Databases: Planning a database

iT Centre Learning

iT services

UNIVERSITY OF OXFORD

The small print

Prerequisites

Time in the workshop is precious – it is an opportunity for you to interact with the workshop leader and other participants through questions and discussions and to share your experiences and concerns. To make the most of this time we sometimes ask you to carry out learning activities ahead of the workshop so that everyone comes into the class with the same basic knowledge. We keep this prior learning to a minimum and often make use of online videos. Online videos provided through LinkedIn Learning can be accessed free of charge by University members anytime, anywhere, through a browser or app.

Your course booking will tell you if any prior learning activity is required. If you don't have an environment where you can do this learning, you can come along to one of our LinkedIn Learning sessions. These are a quiet space where you can work through videos or other workshop resources.

If you arrive for a workshop without having done the prior learning, the workshop leader may suggest that you come back on another session.

Copyright

About the workshop designer

Pamela Stanworth has over a decade's experience working on databases with researchers and departments across the University. She brings a pragmatic approach to building projects that are effective, reliable and sustainable.

Pamela's roots are in engineering, working with blue-chip industrial companies, technical consultancy and small businesses. Her commitment in teaching and consulting is to enable people to use appropriate technology in their work, efficiently and to a high standard.]

Revision history

Version	Date	Author	Comments
1.0	March 2021	Pamela Stanworth	Relaunched from Concepts course

About this workshop

If you were building your dream house, not only would you need to learn practical building skills such as bricklaying and plumbing, but you also need to draw out a design before starting work. The same applies to a database – time spent on drawing up a workable design will transform the value of the structure you create.

This workshop helps you understand how relational databases work, and the important concepts that control them. If you need to design a new database, or re-think an existing database, these concepts underpin your planning.

What you will learn

We will discuss the value of relational databases in managing and analysing data. Using worked examples and hands-on activities we will explore why data needs to be organised into tables with joins. We will work through the steps you should follow when analysing your situation and devising a database structure.

We will include pointers to other workshops and further resources that will help you go on later to create and manage a database.

What you need to know

The ideas and techniques covered in this workshop will apply to a range of tools. We will illustrate using *Access for Windows*, which is widely available. However, the concepts will be the same or similar, whatever relational database software you decide to use.

If you need to review these activities, LinkedIn Learning is a great place to get guidance. There is an activity with relevant videos in the IT Learning Portfolio: visit skills.it.ox.ac.uk/it-learning-portfolio and search for “database planning activity”.

The resources you need

Sample scenarios that you can use to experiment with will be made available, but you may like to apply the concepts to your own situation.

The resources for most workshops, including any pre-course activity, are in the IT Learning Portfolio: visit skills.it.ox.ac.uk/it-learning-portfolio and search for “database planning activity”.

Group Activities – Part 1

Scenario One - William Gladstone's Diaries

William Gladstone (Prime Minister during the period 1868-94) kept a diary all his life, recording every person he met. He met some people many times, others only once. Each person was associated with a political party or group.

The diaries have now been published and the editor wants to produce a final index volume, giving details about each person mentioned and the date/s when Gladstone met them, as well as their political affiliations. She also wants to be able to find all the people whom he saw on a particular day, for checking.

Discuss in your group the fields that may be needed. Using the text provided in the first box below, choose which are likely to be needed as fields, discard any irrelevant ones and write any other fields that you think of. Start to create a database diagram in the empty box on the next page.

Then organise the fields. Collect the field names into groups which belong together, and allocate them to tables.

For each field in a table, discuss and decide on the data type (text, number, date, yes/no etc.).

GroupName

MeetingDate

GroupLeader

Notes

PersonMet

LastName

PoliticalGroupID

PersonID

GroupID

GroupJoined

PartyPolicies

MeetingRemarks

MeetingStartTime

Monarch

FirstName

MeetingLocation

Create your diagram for the Gladstone Diaries database here

Scenario Two - HL Consultants and Projects

HL Consultants Ltd provide consultants to work on clients' projects. Each consultant works on only one project at a time, but a project may employ more than one consultant.

Look at the table below and design a database to store this information efficiently. In the box below, sketch out the tables needed, and name the fields in each.

Consultant ID	Project no	Hours	Project name	Consultant name	Project location	Hourly rate
21	A92	450	Apollo	Gray	Glasgow	£ 100.00
25	Z50	90	Zeus	Brown	Edinburgh	£ 90.00
33	Z50	20	Zeus	White	Edinburgh	£ 95.00
37	M75	135	Mercury	Green	Aberdeen	£ 150.00

Scenario Three - Room bookings

An admin assistant has been asked to look after a set of meeting rooms, and to keep track of room bookings that are made by people from various other departments. He plans to create a computerised database for this.

Discuss in your group the fields that may be needed.

Create a diagram in the box below.

Organise the fields into groups which belong together, and allocate them to tables.
For each field in a table, decide on the data type (text, number, date, yes/no etc.).

As with any real-life design, you will have to make assumptions or simplifications. Note these below the relevant table.

End of Group Activities Part 1

Stop here, and Resume the main meeting
when your teacher invites you back

Group Activities – Part 2

Scenario Four - Highland Holidays

Highland Holidays rent out holiday chalets. They need a system that will keep records of their customers, showing which chalet has been booked and for how long, and thus the amount of money owed.

Design a database that includes this and perhaps some other relevant data, organised into tables.

In the box below, sketch out the tables needed, and the fields to be included in each. Show how the tables are related.

Note any assumptions or simplifications you agree on.

Scenario Five - Shellfish Species Survey

A zoologist visits 10 different beaches, looking for 50 species of shellfish. On each visit, he records how many of each species he finds at each beach.

There will be more fields with information about the beaches and the species. He will visit some of the beaches more than once.

Can you suggest a relational structure for the data shown?

Name your tables and fields and show how they are related.

DateMeasured	BeachName	SpeciesName	CountOfSpecie:
12/08/2003	Five Mile	Turanicus Rond	23
12/08/2003	Five Mile	Saurosa B.	65
12/08/2003	Five Mile	Saurosa Majori	25
17/08/2003	Five Mile	G. Japonica	43
17/08/2003	Five Mile	G. Diabocatus	72
17/08/2003	Five Mile	Saurosa B.	47
20/08/2003	Five Mile	Turanicus Rond	10
20/08/2003	Five Mile	Saurosa B.	14
20/08/2003	Five Mile	Saurosa Majori	15
12/08/2003	GreyStones	Turanicus Rond	53
12/08/2003	GreyStones	Saurosa B.	56
12/08/2003	GreyStones	G. Diabocatus	39
17/08/2003	GreyStones	Saurosa Majori	31
17/08/2003	GreyStones	G. Japonica	32
17/08/2003	GreyStones	G. Diabocatus	7
20/08/2003	GreyStones	Turanicus Rond	16
20/08/2003	GreyStones	Saurosa Majori	18
20/08/2003	GreyStones	G. Diabocatus	20
12/08/2003	North Tideway	Turanicus Rond	26
12/08/2003	North Tideway	Saurosa B.	62
12/08/2003	North Tideway	G. Diabocatus	64
17/08/2003	North Tideway	Saurosa Majori	61
17/08/2003	North Tideway	G. Diabocatus	58
17/08/2003	North Tideway	Turanicus Rond	52
20/08/2003	North Tideway	Saurosa B.	50
20/08/2003	North Tideway	Saurosa Majori	44
20/08/2003	North Tideway	G. Diabocatus	42
12/08/2003	Beasdale	Turanicus Rond	46
12/08/2003	Beasdale	Saurosa B.	41
17/08/2003	Beasdale	Saurosa Majori	40

Scenario Six - Slater Menswear

The table below shows a sample of data collected by the Menswear Sales department of an independent shop. Provisionally, data has been collected in a spreadsheet.

Analyse the data and produce a data model for a relational database. Break the data down (normalise) into related tables so the information can be managed in a relational database.

Order No	Date	CustNo	Name	Address	ProdNo	Desc	Price	Qty
1	05/10/2017	22	Smith	London	A95	Jacket	£ 55.00	4
					G17	Coat	£ 120.00	8
					K10	Suit	£ 90.00	5
2	19/10/2017	47	Jones	Paris	G17	Coat	£ 120.00	9
					D77	Shirt	£ 35.00	20
3	37/10/2017	25	West	Glasgow	E30	Tie	£ 15.00	25
					D77	Shirt	£ 35.00	4

Scenario Seven - Choir Performance Pieces

A choirmaster is setting up a database of the music his choir performs. For each piece, he needs to know details about the piece itself (title, composer and so on), and where and when it has been performed.

A typical concert consists of around 10 pieces, and some popular pieces are presented repeatedly. He also needs a list of his choristers with their contact information.

Which tables should he set up? Suggest suitable fields.

How would the tables be related?

Scenario Eight - Car maintenance

Design a database to help a car maintenance workshop manage its business.

When a customer brings along a car for repair or service, staff need to check its service history (i.e. the work they have done on this vehicle in the past). They keep a note of every piece of work done on the vehicle, and which member of the team carried out each task.

This database does not manage any costing, pricing or salary information.

Scenario Nine - Castellan Course Administration

Castellan Ltd is a large insurance company whose training department runs internal training courses. Courses cover subjects such as employee induction, fire evacuation procedures, as well as training on the bespoke computer systems used within the company. In addition, the department advises staff on external training for general software packages and co-ordinates bookings for these.

Until now, records have been collected in an *Excel* spreadsheet.

Analyse the present system and produce a more flexible data model.

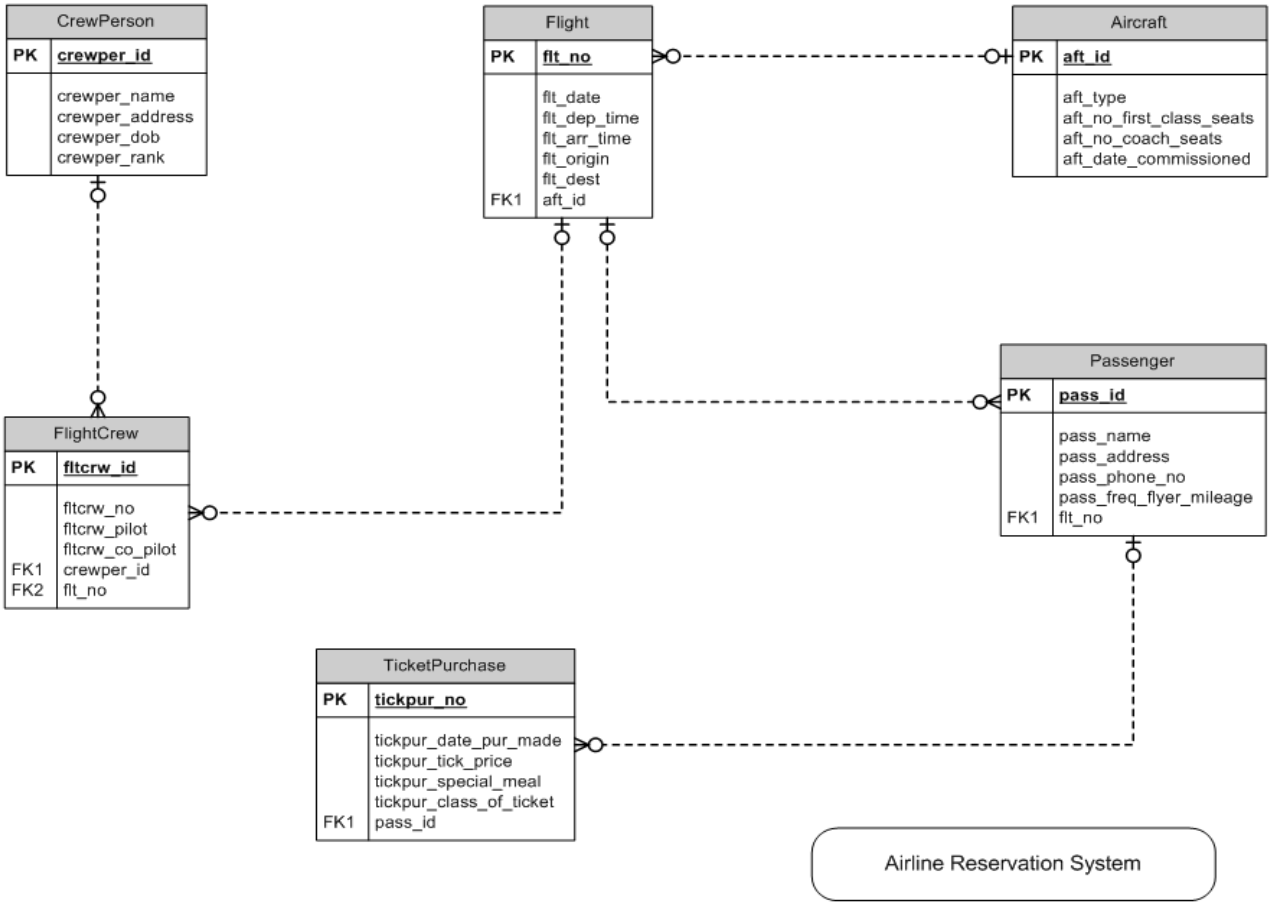
Course code		**IND1**	**FIR1**	**ACC1**
Course Title		Staff Induction	Fire Safety	Intro to MS Access
Start Date		27/03/2007	29/03/2007	24/04/2007
Attendee-1	**Name**	Neil Smith	Peter Brown	Jenny Wong
	Dept	Accounts	Admin	IT
Attendee-2	**Name**		Joshua Ndola	Peter Brown
	Dept		IT	Admin
Attendee-3	**Name**		H Singh	
	Dept		Senior	
Attendee-4	**Name**		Sonia Tonn	
	Dept		HR	
Attendee-5	**Name**		Jim and Sue	
	Dept		IT	

Scenario Ten - Airline Reservation System

An airline needs to improve its reservation system. This should include details of passengers and the tickets they purchase, showing the flight information. Crew are allocated to each flight, drawn from the 60 people employed. The airline owns 6 planes, so it needs to record which craft is used for each flight.

Study the proposed relationship diagram: can you work out what each table is for and what each join line means?

Consider whether you agree with the way data is organised into tables with relationships. Is anything missing? What would you add or simplify?



Sketch your design for the Airline Reservation System:

End of Group Activities Part 2

Stop here, and Resume the main meeting
when your teacher invites you back

Further information

Getting extra help

Course Clinics

The IT Learning Centre offers bookable clinics where you can get pre- or post-course advice. Contact us using **courses@it.ox.ac.uk**.

Study Videos from LinkedIn Learning

On our website, you will find our collection of self-service courses and resources. This includes providing LinkedIn Learning video-based courses free to all members of the University. Visit skills.it.ox.ac.uk/linkedin-learning and sign in with your Single Sign-On (SSO) credentials.

Some courses recommend pre- and/or post-course activities to support your learning. You can watch the online videos anywhere, anytime, and even download them onto a tablet or smartphone for off-line viewing.

About the IT Learning Portfolio online

Many of the resources used in the IT Learning Centre courses and workshops are made available as Open Educational Resources (OER) via our Portfolio website at skills.it.ox.ac.uk/it-learning-portfolio.

Find the pre-course activity for this course in the IT Learning Portfolio: visit skills.it.ox.ac.uk/it-learning-portfolio and search for “database planning activity”.

About the IT Learning Centre

The IT Learning Centre delivers over 100 IT-related teacher-led courses, which are provided in our teaching rooms and online, and we give you access to thousands of on-line self-service courses through LinkedIn Learning.

Our team of teachers have backgrounds in academia, research, business and education and are supported by other experts from around the University and beyond.

Our courses are open to all members of the University at a small charge. Where resources allow, we can deliver closed courses to departments and colleges, which can be more cost-effective than signing up individually. We can also customize courses to suit your needs.

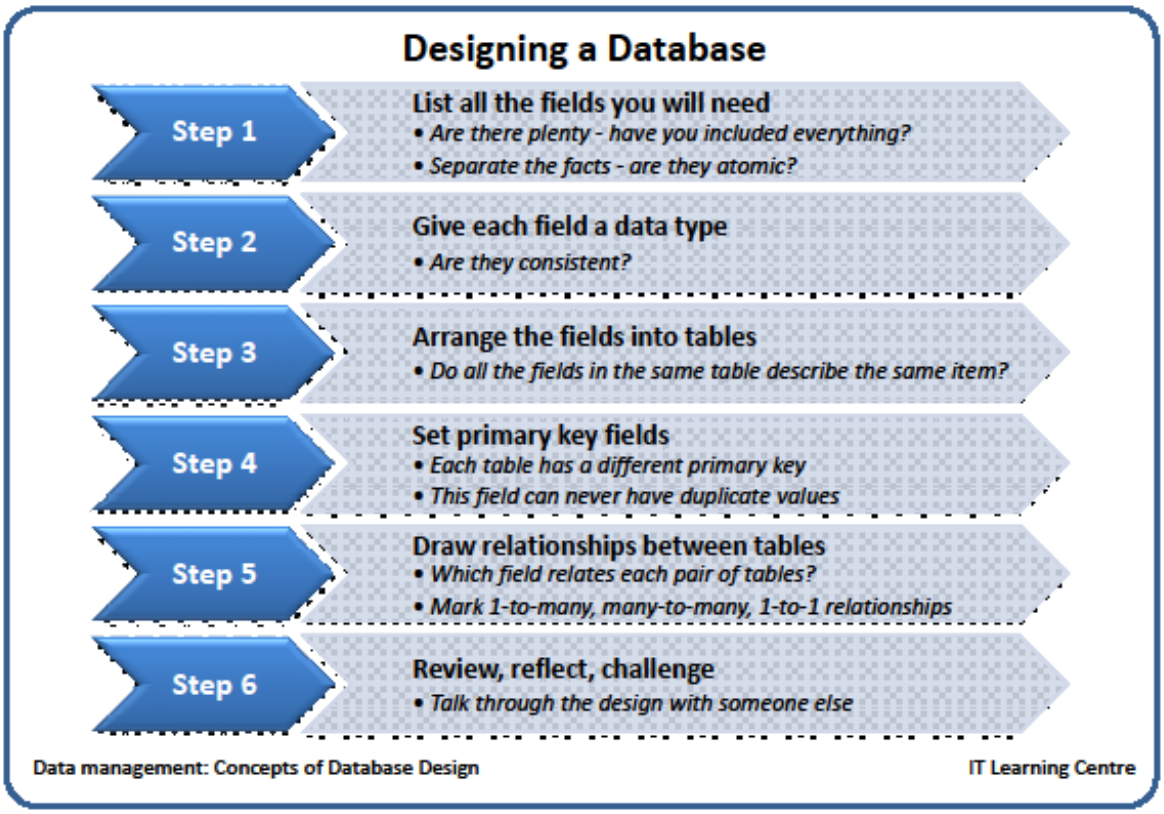
Our fully equipped suite of seven teaching and training rooms are usually available for hire for your own events and courses.

For more information, contact us at courses@it.ox.ac.uk.

About IT Customer Services

The IT Learning Centre is part of the Customer Services Group. The group provides the main user support services for the department, assisting all staff and students within the University as well as retired staff and other users of University IT services. It supports all the services offered by IT Services plus general IT support queries from any user, working in collaboration with local IT support units.

The Customer Services Group also offers a data back-up service; an online shop; and a PC maintenance scheme. Customer Services is further responsible for desktop computing services – for staff and in public/shared areas – throughout UAS and the Bodleian Libraries.


Designing a Database
Step 1
List all the fields you will need
• Are there plenty - have you included everything?
• Separate the facts - are they atomic?
Step 2
Give each field a data type
• Are they consistent?
Step 3
Arrange the fields into tables
• Do all the fields in the same table describe the same item?
Step 4
Set primary key fields
• Each table has a different primary key
• This field can never have duplicate values
Step 5
Draw relationships between tables
• Which field relates each pair of tables?
• Mark 1-to-many, many-to-many, 1-to-1 relationships
Step 6
Review, reflect, challenge
• Talk through the design with someone else
Data management: Concepts of Database Design
IT Learning Centre

Welcome to the IT Learning Centre

You are in the right place …

We'll be starting soon

1

Databases:
Planning a database

Pamela Stanworth
pamela.stanworth@it.ox.ac.uk

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Ready To Learn?

Today's session takes place in a video-call using *Teams*

You can turn on Live Captions using 

Don't plan to multi-task 

3

Your safety and comfort are important

Where is the fire exit?

Please tell us if anything doesn't work

The welcome area has vending machines and a water cooler

The toilets are along the corridor outside the teaching rooms

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Resources for your learning

Videos with today's topics in LinkedIn Learning

Follow-up work

- Continue with exercises after the session
- Bookable Course Clinics later

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Road map for "Planning a database"

Demo: a finished database

Where to start

A database with multiple tables

- Group work: some scenarios

Joins between tables

Some more difficult cases

A workflow for designing a database

- Group work: more scenarios

Recap and next steps

6

Demo: A finished database

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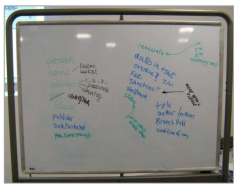
Decide on the fields

Think of all the facts that will be collected

- plenty of fields
- consult widely
- small fields “atomic”



Set the data type for each field

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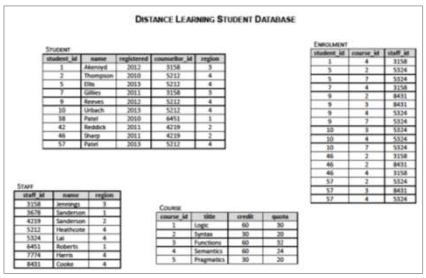
Collect the fields into tables



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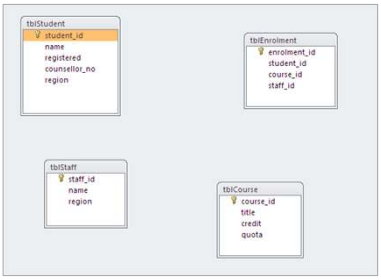
Decide on fields
Collect them into tables

Assign a data type to each field



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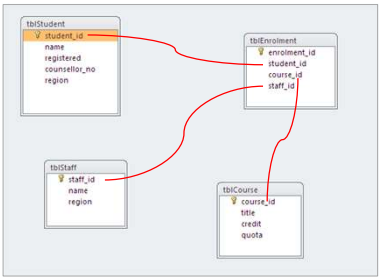
Link related fields between tables



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Group work 1

Go to your group
Look into your coursebook
Read each scenario, discuss a design

About 8 minutes on each scenario
Resume at 10:40

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Relationships between tables

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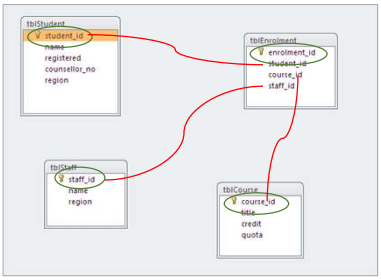
Tables and fields



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Primary key

Every table must have a primary key

A field that never has duplicate values

Used for joining between tables

Usually a field that auto-numbers

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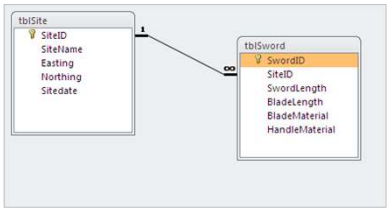
Archaeology and swords example



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tblSwords

SwordID	SiteID	SwordLength	BladeLength	BladeMaterial	HandleMaterial
1	2	1.05	0.8	bronze	bronze
2	3	0.67	0.3	iron	wood
3	5	0.5	0.1	bronze	wood
4	2	1.2	1.1	unknown	iron
5	4	1.04	0.9	steel	steel
6	5	0.95	0.7	iron	wood
7	1	0.92	0.7	bronze	wood
8	6	0.8	0.6	unknown	iron
9	7	0.73	0.5	iron	iron
10	3	0.45	0.4	bronze	wood
11	4	0.5	0.4	bronze	bronze
12	1	1.2	0.8	iron	wood

tblSites

SiteID	SiteName	Easting	Northing	Sitedate
1	Hereford	349926	240344	12th century
2	Okehampton	258796	095203	65 - 200 AD
3	Pickering	479647	483943	Civil War
4	Fordhouses	390736	302946	14th century
5	Housesteads	336709	555434	100-400 AD
6	Colchester A	596314	226571	100-400 AD
7	Colchester B	602646	222634	100-400 AD

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Archaeology and swords example

- How many swords are there with wooden handles?
- Give the lengths of all swords found at Hereford
- What is the likely date of the sword that is made of steel & steel?

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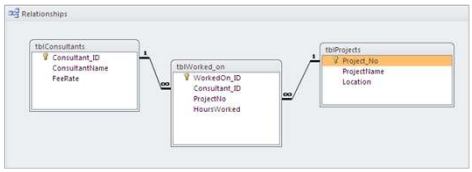
Project Consultants example



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tblConsultants

Consultant_	ConsultantName	FeeRate
1	Grey	£110.00
2	Brown	£95.00
3	White	£90.00
4	Green	£90.00
5	Black	£90.00

tblProjects

Project_No	ProjectNam	Location
1	Apollo	Glasgow
2	Zeus	Edinburgh
3	Mercury	Aberdeen
4	Athena	Bury
5	Luna	Lincoln

tblWorked_On

WorkedOn_	Consultant_	ProjectNo	HoursWorke	Click to Add
1	1	5	45	
2	3	2	25	
3	2	5	25	
4	4	1	37	
5	5	2	150	
6	1	4	156	
7	1	2	25	
8	3	5	37	
9	3	1	10	
10	4	2	5	

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Project Consultants example

- How many hours has the team worked in Glasgow?
- Which consultants have worked over 50 hours on a project (give names)?
- Which cities has Grey worked in?

And now a tough one:

- Name the consultant/s who have worked in Glasgow

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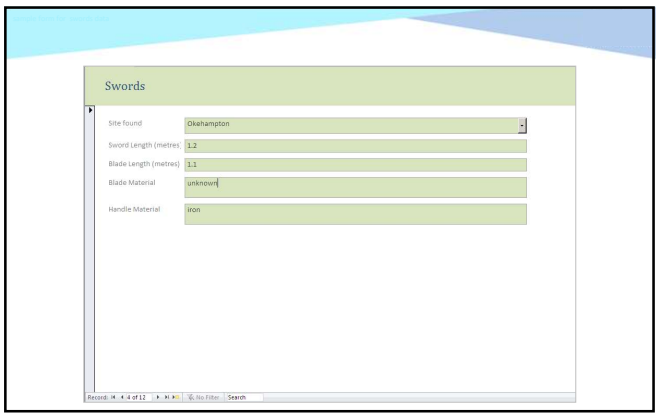

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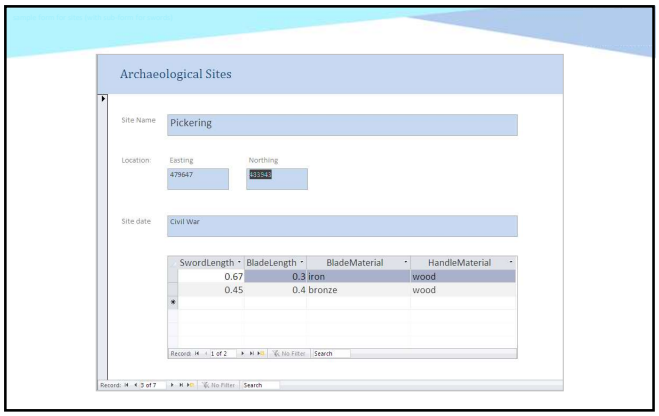

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Planning a database

Take a break

Resume at 11:20

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Find the resources for this workshop in our IT Learning Portfolio

Download the files (and more) from the IT Learning Portfolio at
skills.it.ox.ac.uk/it-learning-portfolio

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Relationships between tables

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Flat file design?

All data in one table – like a spreadsheet
But does this suit your real situation?

Clues in the data
- Redundant data
- Inconsistent data
- Inflexible data, difficult to analyse

Multiple tables generally mean a better model

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Relationship types

One-to-many (the most common)
- One record in *this* table corresponds to several records in *that* table
- Primary key is on the "one" side

One-to-one
- Less common

Many-to-many
- Modelled using two one-to-many joins, with an intermediate table to link them

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A workflow for database design

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Designing a Database

Step 1	**List all the fields you will need** • *Are there plenty - have you included everything?* • *Separate the facts - are they atomic?*
Step 2	**Give each field a data type** • *Are they consistent?*
Step 3	**Arrange the fields into tables** • *Do all the fields in the same table describe the same item?*
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Step 6	**Review, reflect, challenge** • *Talk through the design with someone else*

30

Library catalogue scenario

An analysis of a lending library has gathered the following data:

catalogNum ISBN title author
YearOfPub PublisherName address TelNum
cardNumber name address TelNum
DateOut DueDate ReturnedDate FeeDue

How can this data be organised into tables?

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Library catalogue scenario

An analysis of a lending library has gathered the following data:

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Library catalogue scenario

tblBooks
[catalogNum, ISBN, title, author, YearOfPub]

tblPublishers
[PublisherName, address, TelNum]

tblBorrowers
[cardNumber, name, address, TelNum]

tblBorrowing-Event
[DateOut, DueDate, ReturnedDate, FeeDue]

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Library catalogue scenario

tblBooks
[catalogNum, ISBN, title, author, YearOfPub, **BookID**]

tblPublishers
[PublisherName, address, TelNum, **PublisherID**]

tblBorrowers
[**BorrowerID**, cardNumber, name, address, TelNum]

tblBorrowing-Event
[DateOut, DueDate, ReturnedDate, FeeDue, **BorrowingID**]

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Library catalogue scenario

tblBooks
[**BookID** , catalogNum, ISBN, title, author, YearOfPub, PublisherID]

tblPublishers
[PublisherName, address, TelNum, **PublisherID**]

tblBorrowers
[**BorrowerID**, cardNumber, name, address, TelNum]

tblBorrowing-Event
[DateOut, DueDate, ReturnedDate, FeeDue, **BorrowingID**, BookID, BorrowerID]

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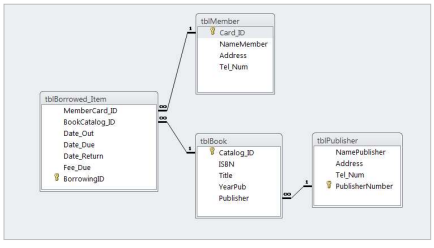
Library catalogue scenario



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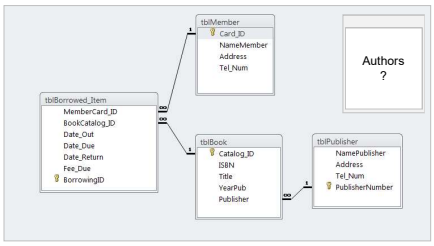
Library catalogue scenario



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Group work 2

Go back to your group for some more scenarios

This time, use the *Designing* workflow

Resume at 12:25

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Reflect

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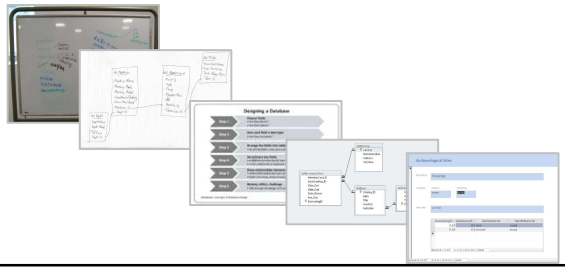
Reflect



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Where next?

Start design for your own project

Course Clinic

IT Learning Portfolio
skills.it.ox.ac.uk/it-learning-portfolio

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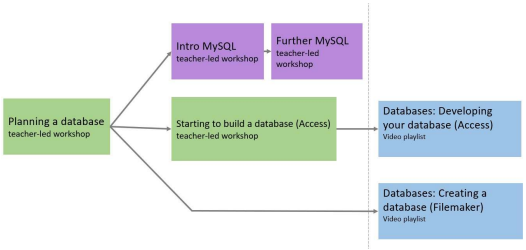
Where next?



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Find the resources for this workshop in our IT Learning Portfolio

Download the files (and more) from the IT Learning Portfolio at

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pamela.stanworth@it.ox.ac.uk

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