustID	CustName	SalesID	SalesPer son	Region
8023	J Anderson	SM003	Smith	South
9167	A Bancroft	HK001	Hicks	West
7924	D Hobbs	SM003	Smith	South
6837	G Tucker	HD005	Hernand ez	East
8596	W Eckersley	HK001	Hicks	West
7018	C Arnold	FB009	Faulb	North

Update anomalies

Sales person Smith is now in charge of West regions and Hicks in charge of South.

Why is this update inefficient and what problems could it cause?

CustID	CustName	SalesID	SalesPerson	Region
8023	J Anderson	SM003	Smith	South
9167	A Bancroft	HK001	Hicks	West
7924	D Hobbs	SM003	Smith	South
6837	G Tucker	HD005	Hernandez	East
8596	W Eckersley	HK001	Hicks	West
7018	C Arnold	FB009	Faulb	North

Normalization

Why Normalize?

Avoid a contradictory states in the database:

We want good data

Efficient storage

Avoid anomalies

Produce smaller and well-structured relations/tables:

An Integrated approach

Efficient sharing of data

Avoiding redundancy (avoid the same data in multiple locations)

Consistency (changes only affect the data required to be updated)

Validate the logical design before proceeding to physical design:

Conform to data standards

What is Normalization?

- A technique for producing a set of tables with minimal redundancy that support the data requirements of an organisation.
- Analysis of functional dependency/ restrictions between our attributes.
- Organising our tables/relations into a more manageable form.

Normalization 1NF

A table is in first normal form (1NF):

1. Every attribute is single valued for each tuple (row)
2. Each attribute has a unique name
3. Assign a primary key

Normalizing (1NF) to solve the anomalies

CustID	CustName	SalesID	SalesPerson	Region
8023	J Anderson	SM003	Smith	South
9167	A Bancroft	HK001	Hicks	West
7924	D Hobbs	SM003	Smith	South
6837	G Tucker	HD005	Hernandez	East
8596	W Eckersley	HK001	Hicks	West
7018	C Arnold	FB009	Faulb	North

Step One: Every attribute is single valued

Step One: Every attribute is single valued

CustID	CustInitial	CustSName	SalesID	SalesPerson	Region
8023	J	Anderson	SM003	Smith	South
9167	A	Bancroft	HK001	Hicks	West
7924	D	Hobbs	SM003	Smith	South
6837	G	Tucker	HD005	Hernandez	East
8596	W	Eckersley	HK001	Hicks	West
7018	C	Arnold	FB009	Faulb	North

Every attribute is single valued for this table

2. Each attribute has a unique name

CustID	CustInitial	CustSName	SalesID	SalesPerson	Region
8023	J	Anderson	SM003	Smith	South
9167	A	Bancroft	HK001	Hicks	West
7924	D	Hobbs	SM003	Smith	South
6837	G	Tucker	HD005	Hernandez	East
8596	W	Eckersley	HK001	Hicks	West
7018	C	Arnold	FB009	Faulb	North

3. Assign a primary key

CustID	CustInitial	CustSName	SalesID	SalesPerson	Region
8023	J	Anderson	SM003	Smith	South
9167	A	Bancroft	HK001	Hicks	West
7924	D	Hobbs	SM003	Smith	South
6837	G	Tucker	HD005	Hernandez	East
8596	W	Eckersley	HK001	Hicks	West
7018	C	Arnold	FB009	Faulb	North

This table is in 1NF

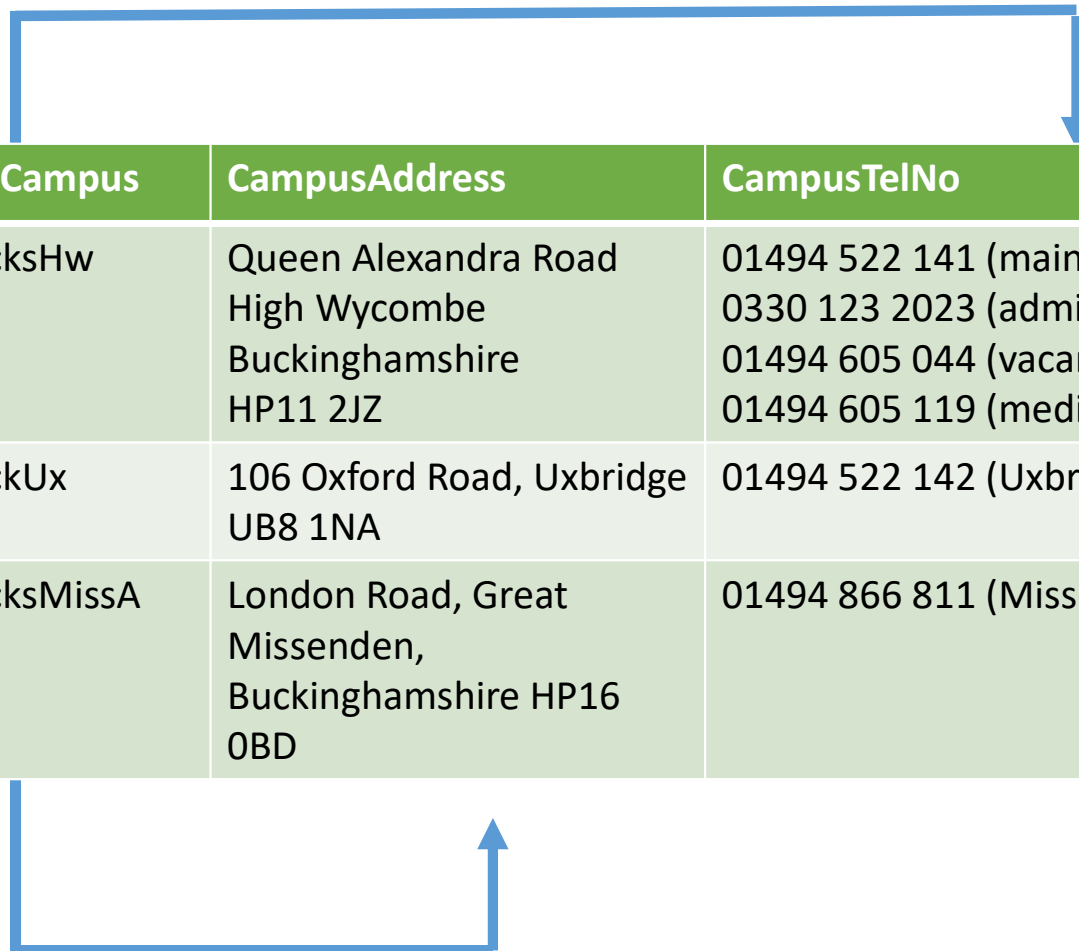
CustID (PK)	CustInitial	CustSName	SalesID	SalesPerson	Region
8023	J	Anderson	SM003	Smith	South
9167	A	Bancroft	HK001	Hicks	West
7924	D	Hobbs	SM003	Smith	South
6837	G	Tucker	HD005	Hernandez	East
8596	W	Eckersley	HK001	Hicks	West
7018	C	Arnold	FB009	Faulb	North

Convert this table to 1NF

UniCampus	CampusAddress	CampusTelNo
BucksHw	Queen Alexandra Road High Wycombe Buckinghamshire HP11 2JZ	01494 522 141 (main switchboard) 0330 123 2023 (admissions enquiry) 01494 605 044 (vacancies) 01494 605 119 (media)
BuckUx	106 Oxford Road, Uxbridge UB8 1NA	01494 522 142
BucksMissA	London Road, Great Missenden, Buckinghamshire HP16 OBD	01494 866 811

UniCampus	CampusAddressLine1	Town	County	PostCode	CampusTelNo	CampusLocation
BucksHw	Queen Alexandra Road	High Wycombe	Buckinghamshire	HP11 2JZ	01494 522 141	main switchboard
BucksHw	Queen Alexandra Road	High Wycombe	Buckinghamshire	HP11 2JZ	0330 123 2023	admissions enquiry
BucksHw	Queen Alexandra Road	High Wycombe	Buckinghamshire	HP11 2JZ	01494 605 044	vacancies
BucksHw	Queen Alexandra Road	High Wycombe	Buckinghamshire	HP11 2JZ	01494 605 119	media
BuckUx	106 Oxford Road, UB8	Uxbridge		1NA	01494 522 142	Uxbridge
BucksMissA	London Road	Great Missenden	Buckinghamshire	HP16 0BD	01494 866 811	Missenden

Representing functional dependency



UniCampus	CampusAddress	CampusTelNo
BucksHw	Queen Alexandra Road High Wycombe Buckinghamshire HP11 2JZ	01494 522 141 (main switchboard) 0330 123 2023 (admissions enquiry) 01494 605 044 (vacancies) 01494 605 119 (media)
BuckUx	106 Oxford Road, Uxbridge UB8 1NA	01494 522 142 (Uxbridge)
BucksMissA	London Road, Great Missenden, Buckinghamshire HP16 0BD	01494 866 811 (Missenden)

UniCampus (PK)	CampusAddress			
BucksHw	AddressLine1	Town	County	PostCode
	Queen Alexandra Road	High Wycombe	Buckinghamshire	HP11 2JZ
BuckUx	106 Oxford Road	Uxbridge		UB8 1NA
BucksMissA	London Road	Great Missenden	Buckinghamshire	HP16 0BD

CampusTelNo (PK)	CampusLocation	UniCampus (FK)
01494 522 141	Main switchboard	BucksHw
0330 123 2023	Admissions enquiry	BucksHw
01494 605 044	Vacancies	BucksHw
01494 605 119	Media	BucksHw
01494 522 142	Uxbridge	BuckUx
01494 866 811	Missenden	BucksMissA

In this case when dependants share the same determinants you make a decision on where the master and where the copy resides. The master is the PK and the copy if the FK.

The table is in 1NF

UNF	1NF
UniCampus (PK) CampusAddress CampusTelNumber	CampusAddressTable UniCampus (PK) CampusAddressLine1 Town County Postcode CampusTelContactTable CampusTelNo (PK) CampusLocaction UniCampus (FK)

Convert this tables to 1NF?

StaffNo	Name	Position	Salary	dCenterNo
S1500	Tom Daniels	Manager	48000	D001
S0003	Sally Adams	Assistant	30000	D001
S0010	Mary Martinez	Manager	51000	D002
S3250	Robert Chin	Assistant	33000	D002
S0415	Art Peters	Manager	42000	D003
S2250	Sally Stern	Manager	48000	D004

Table is in 1NF

StaffNo (PK)	FirstNa me	Surname	Position	Salary	dCente rNo
S1500	Tom	Daniels	Manager	48000	D001
S0003	Sally	Adams	Assistant	30000	D001
S0010	Mary	Martinez	Manager	51000	D002
S3250	Robert	Chin	Assistant	33000	D002
S0415	Art	Peters	Manager	42000	D003
S2250	Sally	Stern	Manager	48000	D004

UNF	1NF
StaffNo Name Postion Salary dCentrNo	StaffNo (PK) FirstName Surname Postion Salary dCentrNo

Convert this table into 1NF

dCenterNo	dAddress	dTelNo
D001	8 Jefferson Way, High Wycombe, HP11 8TY	503 555 3618 503 666 2598
D002	City Centre, Manchester, MD1 1JU	061 852 147 0161 236 111
D003	14 Avenue, Slough, SL6 782	015 025 951 015 782 456
D004	West Gate, Oxford, OX7 2QA	023 357 753

dCenterNo (PK)	dAddress	Town	Postcode
D001	8 Jefferson Way	High Wycombe	HP11 8TY
D002	City Centre	Manchester	MD1 1JU
D003	14 Avenue	Slough	SL6 782
D004	West Gate	Oxford	OX7 2QA

Tables are in 1NF

UNF	1NF
dCenterNo (PK) dAddress dTelNo	<p>dAddressTable dCenterNo (PK) dAddress Town Postcode</p> <p>dTelContactTable dTelNo (PK) dCenterNo (FK)</p>

dCenterNo (FK)	dTelNo (PK)
D001	503 555 3618
D001	503 666 2598
D002	061 852 147
D002	0161 236 111
D003	015 025 951
D003	015 782 456
D004	023 357 753

Convert this tables to 1NF?



StaffNo	FirstName	Surname	Position	Salary	dCenterNo	dAddress	dTelNo
S1500	Tom	Daniels	Manager	48000	D001	8 Jefferson Way, High Wycombe, HP11 8TY	503 555 3618
S0003	Sally	Adams	Assistant	30000	D001	8 Jefferson Way, High Wycombe, HP11 8TY	503 666 2598
S0010	Mary	Martinez	Manager	51000	D002	City Centre, Manchester, MD1 1JU	061 852 147
S3250	Robert	Chin	Assistant	33000	D002	City Centre, Manchester, MD1 1JU	0161 236 111
S0415	Art	Peters	Manager	42000	D003	14 Avenue, Slough, SL6 782	015 025 951
S2250	Sally	Stern	Manager	48000	D004	West Gate, Oxford, OX7 2QA	023 357 753

Tables are in 1NF

UNF	1NF
StaffNo	StaffNo (PK)
FirstName	FirstName
Surname	Surname
Postion	Postion
dCentreNo	dCentreNo
dAddressLine	dAddressLine1
dTenNo	Town
	Postcode
	dTenNo

Convert this table into 1NF?

Project Code	ProjectTitle	Project Manager	Project Budget	EmployeeNo.	EmployeeName	DepartmentNo.	Department Name	HourlyRate
PC010	Pensions System	M Phillips	24500	S10001	A Smith	L004	IT	£22.00
PC010	Pensions System	M Phillips	24500	S10030	L Jones	L023	Pensions	£18.50
PC010	Pensions System	M Phillips	24500	S21010	P Lewis	L004	IT	£21.00
PC045	Salaries System	H Martin	17400	S10010	B Jones	L004	IT	£21.75
PC045	Salaries System	H Martin	17400	S10001	A Smith	L004	IT	£18.00
PC045	Salaries System	H Martin	17400	S31002	T Gilbert	L028	Database	£25.50
PC045	Salaries System	H Martin	17400	S13210	W Richards	L008	Salary	£17.00
PC064	HR System	K Lewis	12250	S31002	T Gilbert	L028	Database	£23.25
PC064	HR System	K Lewis	12250	S21010	P Lewis	L004	IT	£17.50
PC064	HR System	K Lewis	12250	S10034	B James	L009	HR	£16.50
PC010	Pensions System	M Phillips	24500	S10001	A Smith	L004	IT	£22.00
PC010	Pensions System	M Phillips	24500	S10030	L Jones	L023	Pensions	£18.50
PC010	Pensions System	M Phillips	24500	S21010	P Lewis	L004	IT	£21.00
PC045	Salaries System	H Martin	17400	S10010	B Jones	L004	IT	£21.75
PC045	Salaries System	H Martin	17400	S10001	A Smith	L004	IT	£18.00
PC045	Salaries System	H Martin	17400	S31002	T Gilbert	L028	Database	£25.50
PC045	Salaries System	H Martin	17400	S13210	W Richards	L008	Salary	£17.00
PC064	HR System	K Lewis	12250	S31002	T Gilbert	L028	Database	£23.25
PC064	HR System	K Lewis	12250	S21010	P Lewis	L004	IT	£17.50
PC064	HR System	K Lewis	12250	S10034	B James	L009	HR	£16.50

Functional dependency

Everything about the project



Project Code	ProjectTitle	Project Manager	Project Budget	EmployeeNo	EmployeeName	DepartmentNo	Department Name	HourlyRate
PC010	Pensions System	M Phillips	24500	S10001	A Smith	L004	IT	£22.00
PC010	Pensions System	M Phillips	24500	S10030	L Jones	L023	Pensions	£18.50
PC010	Pensions System	M Phillips	24500	S21010	P Lewis	L004	IT	£21.00
PC045	Salaries System	H Martin	17400	S10010	B Jones	L004	IT	£21.75
PC045	Salaries System	H Martin	17400	S10001	A Smith	L004	IT	£18.00
PC045	Salaries System	H Martin	17400	S31002	T Gilbert	L028	Database	£25.50
PC045	Salaries System	H Martin	17400	S13210	W Richards	L008	Salary	£17.00
PC064	HR System	K Lewis	12250	S31002	T Gilbert	L028	Database	£23.25
PC064	HR System	K Lewis	12250	S21010	P Lewis	L004	IT	£17.50
PC064	HR System	K Lewis	12250	S10034	B James	L009	HR	£16.50
PC010	Pensions System	M Phillips	24500	S10001	A Smith	L004	IT	£22.00
PC010	Pensions System	M Phillips	24500	S10030	L Jones	L023	Pensions	£18.50
PC010	Pensions System	M Phillips	24500	S21010	P Lewis	L004	IT	£21.00
PC045	Salaries System	H Martin	17400	S10010	B Jones	L004	IT	£21.75
PC045	Salaries System	H Martin	17400	S10001	A Smith	L004	IT	£18.00
PC045	Salaries System	H Martin	17400	S31002	T Gilbert	L028	Database	£25.50
PC045	Salaries System	H Martin	17400	S13210	W Richards	L008	Salary	£17.00
PC064	HR System	K Lewis	12250	S31002	T Gilbert	L028	Database	£23.25
PC064	HR System	K Lewis	12250	S21010	P Lewis	L004	IT	£17.50
PC064	HR System	K Lewis	12250	S10034	B James	L009	HR	£16.50

Everything about the employee working on the project



Table is in 1NF

Project Code (PK)	ProjectTitle	Project ManagerInitial	Project ManagerSName	Project Budget
PC010	Pensions System	M	Phillips	24500
PC045	Salaries System	H	Martin	17400
PC064	HR System	K	Lewis	12250

ProjectCode (FK)	EmployeeNo (PK)	EmployeeInitial	EmployeeSName	DepartmentNo.	DepartmentName	HourlyRate
PC010	S10001	A	Smith	L004	IT	£22.00
PC045	S10001	A	Smith	L004	IT	£18.00
PC064	S10034	B	James	L009	HR	£16.50
PC045	S10010	B	Jones	L004	IT	£21.75
PC010	S10030	L	Jones	L023	Pensions	£18.50
PC010	S21010	P	Lewis	L004	IT	£21.00
PC064	S21010	P	Lewis	L004	IT	£17.50
PC045	S31002	T	Gilbert	L028	Database	£25.50
PC064	S31002	T	Gilbert	L028	Database	£23.25
PC045	S13210	W	Richards	L008	Salary	£17.00

Table is in 1NF

UNF	1NF
ProjectCode	ProjectCode (PK)
ProjectTitle	ProjectTitle
ProjectManager	ProjectManagerInitial
ProjectBudget	ProjectManagerSName
EmployeeNo	ProjectBudget
EmployeeName	ProjectCode (FK)
DepartmentNo	EmployeeNo (PK)
DepartmentName	EmployeeInitial
HourlyRate	EmployeeSName
	DepartmentNo
	DepartmentName
	HourlyRate

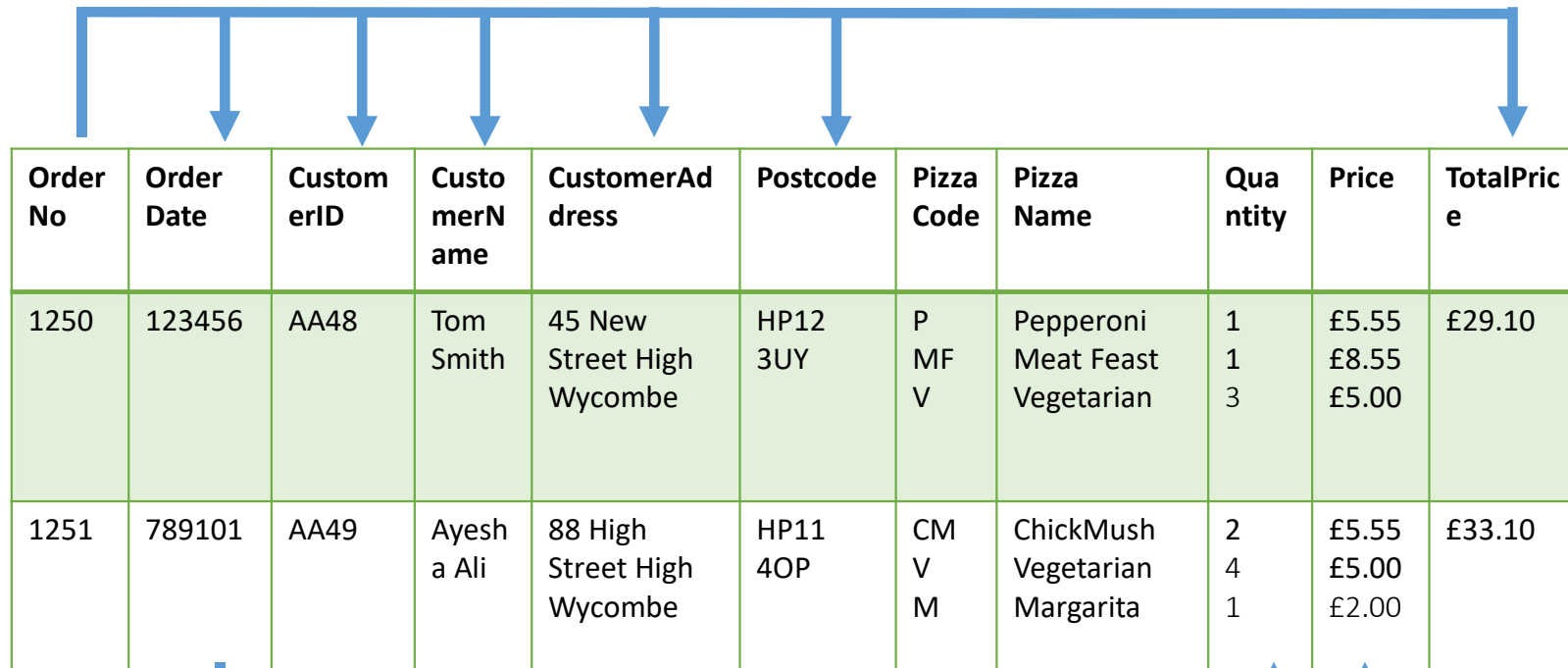
Can you convert this table into 1NF?



Order No	Order Date	CustomerID	CustomerName	CustomerAddress	Postcode	Pizza Code	Pizza Name	Quantity	Price	TotalPrice
1250	123456	AA48	Tom Smith	45 New Street High Wycombe	HP12 3UY	P	Pepperoni	1	£5.55	£29.10
						MF	Meat Feast	1	£8.55	
						V	Vegetarian	3	£5.00	
1251	789101	AA49	Aysha Ali	88 High Street High Wycombe	HP11 4OP	CM	ChickMush	2	£5.55	£33.10
						V	Vegetarian	4	£5.00	
						M	Margarita	1	£2.00	

Identifying functional dependency

Everything to do with the customer order – to deliver



Order No	Order Date	CustomerID	CustomerName	CustomerAddress	Postcode	Pizza Code	Pizza Name	Quantity	Price	TotalPrice
1250	123456	AA48	Tom Smith	45 New Street High Wycombe	HP12 3UY	P MF V	Pepperoni Meat Feast Vegetarian	1 1 3	£5.55 £8.55 £5.00	£29.10
1251	789101	AA49	Aysha Ali	88 High Street High Wycombe	HP11 4OP	CM V M	ChickMush Vegetarian Margarita	2 4 1	£5.55 £5.00 £2.00	£33.10

Everything to do with pizza menu – to make pizza

1NF

Order No (PK)	Order Date	CustomerID	CustomerFName	CustomerS FName	CustomerAddress1	Town	Postcode	TotalPrice
1250	123456	AA48	Tom	Smith	45 New Street	High Wycombe	HP12 3UY	£29.10
1251	789101	AA49	Ayesha	Ali	88 High Street	High Wycombe	HP11 4OP	£33.10

Order No (FK)	Pizza Code (PK)	Pizza Name	Quantity	Price
1250	P	Pepperoni	1	£5.55
1250	MF	Meat Feast	1	£8.55
1250	V	Vegetarian	3	£5.00
1251	CM	ChickenMushroom	2	£5.55
1251	V	Vegetarian	4	£5.00
1251	M	Margarita	1	£2.00

Table in 1NF



UNF	1NF
OrderNo	OrderNo (PK)
OrderDate	OrderDate
CustomerID	CustomerID
CustomerName	CustomerFName
CustomerAddress	CustomerSName
Postcode	CustomerAddress (addressline1, town)
TotalPrice	Postcode
PizzaCode	TotalPrice
PizzaName	
Quantity	OrderNo (FK)
Price	PizzaCode (PK)
	PizzaName
	Quantity
	Price