

Designing and Creating Databases

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7 Database Structures

We see how to:

1. design and create database structures
2. modify database structures
3. apply validation
4. copy database structures
5. save and print database structures
6. enter data into a database
7. import structure and data from comma-delimited files
8. merge data files

7.1 Design and Create Database Structures

Background

An Access database contains one or more tables. A table contains rows and columns. A row is called a record. A column is called a field.

Name	Date of Birth	Gender
Pearl Button	5 July 1989	female
Jo King	10 April 1991	male
Barry Cade	28 December 1990	male
Carrie Oakey	31 October 1988	female
Priti Manek	12 April 1992	female
Tim Burr	25 May 1993	male

a record

a field

A field has:

- a name e.g. Date of Birth
- a type e.g. Date
- properties e.g. Long Date
- values - all of the same type e.g. all dates

As part of the design process you choose descriptive field names and appropriate data types. A data type is a set of similar values e.g. all numbers, or all text. Access data types include:

Data Type	Description	Use For
Text	digits, letters, punctuation and symbols. 255 characters maximum - about the size of a typical paragraph.	names, addresses, phone numbers, product descriptions
Memo	a lot of text, up to about 65,000 characters - about the size of an average chapter in a novel.	articles, memos, letters
Number	you do arithmetic with numbers. For example, the number of keyboards in your stock is reduced by one every time you sell a keyboard. Includes whole numbers (integers) and numbers with a decimal point e.g. 3.1416	measurements, counts, percentages, time intervals e.g. the number of minutes spent running a marathon
Date/Time	Calendar dates e.g. 27 August 2009, and time e.g. 22:19.	birth dates, order dates, shipping dates appointment times
Currency	Great Britain Pounds (GBP). For example: £399.99	prices, payments, expenses, salaries
AutoNumber	an automatic counter that creates a new number each time you add a new record.	key field to uniquely identify a record. No two records will have the same auto generated number. Often named ID.
Yes/No	just two values: <i>yes</i> or <i>no</i> .	isDeleted = yes isRich = no
Hyperlink	a website or e-mail address, or a file path	www.lec.ac.uk daisycutter@lec.ac.uk f:\documents\report.doc
Attachment	one or more separate files - the content of these files are copied into the database	pictures, word docs, spreadsheets, ...

AutoNumber guarantees that every record has a unique number. Usually, the numbers look like a sequence: 1, 2, 3, 4, 5, ... But if you start entering a record, record number 6 say, then you change your mind, delete it and then enter the corrected record, number 6 is not used again. Instead, the next new record number is used. You see: 1, 2, 3, 4, 5, 7, ... The 6 is missing. This is quite normal and not a problem.

As database designers, we aim to maximise its speed by minimising the amount of data storage required. As a rough guide, we allow:

Application	Size
first and last names	25 characters for a first name, 50 for a last name
middle initial	just one character
e-mail address	50 characters
towns, cities, countries, places	50 characters
street address: number, street-name, Rd, or St or Pl or Sq or ...	50 characters
phone numbers, post codes, credit-card numbers	count them and ignore spaces, set the maximum to match. Use an input mask (see Level; 3) to add brackets, spaces, .. as required
descriptions and comments	255 characters is three or four sentences, any more than that then use the Memo type.

We can also choose the size of storage required for numbers.

	Size	Description	Examples
Smallest	Integer	a whole number between about $\pm 32,000$	calendar year, number of employees in a business, counting
	Long Integer	a whole number between about $\pm 2,000$ million	the safest integer to use: populations, car component production
	Single	a number with a decimal point, 7 decimal places of accuracy	a person's height in metres, weather e.g. temperature, rainfall
	Double	a large number with a decimal point, 15 decimal places of accuracy	company accounts, scientific measurements
Largest	Decimal	a huge number with a decimal point, 28 decimal places of accuracy	astronomical distances, atomic physics



The different date and time formats occupy the same amount of space. But you can choose to hide the time component and display just the date, or hide the date component and display just the time.

Format	Example
General Date	19/09/2009 10:25 AM
Long Date	19 September 2009 10:25 AM
Medium Date	19-Sep-09
Short Date	19/09/09
Long Time	10:27:45 AM
Medium Time	10:27 AM
Short Time	10:27

Design

Spreadsheet pros think about the design before they sit down in front of a computer to write the database.

We design a database that will help a computing department librarian keep track of resources such as videos, books and equipment.

Like the greatest thinkers, we do our thinking on paper - on the back of a fag packet, on the back of an old envelope or in a notebook for example. We start by considering some example data. In doing so we think of new fields, choose and change field names, spot possible problems, ... as we become familiar with the problem. Then we add a sentence or two of explanation.

Category	Item	OutOnLoan	LastBorrower	DateBorrowed	Deleted
Video	Website Design	yes	Pearl	25-Sep-09	no
Book	Office 2007	no	Jo	26-Sep-09	no
Equipment	Video	yes	Barry	27-Sep-09	yes
Equipment	Camera	yes	Carrie	28-Sep-09	no
Book	Access 2007	no	Priti	28-Sep-09	no
Video	Database Design	yes	Tim	29-Sep-09	no

When a lecturer borrows an item, a new record is created and OutOnLoan is set to yes. When the item is returned, OutOnLoan is set to no. If an item becomes lost or damaged beyond repair, Deleted is set to yes.

Now we can construct a table showing the field names, their types (chosen from the list on page 2 above), and their properties such as Field Size.

Table: tblResourceManagement				
Fields				
Name	Type	Properties	Example	Comment
ID	AutoNumber		2	key field
Category	Text	Field Size = 10	Equipment	Video or Book or Equipment
Item	Text	Field Size = 50	Video on website design	
OutOnLoan	Yes/No		Yes	
LastBorrower	Text	Field Size = 50	Jo King	
DateBorrowed	Date/Time	Medium Date	19-Sep-09	
Deleted	Yes/No		No	marked as deleted when the item is lost

Notice that, like most professionals, we do not use spaces in field names. Ok. Access work ok *most* of the time with spaces in field names, but not in every situation.

Exercise 7.1

Complete the exercises shown below on paper.

1. You have just been employed in the office of Matches Made in Heaven - a dating agency. Many customers complain that they are being repeatedly matched with the same people, people who they have previously rejected. Design a simple database that records who has been matched with whom. Explain how your database might solve the problem. Get a colleague to look for errors in your design.
2. You have just landed a job with Les Plack, a local dentist. The current booking system is a large book, arranged like a calendar. Les wants to see at-a-glance on his computer screen who is due to come for treatment that day, and when. Design a simple database that records Dental Appointments. Explain how your database might work. Get a colleague to look for errors in your design.
3. You have volunteered to design a database for the local allotment society, GrowAllot. The secretary needs to keep track of who has rented which plot, and which plots are available for rent. The plots are numbered 1, 2, 3, ... up to 120. Some plots are split into 2, 3 or 4 parts. These parts are identified with the letters A, B, C and D. No two plots have the same *number* e.g. you do not get two plots labelled 24B. Rents are due in October each year. Twice a year, in June and in August, the committee inspects the plots. If a plot looks like it is not being used, a letter is sent to the plot holder requesting they improve the plot within four weeks. If a plot holder is sent two consecutive letters, they are obliged to give up their plot; the plot then becomes vacant

ready for the next new plot holder. From time to time current plot holders leave, and their plots also become vacant. Design a simple database that will help the secretary manage the plot allocation system. Explain how your database might work. Get a colleague to look for errors in your design.

Create

You are employed in the Reception department of Zoom Cars. Zoom specialises in selling Mazdas, servicing them, and repairing them. Your current job is to create a database to help manage the workshop appointments system. You create the design shown below.

Table: tblWorkshopAppointments				
Fields				
Name	Type	Properties	Example	Comment
ID	AutoNumber		2	key field
AppointmentDate	Date/Time	Format = Long Date	Friday 13 September 2009	cannot be before today
RegistrationNumber	Text	Field Size = 7	GDS678X	must be present
Model	Text	Field Size = 5	MX5	must be a Mazda model: 2, 3, 5, MX5, 6, RX8
YearOfManufacture	Number	Field Size = Integer	1985	cannot be after this year
FirstName	Text	Field Size = 25	Priti	must be present
LastName	Text	Field Size = 25	Manek	must be present
Job	Text	Field Size = 255	MOT, 50000 mi service	must be present

All fields:

- Required = Yes
- Allow Zero Length = No

A new record is created when a customer asks for their car to be serviced or repaired. Each record is identified with its own ID number. If a customer cancels then their appointment record is deleted.

Now you need to create the database.

A Create a Blank Database

1. On the Getting Started with Microsoft Office Access page, under New Blank Database, click Blank Database.



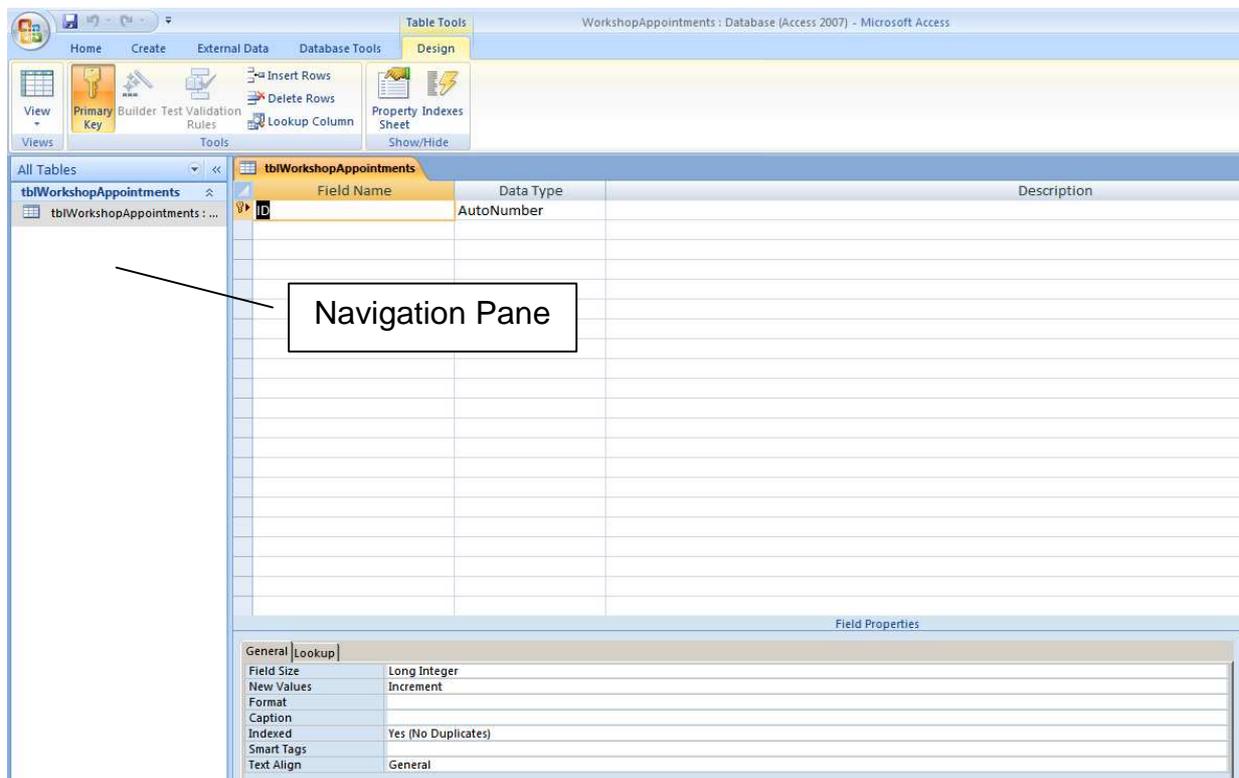
2. In the Blank Database pane, type a file name in the File Name box. A suitable file name would be *WorkshopAppointments*. Click Browse  (next to the File Name box) for a location to put your database. Navigate to the new location, and then click OK.
3. Click Create.

Access creates the database with an empty table named Table1, and then opens Table1 in Datasheet view.

B Create the Database Table Structure

You create the table structure in Design view.

1. Right click Table1:Table in the Navigation pane, then click  Design View. Access then prompts you for a table name: *tblWorkshopAppointments* will do nicely. OK. Access then switches to Design view; you see columns headed Field Name, Data Type and Description. The fields are now shown in rows.



2. For each field in the table shown on page 6, type a field name in the Field Name column, and then select a data type from the Data Type list. Type a description for each field. Set properties such as Field Size to the smallest reasonable value. For each field set Required to Yes and Allow Zero Length to No. Note: no spaces in field names.
3. After you have added all your fields, save the table: right click on the tblWorkshopAppointments tab and choose Save.
4. Print the table structure: on the Database Tools tab, in the Analyze Group, click Database Documenter, click Tables tab, select tblWorkshopAppointments, OK. Close the table if prompted. Choose Print (on the Ribbon). Close Print Preview when finished.

Exercise 7.2

1. You have volunteered to work for the organiser of the Mad Hatters Marathon. Your job is to design and create a database for the marathon entries. An entry form is shown below. Each entry is allocated a unique competitor number. Design and create an appropriate database table. Print the database table structure.

Entry Form	Please complete the form and send it to LOROS Hospice, Mad Hatter, Leicester, LE99 99YZ before 30 September 2009		
I wish to enter the Mad Hatters Marathon	<input type="checkbox"/>	£20	
I wish to enter the Half Marathon	<input type="checkbox"/>	£15	
Payment by	<input type="checkbox"/>	Cheque Made payable to LOROS.	
	<input type="checkbox"/>	Postal order.	
First Name	<input type="text"/>	Last Name:	<input type="text"/>
Address	<input type="text"/>		
Post Code	<input type="text"/>		
Phone	<input type="text"/>		
E-Mail	<input type="text"/>	Date of Birth	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>
Sex: Male	<input type="checkbox"/>	Female	<input type="checkbox"/>
		Wheelchair Competitor	<input type="checkbox"/>
Size of t-shirt required:	Small <input type="checkbox"/>	Medium <input type="checkbox"/>	Large <input type="checkbox"/> X-Large <input type="checkbox"/>
I confirm I have completed sufficient training for the race and believe I am fit enough to complete the event.			
Signed:	<input type="text"/>		Date: <input type="text"/>

7.2 Modify Database Structures

You have spent half the night unable to sleep. You begin thinking about your Zoom Cars database structure. Ahh. You have forgotten to include a phone number for the customer who must be contacted if something unexpected and major is found to be wrong with his or her car. You need to modify your table.

You want to insert the customer contact phone number after Last Name but before Job.

With the WorkshopAppointments database open:

1. Right click the table tblWorkshopAppointments in the Navigation pane and select Design View
2. Right click Job
3. Choose Insert Rows
4. Enter Contact Phone Number, choose Text, set Size = 11, in Description write No spaces e.g. 01234567890. Leave Required = No and Allow Zero Length = Yes.
5. Right click tblWorkshopAppointments tab and choose Save

Exercise 7.3

1. The Timings and Results team have heard of your database to record the entries for the Mad Hatters Marathon. They think it would be a good idea if the database also recorded the runners time and position in both the half- and full-marathons. Modify your database structure to include fields for Time and Position. Set both the Time and Position to zero as the default value. If the Time or Position remains zero, then either the competitor did not start or the competitor did not finish. By runners time we mean the time taken to complete the course in minutes e.g. 150

7.3 Apply Validation

Validation involves ensuring that data complies with pre-defined standards, that data falls within pre-defined limits. For example, when creating a new workshop appointment record:

AppointmentDate	must be today or after today
RegistrationNumber	cannot be null, must be less than eight characters
Model	must be a Mazda Model: 2, 3, 5, MX5, 6, or RX8
YearOfManufacture	four digits, must be this year or before this year, and after 1980
FirstName	cannot be null, must be less than 31 characters
LastName	cannot be null, must be less than 31 characters
ContactPhoneNumber	can be null, must be less than 12 characters
Job	cannot be null, must be less than 226 characters

We refine our initial thoughts.

Field	Validation Rule - English	Validation Rule - Access
AppointmentDate	must be today or after today	>=Date()
RegistrationNumber	must be present, maximum length = 7 characters	Field Size = 7 Required = Yes Allow Zero Length = No
Model	must be a Mazda Model: 2, 3, 5, MX5, 6, or RX8	In("2", "3", "5", "MX5", "6", "RX8")
YearOfManufacture	four digits, must be between 1980 and this year inclusive	>=1980 And <= Year(Date())
FirstName	must be present, maximum length = 25 characters	Field Size = 25 Required = Yes Allow Zero Length = No
LastName	must be present, maximum length = 25 characters	Field Size = 25 Required = Yes Allow Zero Length = No
ContactPhoneNumber	may be blank, maximum length = 11 characters	Field Size = 11 Required = No Allow Zero Length = Yes
Job	must be present, maximum length 225 characters	Field Size = 225 Required = Yes Allow Zero Length = No

1. Right click the table tblWorkshopAppointments in the Navigation pane and select Design View
2. Select a field. In the lower section, set the field size and required, and set both the Validation Rule, and the Validation Text. For example, the validation rule for Date of Appointment might be $\geq \text{Date}()$, and the validation text (a helpful message to the user) could be *Date of Appointment cannot be before today*.
3. Consider field size, required, and a validation rule and validation text for each field.
4. Save your table when finished

Validation is all about getting the data in the database as right as possible, remembering that users are human and that humans make mistakes. Validation does not guarantee that the data in your database is all correct; it merely increases the chances of the data being correct and consistent.

We test the validation rules when we get to the Enter Data stage (§1.6 below).

Other validation methods include: input masks, table lookups and table validation rules. But these methods are not required for C & G Level 2 - probably.

Exercise 7.4

1. Design and apply field validation rules to your Mad Hatters Marathon table.

7.4 Copy Database Structures

1. Right click the original table name in the Navigation pane, and click Copy
2. Right click in the Navigation pane and choose Paste
3. Supply a new table name, and choose Structure Only (or Structure with data, or Append to an existing table, as you please). OK

7.5 Save and Print Database Structures

Save

1. Right click the table tab (when in Design View), and choose Save

Print

2. On the Database Tools tab, in the Analyze Group, click Database Documenter, click Tables tab, select tblWorkshopAppointments, OK. Close the table if prompted. Choose Print (on the Ribbon). Close Print Preview when finished.

7.6 Enter Data

Database designers use the datasheet to enter data and to test out their field validation measures before handing their database over to the users. We use the test data listed below:

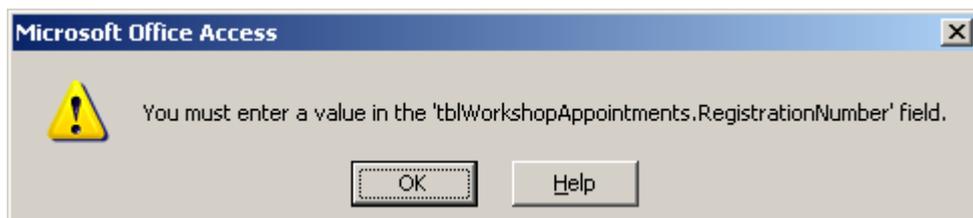
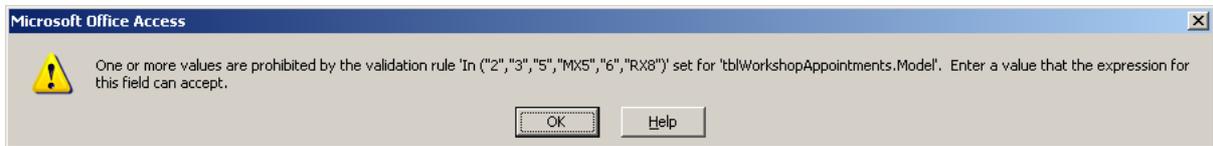
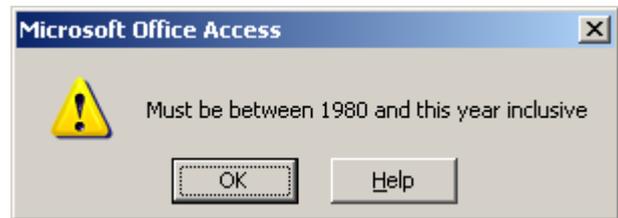
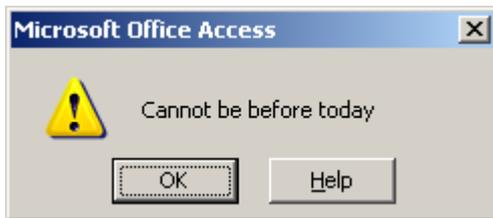
Test #	Date of Appointment	Reg Number	Model	Year of Manufacture	First Name	Last Name	Contact Phone Number	Job	Comment
1	today's date	AB05XYZ	MX5	2005	Jo	King	12345678900	MOT	normal
2	yesterday's date								yesterday
3	tomorrow's date	AB05XYZ	MX						not a Mazda model
4	tomorrow's date	AB05XYZ	MX5	next year e.g. 2010					not yet made
5	tomorrow's date		MX5	2005	Jo	King	12345678900	MOT	no car reg
6	tomorrow's date	AB05XYZ	MX5	2005					no first name
7	tomorrow's date	AB05XYZ	MX5	2005	Jo			MOT	no last name
8	tomorrow's date	AB05XYZ	MX5	2005	Jo	King	123456789000	MOT	phone number too large
9	tomorrow's date	AB05XYX	MX5	2005	Jo	King	12345678900		no job

Note: if today is the 19 September 2009, then yesterday's date is 18 September 2009 and tomorrow's date is the 20 September 2009.

Our own validation tests e.g. `>=Date()`, are carried out immediately we enter data in a field. The inbuilt validation tests, such as Required = Yes, Allow Zero Length = No, are executed when you have finished entering data for the entire record. It is a bit of a pain - the resolution is a bit beyond C & G Level 2.

1. Rapid double click on your table name in the Navigation pane. This opens the Datasheet View.
2. Set column widths: position the cursor on the boundary between two field names - the cursor changes shape to a double-headed arrow - and then rapid double click.
3. Try each test listed above and check that you get the appropriate error message. Note that where you rely on the field properties for validation e.g. when nothing is entered in a required text field, the Access generated error message does not appear until you attempt to move onto the next record.
4. When finished, right click the tblWorkshopAppointments tab and choose Save. Right click the tab again and choose Close.

Some error messages are shown below.



Exercise 7.5

1. Construct a test data table for your Mad Hatter's Marathon database
2. Apply your test data to your database and check that you get the expected error messages. Fix any problems you find.

7.7 Import Data and Structure from Comma-delimited Files

You have some data in a text file that you want to import into an Access database table. You can import the data itself in to an existing database table. You can import the data into a new database table and, in doing so, import its structure. We see how.

Create a text file

1. Use Notepad (Start, Programs, Accessories, Notepad) to create the data table shown below

```
ID,AppointmentDate,RegistrationNumber,Model,YearOfManufacture,FirstName,LastName,ContactPhoneNumber,Job
11,1/11/2009,HAD10XY,MX5,2006,Pearl,Button,10234567890,MOT
12,1/11/2009,AB05CDE,2,2007,Barry,Cade,1234567891,3000 ms
13,2/11/2009,ZY05BCA,6,2005,Carrie,Oakey,1357924680,5000 ms
14,3/11/2009,JKL678X,MX5,1985,Tim,Burr,,respray
15,3/11/2009,MA01XYX,RX8,2008,Justin,Case,2468013579,cam belt
```

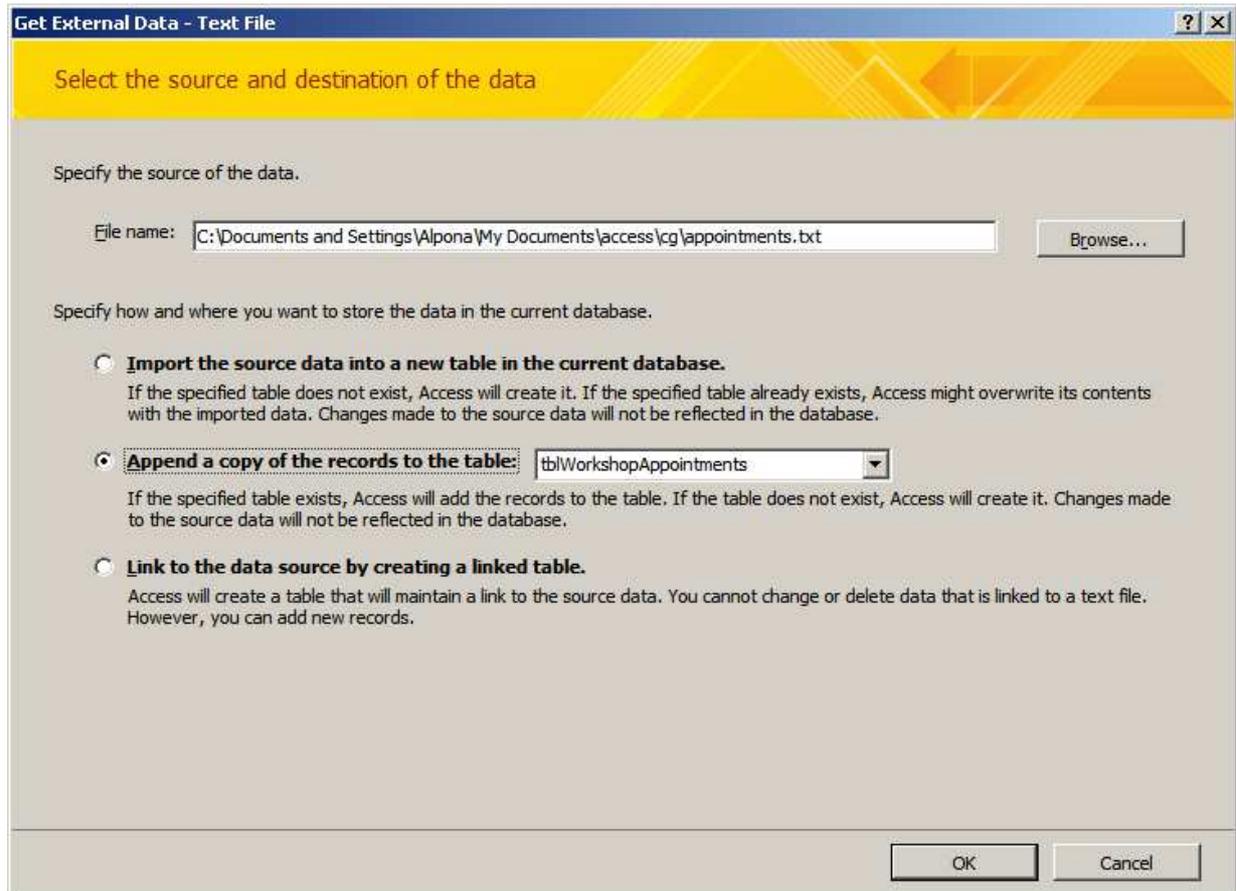
Ensure the date of appointment is today's date or after.

We need to give Access as much help as possible. So we:

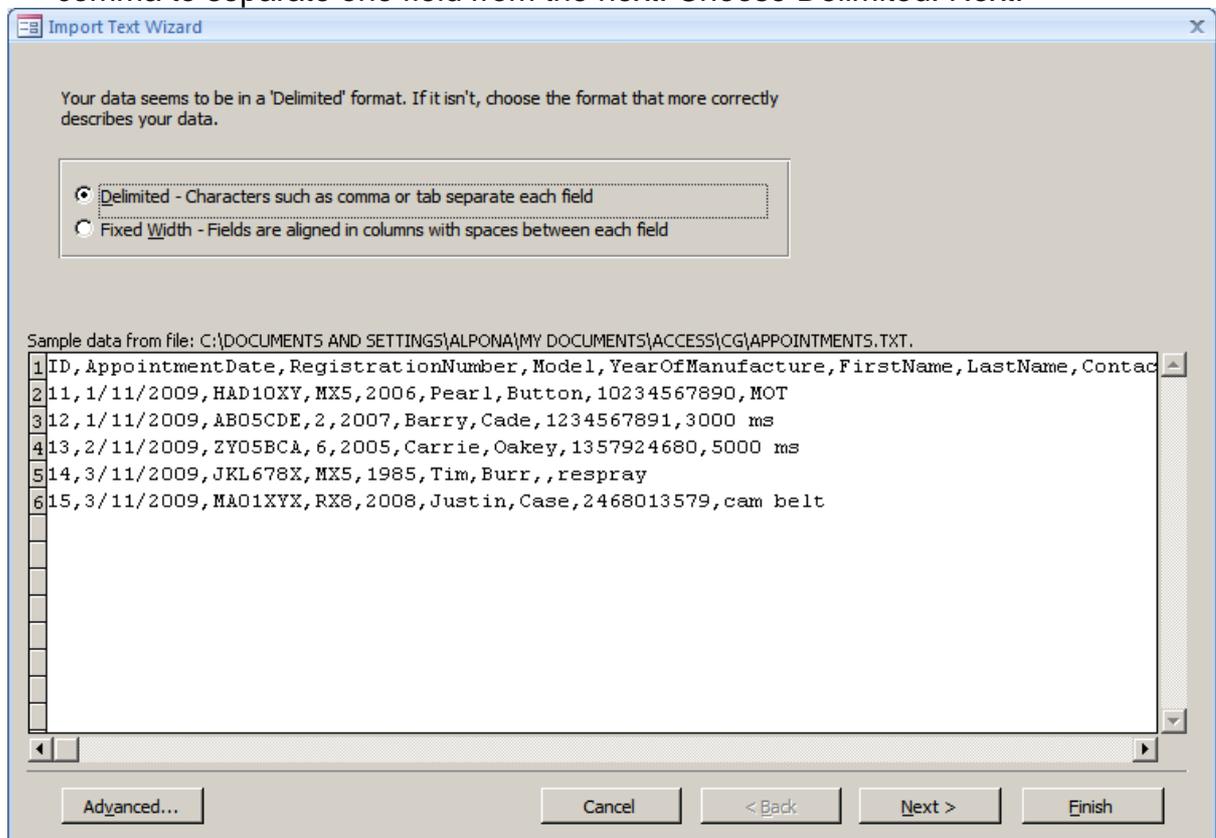
- provide the field names exactly as they are in our Access Database table
 - separate each item with a comma
 - ensure the keyfield values do not clash with any of those in our Access Database Table
 - provide dates in the format day/month/year
 - remove all spaces between field values
 - remove any blank lines
2. Save your comma-separated table as appointments.txt

Import a Text File

1. Under the External Data tab on the Ribbon, in the Import Group, click Text File. A wizard is launched.
2. Browse to where your text file, appointments.txt, was saved, and double click in the file name itself.
3. Choose where to place the imported file content. Create a new table imports both data and structure. Append to an existing table just adds the data. Choose Append. OK.



4. Specify the type of text file: Delimited text files uses a character such as a comma to separate one field from the next. Choose Delimited. Next.



- Specify that the field separator is a comma. Check the box to confirm that First Row Contains Field Names. Next.

What delimiter separates your fields? Select the appropriate delimiter and see how your text is affected in the preview below.

Choose the delimiter that separates your fields:

Tab
 Semicolon
 Comma
 Space
 Other:

First Row Contains Field Names
 Text Qualifier:

ID	AppointmentDate	RegistrationNumber	Model	YearOfManufacture	FirstName	LastName	Contact
11	1/11/2009	HAD10XY	MX5	2006	Pearl	Button	1023456
12	1/11/2009	AB05CDE	2	2007	Barry	Cade	1234567
13	2/11/2009	ZY05BCA	6	2005	Carrie	Oakey	1357924
14	3/11/2009	JKL678X	MX5	1985	Tim	Burr	
15	3/11/2009	MA01XYX	RX8	2008	Justin	Case	2468013

Advanced... Cancel < Back Next > Finish

- Provide the name of the table the data is to be added to - tblWorkshopAppointments. (Provide a new and different table name if you want to import both data and structure).
- Click Finish to finalise your choices
- Use the Datasheet view to check that the import has worked successfully

ID	AppointmentDate	RegistrationNumber	Model	YearOfManufacture	FirstName	LastName	ContactPhoneNumber
	20 September 2009	AB05XYZ	MX5	2005	Jo	King	12345678900
11	01 November 2009	HAD10XY	MX5	2006	Pearl	Button	10234567890
12	01 November 2009	AB05CDE	2	2007	Barry	Cade	1234567891
13	02 November 2009	ZY05BCA	6	2005	Carrie	Oakey	1357924680
14	03 November 2009	JKL678X	MX5	1985	Tim	Burr	
15	03 November 2009	MA01XYX	RX8	2008	Justin	Case	2468013579
*	(New)						

Note that the copy process does not always work reliably. Sometimes you have to manually check and correct the new, copied entries in the database table. Most errors in the translation process are stored in a new table created by Access, which you may, or may not, find helpful.

Exercise 7.6

1. Create a text file of seven records to be added your Mad Hatter's Marathon table.
2. Append the data from your text file (created in 1 above) to your Mad Hatters Marathon table. Check that the import was successful. Explain any failures in the import process. Fix the failures if you can.

7.8 Merge Data Files

By merge data files I suppose C&G means merge two databases into one. Since, at Level 2, we deal with databases containing just one table, the problem is to merge two tables from two databases into one table in one database. Further, we assume the two tables have an identical structure.

One way of achieving this is to use the Windows Clipboard.

1. Copy from a table. In Datasheet view select the records to be copied: click the grey margin next to the first record and drag to the last record. Right click and choose Copy. This copies the records into the Windows Clipboard.
2. Copy to a table. Switch to the database and table you are copying to. Right click on the * next to (New). Choose Paste. This copies the records from the Windows Clipboard.

Ok. Here is the scenario. Zoom Cars have two premises, one on Welford Road (the original premises) and one on Belgrave Road (the new premises). The country is experiencing a financial depression. Not enough people are buying new cars to support the costs of occupying two premises. The Managing Director has decided to merge the two into one site based at Welford Road. So we as database wallas have the job of merging the two workshop appointment database systems into one.

To check out the merging process, we create a workshop appointments database and table for the Belgrave Road premises, and use the data shown below.

```
1 November 2009,BAD10X,3,2006,Barb,Dwyer,01234567891,fit new battery
1 November 2009,BC06FGH,5,2007,Stan,Still,1234567892,1000 miles service
2 November 2009,ZY07ABC,6,2005,Terry,Bull,1357924683,15000 miles service
3 November 2009,MNP456Y,MX5,1985,Paige,Turner, ,fit 4 new tyres
3 November 2009,NB02RST,RX8,2008,Mary,Christmas,2468013574,replace clutch
```

Of course, change the dates if the date of appointment is before today's date.

Then we copy the data from the Belgrave Road workshop appointments table to our original workshop appointments table.

ID	AppointmentDate	RegistrationNumber	Model	YearOfManufacture	FirstName	LastName	ContactPhoneNumber	Job
1	20 September 2009	AB05XYZ	MX5	2005	Jo	King	12345678900	MOT
11	01 November 2009	HAD10XY	MX5	2006	Pearl	Button	10234567890	MOT
12	01 November 2009	AB05CDE	2	2007	Barry	Cade	1234567891	3000 ms
13	02 November 2009	ZY05BCA	6	2005	Carrie	Oakey	1357924680	5000 ms
14	03 November 2009	JKL678X	MX5	1985	Tim	Burr		respray
15	03 November 2009	MA01XYX	RX8	2008	Justin	Case	2468013579	cam belt
16	01 November 2009	BAD10X	3	2006	Barb	Dwyer	01234567891	fit new battery
17	01 November 2009	BC06FH	5	2007	Stan	Still	12345678910	1000 miles service
18	02 November 2009	ZY07ABC	6	2005	Terry	Bull	1357924683	15000 miles service
19	03 November 2009	MNP456Y	MX5	1985	Paige	Turner		fit 4 new tyres
20	03 November 2009	NB02RST	RX8	2008	Mary	Christmas	246801357	replace clutch
(New)								

Exercise 7.8

1. Explain the term primary key and why every table should have one.
2. Explain what validation is and why it is important.
3. Describe a database structure in terms of field names and data types including the attributes or properties of fields where applicable e.g. field length, date format, ...
4. Describe the impact of design on the database function. Hint: you could mention the process specify → design → build → hand over. You must get the specification right otherwise you cannot possibly get the design or the build right. If you get the design wrong you cannot possibly build the right product. If you let errors reach the hand over stage, where the user or the customer discovers them, it costs you a lot (in time, effort, money, reputation, future work) to put the errors right. It is more efficient and cheaper to discover and fix errors at the earliest possible stage than it is to discover them later or let your customers and users find them and give you a bad reputation.

Resources

Some useful resources include:

- MSDN Blogs <http://blogs.msdn.com/access>
- Tech on the Net www.techonthenet.com/access
- MS Office Discussion Groups <http://microsoft.com/office/community>
- MS Tutorials <http://office.microsoft.com/en-us/training>
- GROVER C, MACDONALD M & VANDER VEER E *Office 2007 The Missing Manual* O'Reilly 2007. This book covers Word, Excel, PowerPoint and Access, at about the right level for City and Guilds Level 2.

We have seen how to design, create, modify, copy, save, merge and print database structures. We had a first look at validation. We entered data via a datasheet and by importing data from a text file.

Next, we see how to maintain up-to-date data in a database table.

Bibliography

<http://www.leicestermarathon.org.uk/Entryform2009.pdf> accessed Sep 2009

GROVER C, MACDONALD M & VANDER VEER E *Office 2007 The Missing Manual*
O'Reilly 2007