# Databases:
# Building a database

# The small print

## Prerequisites

Time in the classroom 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 Lynda.com videos. Lynda.com videos can be accessed by University members anytime, anywhere, through a browser or app.

The workshop description will tell you if any prior learning is required. If you don't have an environment where you can do this learning, you can come along to one of our 'Lynda Labs'. These are scheduled every week, and are a quiet space where you can work through Lynda.com videos or other workshop resources.

If you turn up to 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, 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 | September 2016 | Pamela Stanworth | Created |
| 1.1 | March 2017 | Pamela Stanworth | Corrections |

# About this workshop

This workshop will take you through the process of designing and building a relational database. A sound structure is vital to the success of a database project, enabling you to organise your data efficiently and analyse it flexibly.

If you are inheriting an existing database, and need to find your way around it and decide on possible changes, the same techniques will apply. If you are supervising specialists who will do the actual work of building the database, we will give you an insight into the process of designing a database so that you can manage the project effectively.

We will include pointers to other workshops and further resources that will help you go on later to create a user--friendly interface and apply a range of interesting and useful analyses.

## What you will learn

We will start by creating a simple database with just one table, and understanding how field properties can be set to manage the way the database behaves. Then we will develop the idea of relationships between tables, and why these are so important in creating a good model of your data. We will also consider how you can import or link to data that is found outside your database, and how to export interesting parts of the data for other users.

The last part of the workshop will include an opportunity for you to discuss your own project with one of our teachers.

## What you need to know

The ideas and techniques covered in this workshop will apply to a range of tools. We will demonstrate using *Access*, whose graphical interface is a good medium for learning in. However, the concepts will be the same, whatever relational database software you decide to use.

I will assume that you have already decided on your tables, fields and relationships using the ideas covered in the course "Databases – concepts of database design".

If you need to review these activities, Lynda.com is a great place to get guidance. Here are some relevant videos:

"Access 2013 Essential Training", chapter 1

## The resources you need

Sample data and databases that you can use to experiment with will be available, but you may like to bring along your own.

Unless you have been told otherwise, there will be a computer available for you to use with *Access* installed.

You can bring along your own laptop with your preferred tool installed if you want to – just bear in mind that I am not an expert in every tool (although I am sure that between us we will be able to solve most issues!).

## Using the database files for exercises

*Access 2013* files for these exercises have been provided for you on a network drive. Your area of the drive is called the Home Drive H:

Please note that *Access* only trusts files if they have been saved in a "Trusted Location". The Home Drive H:, used for most IT Learning Centre courses, has been designated an Access Trusted Location. If you make copies of the files for these exercises, and save them on your own computer in a location that is not trusted, you may not be able to carry out all the activities described.

## About the tools you can use

There are many applications that you can use to create a relational database, each having different strengths and applications. For example, the selection will depend on how many people are expected to use it (a handful of people, several dozen, thousands?) and how they will get access to it (saved locally or data viewed and contributed on-line? free software or paid-for?). You should also think about the devices that you and other users will be using (Windows, Mac, web browsers on a variety of devices?) and what features will be needed (design your own custom forms, produce charts?). Also what support will you need (courses from IT Learning Centre, videos online, existing expertise in your own team?).

The Database Chooser tool is designed to help you compare your software options, to select one that will suit your project. It is itself a database that runs in *Access*, and a copy is included with the student files for this workshop. The Chooser is currently in beta form, so we hope you will find it useful but if you have any problems using it – or have suggestions about improving it – please contact us using courses@it.ox.ac.uk.

## Web App or Desktop Database?

*Access 2013* can also be used to create a web app database: one where users work on the data via a web browser. This would require communication using *Office 365* or *SharePoint 2013* (not currently available at Oxford University), and is not the subject of this course. We will work on a desktop database, which is saved locally on your computer or a network drive.

## Learning Objectives

This workshop has the following learning objectives.

Learning Objective One – Create a database with 1 table

Learning Objective Two – Set up field properties

Learning Objective Three – Establish relationships between tables

Learning Objective Four – Working with external data

Learning Objective Five – Your own project

## Study Videos

During the workshop, I will point you to a variety of resources that will help you in achieving these objectives.

Videos to support these topics are available from Lynda.com. Find the playlist for this course in the ITLC Portfolio: visit http://portfolio.it.ox.ac.uk and search for "building database playlist".

Watching these videos requires an Oxford University account with Lynda.com. Read about Lynda.com here: http://portfolio.it.ox.ac.uk/resource/lyndacom/lyndacom-welcome-about-these-videos-and-learning-resources

## Learning Objective One – Create a database with 1 table

You are going to create a new database for cataloguing your collection of music (CD's, LP's, MP3's, cloud collection etc).

Make sure you save it with a suitable filename file in the Home Drive H:/.

Create one table with some useful fields, including some text and at least one date field. Each field needs a name and description. Each field needs the right data type for the kind of data it is going to contain. Don't forget to save the table design.

Practice toggling between Datasheet View and Design View, until you are sure what each view is used for.

Confirm that you can enter data values and make corrections. A table is the place for storing data – facts & figures.

One database file can contain many tables.

Later, you will add forms, reports and queries, which will all be saved in the same database file.

## Learning Objective Two – Set up field properties

We have a table where a musician can list the songs his band will play at a gig, with the order they will be done, and you are going to improve some of the fields' formats and properties. Some features will help ensure that users enter their data correctly.

After each change, you will want to test it in Datasheet View.

In the database **Favourites2.accdb**, in the table **tblFavouriteMusicTracks**, change some properties of fields:

> **Title** can have maximum 100 characters
>
> **DatePurchased** has the format Medium Date
>
> **Price** has the Currency data type
>
> **Title** needs to be a mandatory field
>
> Control the **Rank** so that only numbers up to 10 are permitted.
>
> Set up a lookup control to help users choose a person's name for **WhoseFavourite**

Every table needs a **primary key**, so in **tblDJ_Tracks**, set the **SongID** field to be the primary key (primary keys will be important for later activities). Use the Index property to ensure that the **RunningOrder** field cannot contain duplicate values.

## Learning Objective Three – Establish relationships between tables

The Relationships diagram is the heart of any relational database – it specifies how the various tables are joined. Deciding on which tables are linked, and how, takes a lot of thought so you should allow time to work on this and design a diagram which properly models the evidence or data you are collecting.

The example in the database **SchoolOfMotoring.accdb** concerns a driving school, the instructors and students and the lessons they attend.

Arrange all the tables in a Relationships diagram. It is helpful to rearrange the field lists (boxes), move and resize them to a layout that is easy to understand.

Set up joins between tables, using suitable fields. Enforce Referential Integrity for all joins. Then review the Relationships diagram, and confirm that the joins tell a plausible story.

These joins are essential to the way your database will work – any of the queries, forms and reports are likely to rely upon them.

## Learning Objective Four – Working with external data

Continue work in the School Of Motoring database.

Some or all of your data may initially have been collected in some other file format, so you need to import it. You are going to make use of some extra data in your database.

Import a list of teaching resources from **ResourcesTable2.xlsx**, and set up suitable join/s in the relationships diagram.

Append some additional student records from **ExtraStudents.txt** to the existing table of students.

A link is a live connection to data that is stored outside your database. This can be a really useful way of making use of data provided by another person or team. Link to a list of teaching resource **types** in **Extra Resource Data2.accdb**. Confirm, by editing data in the table, that it is successfully linked to the external source.

You can export the data from a whole table, or export the results of a query that pulled together selected data from one or more tables.

Try exporting a table of data in various formats.

## Learning Objective Five – Your own project

The IT Teachers in the IT Learning Centre would be happy to discuss with you your own database project. Talk to the teachers about your design, and the next steps for building your database.

The concepts discussed in this course will apply, whichever software you decide to use for your project: the choice of software depends on a range of factors.

Explore the *Chooser* tool, to think about which software might be suitable for your project.

NB This *Chooser* tool is a guide only, and is currently in the Beta version – you should double-check the suitability of any software you plan to use for any real project.
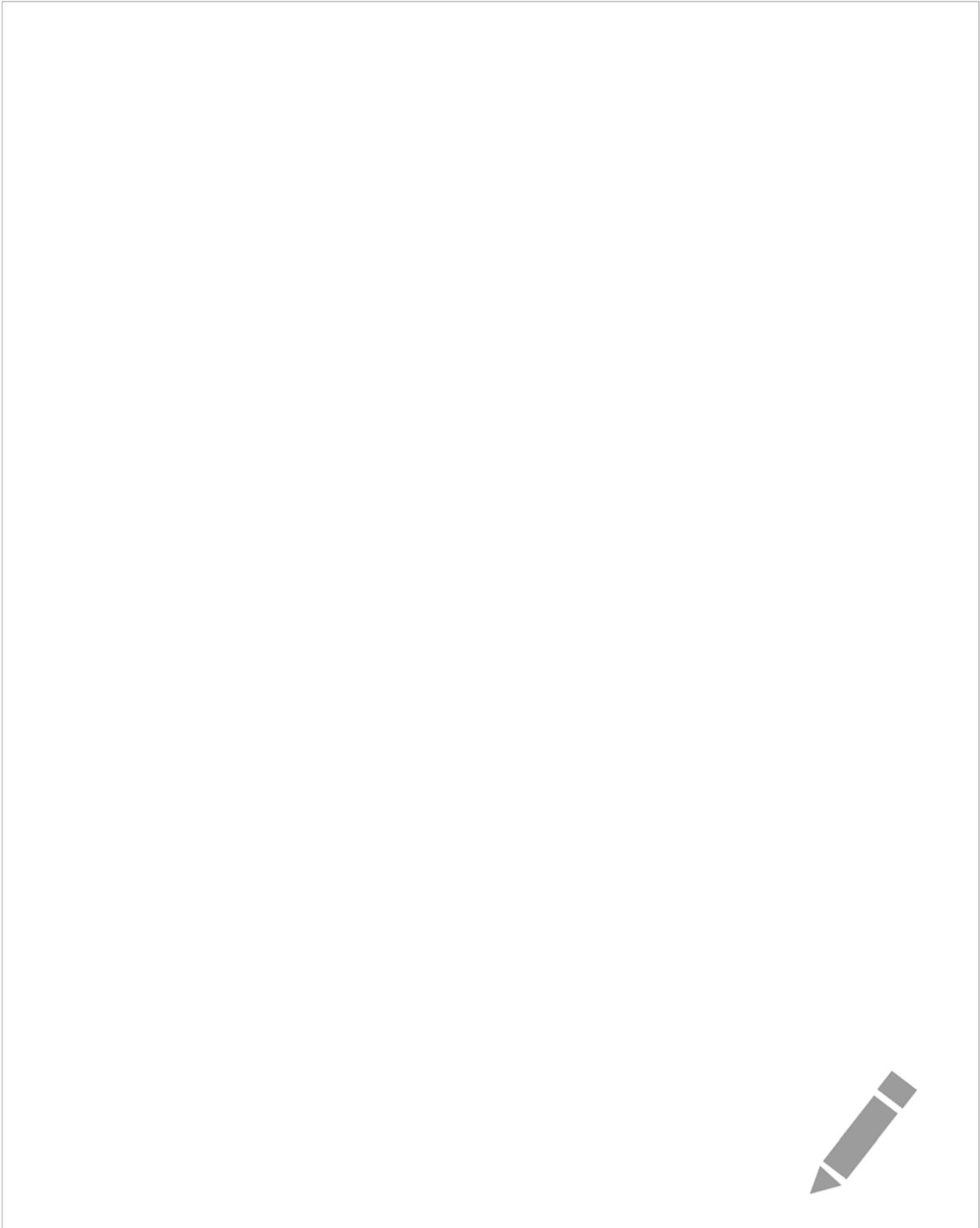
# Further information

## Getting extra help

### Clinics

The IT Learning Centre offers bookable clinics where you can get pre- or post-course advice.

### About Lynda.com

Lynda.com is free to all members of the University. Visit courses.it.ox.ac.uk/lynda and sign in with your Single Sign-On (SSO) credentials. Some courses recommend pre- and/or post-course playlists of Lynda.com videos to support your learning. You can watch these anywhere, anytime, and even download them on to a tablet or smartphone for off-line viewing.

If you need a quiet place to work through playlists away from distractions, the IT Learning Centre offers frequent Lynda Labs that you can book onto.

### About the ITLC 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 http://portfolio.it.ox.ac.uk.

## About the IT Learning Centre

The IT Learning Centre delivers over 100 IT-related classroom-based courses, and gives you access to thousands of on-line course through Lynda.com.

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 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.

## Databases:
## Building a database

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## Your safety and comfort are important

Where is the fire exit?

Please tell us if anything doesn't work

The toilets are along the corridor outside the teaching rooms

The rest area has vending machines and a water cooler
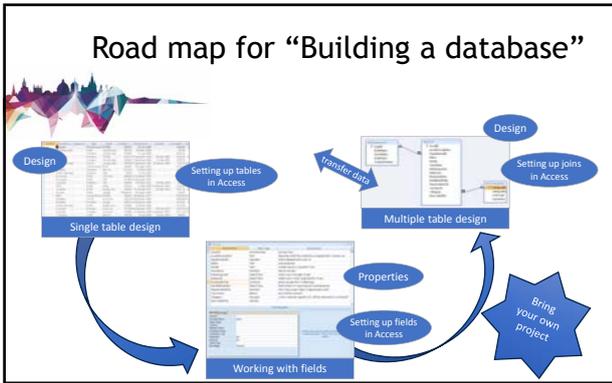
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## Resources for your learning

**Activities for you to practice today**
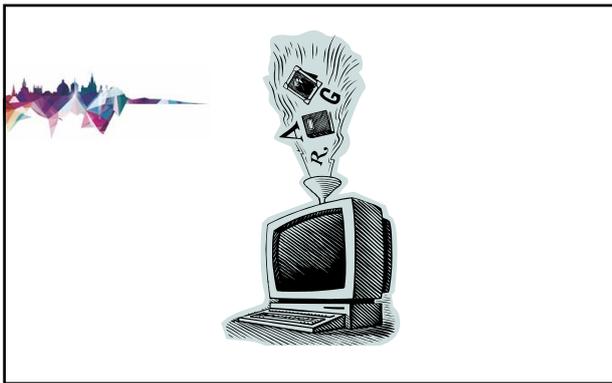In the course handbook
Work at your own pace!
Be selective

Video playlists with today's topics in Lynda.com

**Follow-up work**
Continue with exercises after the session
Bookable Course Clinics later

## Road map for "Building a database"

Design → Single table design

Setting up tables in Access

transfer data

Multiple table design → Design → Setting up joins in Access

Properties

Setting up fields in Access

Working with fields

Bring your own project

## Planning a Database Table

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## Database vocabulary

A database is a collection of data

Data is organised into one or more tables

Each row is a record

Each column is a field

|  | Name | Phone | Town |
|---|---|---|---|
| record 1 | Peter | 238172 | Oxford |
| record 2 | Sheila | 426372 | Witney |
| record 3 | Janine | 826812 | Thame |

## Decide on the fields

Think of all the facts that will be collected

## Designing a table

**tblEvent**

EventTitle

Date

TimeStart

TimeEnd

Venue

PersonOrganising

Sponsor

CateringRequired

...

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## Building a Single-Table Database

## Getting started with *Access*

Start *Access*
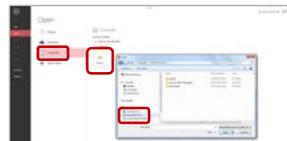Use a desktop icon or Start menu

*Access* version 2013 in teaching rooms

## Create a new database

Create a blank desktop database

All tables, queries, forms, reports etc are saved in one database file    **MyDatabase.accdb**

Today, please work in your home drive H:\

## Enabling active content?

Security Warning    Some active content has been disabled. Click for more details.    Enable Content    ✕

Trusting the File Location
with Access 2013

Trust Center Settings...

## Creating a Table

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## Create a new table

Blank table is offered (or use Table )

Save the table    Save

Table names begin with tbl
No spaces, limited punctuation in names

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## Two views of a table

Datasheet View
  Table data is laid out in rows and columns

Design View
  Fields are listed, with their data types

## Creating fields in Design View

Field name (no spaces)
Data type
Description

(Properties: see later)

| | tblTowns | |
|---|---|---|
| | Field Name | Data Type |
| | identifier | AutoNumber |
| | TownName | Text |
| | PostCodeCentre | Text |
| | Population | Number |
| | contractDoc | Attachment |

## Datasheet View is for viewing raw data

Enter or correct the data
Data is saved as you leave a record

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## Databases - Building a database

Look at Learning Objective One

Restart at 10:00 please

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## If you want to continue with the Exercises, you could …

Copy the Exercise files to a memory stick

Download the files (and more) from the IT Learning Portfolio at http://portfolio.it.ox.ac.uk

Download "Step by Steps"

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## Working With Fields and Properties

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## Tables in a database file



Navigation pane
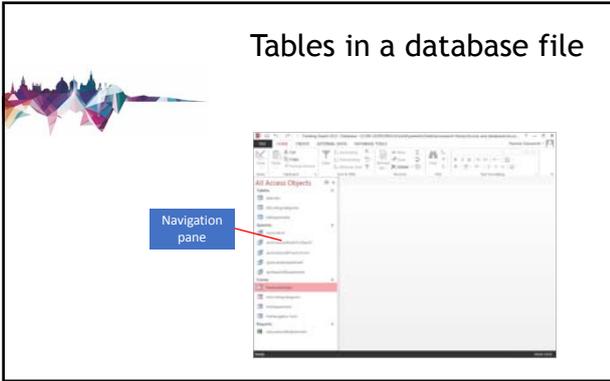
## Properties for individual fields

Set properties to make each field more usable
Field size, caption, format for dates and numbers

Access cannot test whether the values are *correct*, only whether they are *plausible*

Help the user to give accurate data
Default Value
Required Field
Validation Rule
and Validation Text
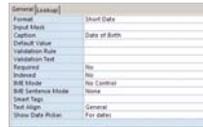


## Make data entry easy – build a lookup

A **lookup** offers a list of permitted values
Helps ensure consistent data entry



Lookup Wizard: it's on the **Data Types** list
Limit to List?

## A word about input masks (*optional*)

Mask sets a pattern which the user must follow
  e.g. ABC-1234 for a product code

Input mask is a property of the field
  Choose from the list of input masks
  Or edit an existing input mask

## Some fields need an index

Index is a list of the order the records lie in, when sorted
  Speeds up calculations and sorting
  Slows down data entry

Set **Indexed** property of a field to **Yes**

| Index | No |
|---|---|
| | No |
| | Yes (Duplicates OK) |
| | Yes (No Duplicates) |
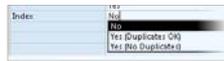
## Choose one field to be the primary key

A field where every record has a *different* value
so it can identify the record uniquely

May create a dedicated field
  e.g. PersonID
  Use **AutoNumber** data type

Or nominate an existing real-world field ?
  e.g. EmployeeNumber
  Use [Primary Key] on **Design** tab
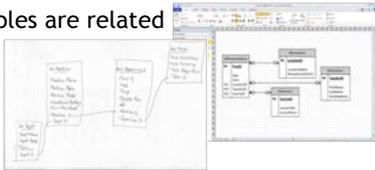
## Designing with Multiple Tables

## Designing a relational database

Plan it on paper first
Choose the tables, then the fields
Mark how the tables are related

## Relating two tables

Nominate a **primary** key in each table
Mark which field links *this* table to *that* table
Convenient to have same or similar field names

## Databases - Building a database

Look at Learning Objective Two

Restart at 11:15

## Relationships In *Access*

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## Creating a multi-table database

One *Access* file contains several tables

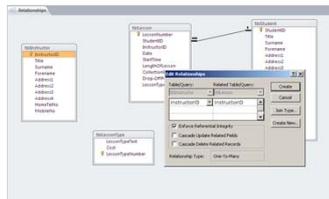Each table must have a primary key

Joins will show how they are related

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## Joins between tables

Move and resize table boxes
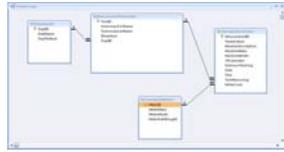
Relationships diagram

Show tables

Make each join by dragging a field name

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## … Referential integrity …

Prevent orphan records

Meaning "Every foreign key value must find a matching primary key value"

Access can enforce referential integrity on a join

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## The complete Relationships Diagram

Join lines appear in the Relationships diagram
   1 and ∞ symbols
   Will be used in future queries

Print the diagram using  Relationship Report

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# Data Management

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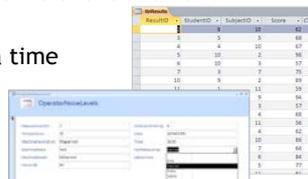
## Easiest for people to work on data using forms

Too risky to work on data in *tables*
   A *form* is safe and efficient for humans

Usually one record at a time
Easy to use
Related data appears
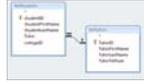via drop-downs

## Using data from an external source

*Access*, *Excel*, text file and others

Import or Link?
Importing makes a duplicate copy in your database
Linking connects to data saved outside your database

Import, then make joins
to existing tables

## Exporting data

One table at a time, or selected records

Data types include *Access*, *Excel*, text files
Data is copied to the new location

Word Merge uses Word's mailmerge tool

## Database Software

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## Choosing software

Database theory is the same, whichever software

Think about:
Relational / Simple list
Number of users
Windows / Mac / other
Working online / locally
Cost and support

Database Chooser tool (beta version; downloadable)

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## More About Databases

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## Other related courses

Databases: Concepts of database design

Next steps:
Databases: User-friendly database design
Databases: Queries and data analysis

 - see the schedule online

Lynda.com videos about databases and other topics

## Databases - building a database

Now look at the remaining Learning Objectives

Then … "BYO: Bring Your Own Project":

Think about your own project: what can you design?
If you have brought your own design for a database, talk to our teachers about it

Finish at 12:15

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