Using Microsoft Access

Relational Databases

In all of the previous exercises you have worked on a simple database that only had one table. In many cases, a database will be too complex to be able to work well with only one table. Consider the following document.

EGBST INVOICE **NO** I393

24 Invisible Road

Kalgoorlie 6430

Joondalup Jewellers
402 Walter Road
Morley WA 6059
93752845

Date 9th April 2004

QTY	Description	Price	Cost
2 ounces	Gold	$800	$1600
20	Rings	$110	$2200
Total			$3800

Suppose a business manually completes an invoice like this every time one of their customers makes a purchase. If the business decides that they want all of this information to be recorded in a database so a neat invoice can be printed, would one table be sufficient to store all of that information?

If we listed all of the fields that might be required to store this information, the fields might include:

- Invoice number
- Customer name
- Customer address
- Customer state
- Customer postcode
- Customer phone number
- Date
- Quantity
- Description
- Price
- Cost
- Total

If one table was used to store this information, it might look something like the example on the following page.

Invoice	Customer Name	Customer Address	Customer state	Customer postcode	Customer phone	Date	Quantity	Description	Price	Cost	Total
I393	Joondalup Jewellers	402 Walter Rd Morley	WA	6059	93752845	9 Apr	2	Gold	$800	$1600	$3800
I393	Joondalup Jewellers	402 Walter Rd Morley	WA	6059	93752845	9 Apr	20	Rings	$110	$3800	$3800
I394	Hourglass Jewellers	230 Light St Morley	WA	6059	93751920	11 Apr	4	Gold	$800	$2400	$2710
I394	Hourglass Jewellers	230 Light St Morley	WA	6059	93751920	11 Apr	5	Watches	$50	$250	$2710
I394	Hourglass Jewellers	230 Light St Morley	WA	6059	93751920	11 Apr	3	Bracelets	$20	$60	$2710
I395	Balcatta Bracelets	45 Russel St Morley	WA	6059	92769385	14 Apr	12	Rings	$110	$1320	$1480
I395	Balcatta Bracelets	45 Russel St Morley	WA	6059	92769385	14 Apr	8	Bracelets	$20	$160	$1480

Problems with Un-Normalised Data

In this example we can see some problems:

- Every time a sales transaction is being entered for an invoice, the entire invoice details (such as invoice number, date and customer details) are being repeated.
- Every time an invoice is prepared for a customer, all of that customer's details are being repeated.
- Some information, such as totals, may not need to be entered if it can be generated by the database.

This duplication shows evidence of **redundancy** in the design and can lead to several problems:

- The database will take up more room on the computer because the same information is being stored several times. This takes up more disk space and makes the database run slower.
- The more times information is added, the more chance there is of making an error in entry.
- If the same information was entered differently, it may be treated as different information. E.g. *Hourglass Jewellers* and *Hourglass-Jewellers* might not be recognised by the database as the same customer if they were entered differently at different times.

This redundancy can be eliminated by designing the database more efficiently using more than one related table. A database designed using multiple tables that are related to each other is referred to as a **Relational Database**.

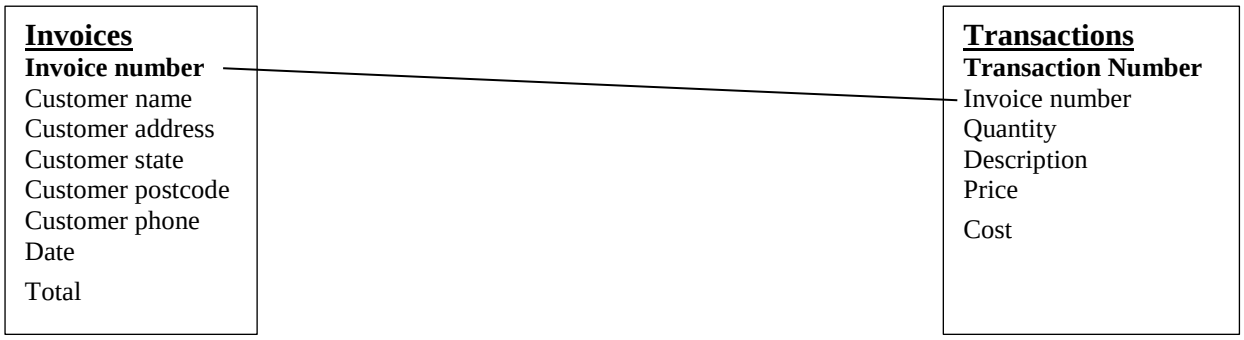
Planning what tables will be needed in a database is usually done using a process known as **Normalisation**. This is a step-by-step process for identifying and eliminating redundancies in a database. The final result is a plan for an efficient database using multiple related tables. This plan is often prepared with the aid of an **Entity Relationship Diagram** (**ERD**). These exercises will only provide a brief explanation of Normalisation. If you need more help on normalising databases, there are plenty of textbooks which cover the topic in detail.

Normalisation

Normalisation usually involves three stages (additional stages are used by some database developers). Each of these stages is referred to as a **Normal Form**.

First Normal Form (1NF)

First normal form involves eliminating repeating groups. In the previous example, every time transactions from an invoice are entered, the details for the invoice would also need to be repeated. This problem can be eliminated by having a table for *Invoice* details and another table for *Transaction* details. The *Transaction* details table could include the *Invoice number* to identify which invoice the transaction belongs to. This would mean that *Invoice number* would be the link, or **Relationship**, between the two tables as illustrated below.



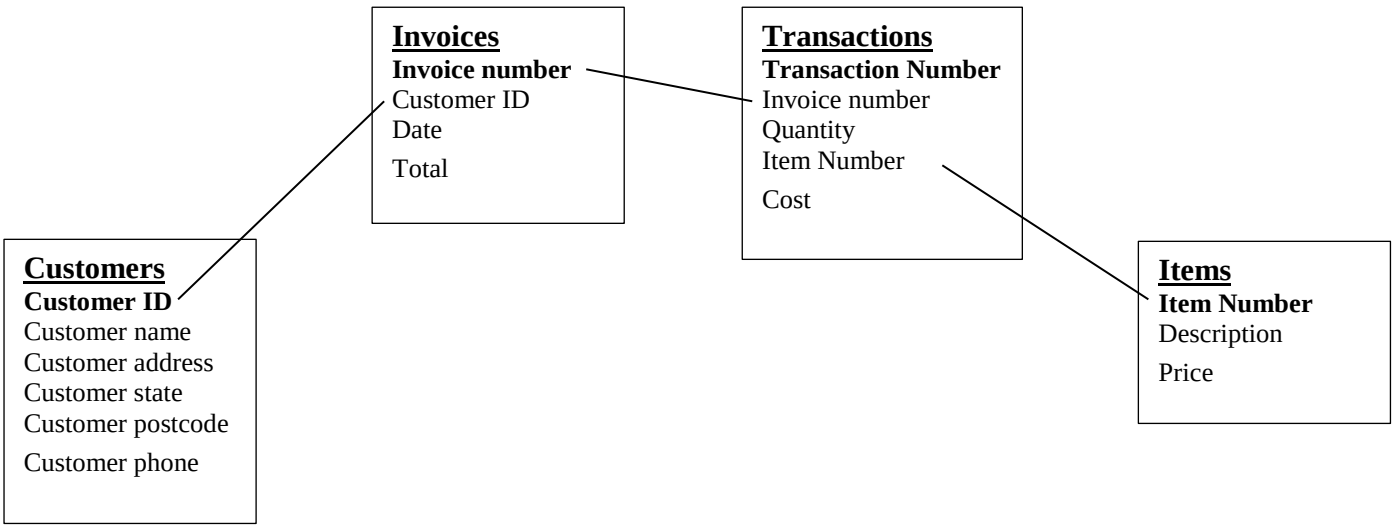
In the above example, the **Primary Key** in each table is indicated using bold formatting. *Transaction number* has been added to the *Transactions* table as a primary key.

Now w the invoice details are entered in the invoices table, whenever a transaction is entered in the Transactions table only the Invoice Number will need to be entered. The invoice number will be related to the rest of the invoice details in the *Invoice* Table. This database is now in **First Normal Form** or **1NF**.

Second Normal Form (2NF)

When a database is in 2NF, all of the fields in each table will depend directly on the primary key. If we look at the *Invoices* table in its current form, we can see that this is not the case. The invoice date and invoice total are dependant on the invoice number, but the rest of the fields are not. Since there may be more than one invoice for the same customer, the fields that provide information about the customer will most likely appear on many invoices. At the moment, they will be repeated for each invoice. This problem can be eliminated by creating a separate table to store the customer details.

The same problem is evident in the *Transactions* table. The quantity and cost is unique to each transaction and therefore dependent on the transaction number. The price and description, however, are not directly dependant on the primary key. Every time there is a transaction for a certain item, the price and description for that item are being repeated. This can be fixed by creating a separate table for the Items that can be sold. The following diagram illustrates the new relational design.

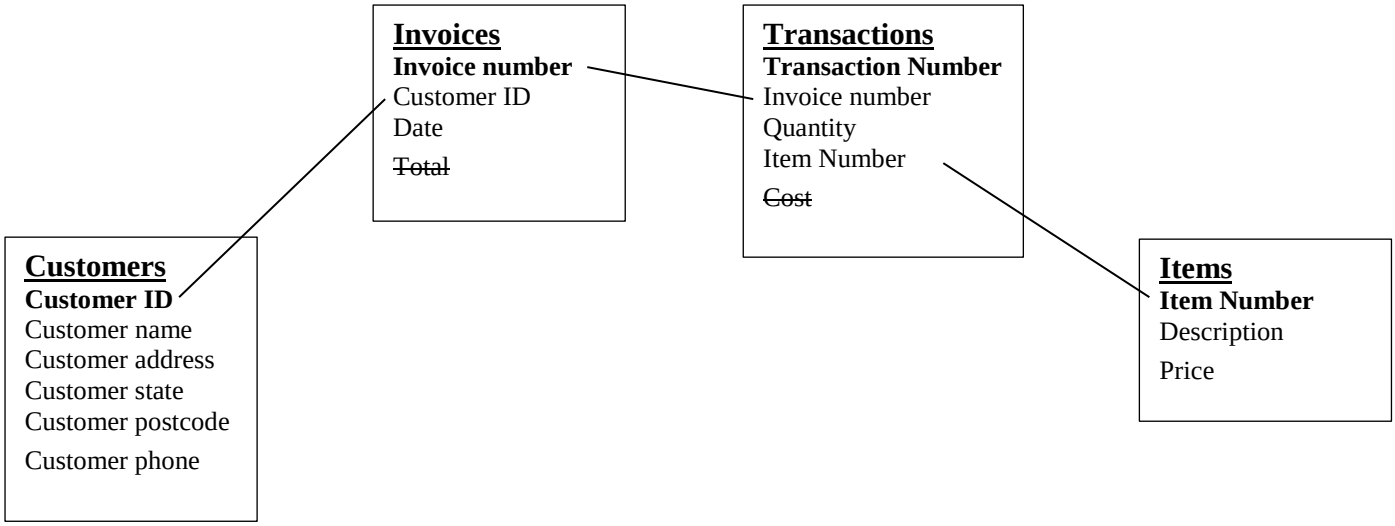


Primary Keys have been created for both the *Customers* table and the *Items* table. The lines between each table indicate which fields will be linked. In database terminology these lines are the **Relationships**. There are different types of relationships in databases (one to many, one to one, many to many) but for the purpose of these exercises, it will be enough to know that the tables need to be related to each other via linked fields.

This database design is now in **Second Normal Form** or **2NF**.

Third Normal Form (3NF)

In 3NF, the database design will not include any redundant fields, such as fields that can be automatically calculated by the database. In the example below, we have eliminated *Cost* from the *Transactions* table since that can be calculated automatically by multiplying *Quantity* sold by the *Price* of the item. We have also eliminated the invoice *Total*, since that can be calculated by adding up the transactions on the invoice.

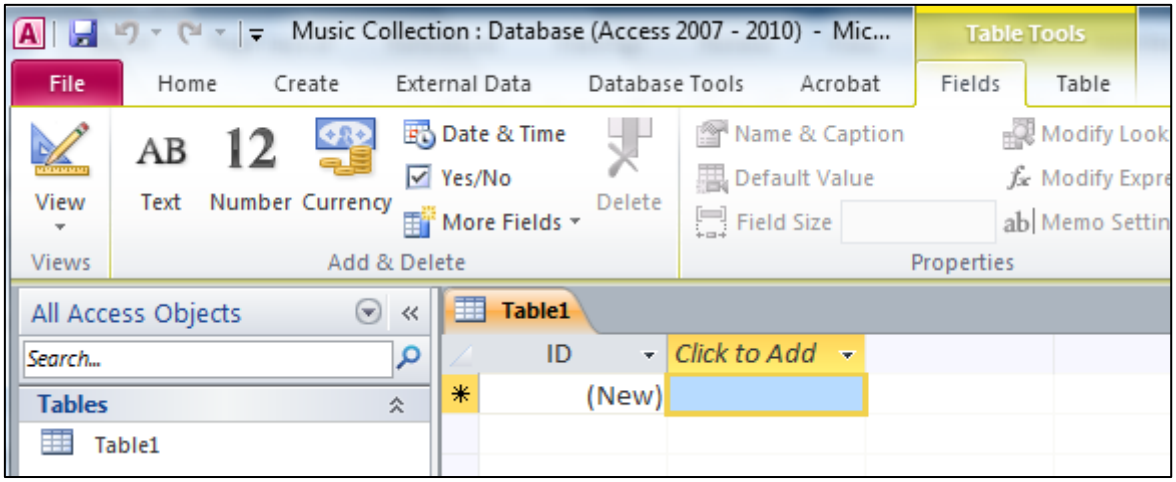


This database design is now in **Third Normal Form** or **3NF**. It can be said to be **Normalised**.

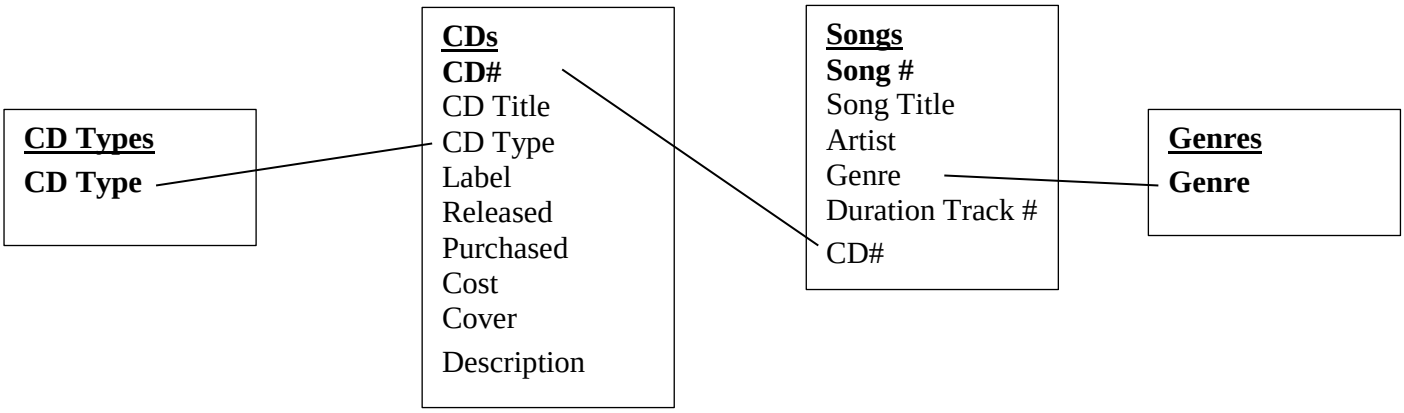
Exercise 1. Creating a Relational Database

In the remaining exercises we will create a relational database that will be used to keep track of a music collection.

1. Open Microsoft Access.
2. Create a new blank Database file with the filename *Music Collection.accdb*.



We will assume that our database has already been planned and normalised, to come up with the following table layout.



The CD Types table and Genres tables have been added to assist in the creation of lookup fields as you will see later.

Exercise 2. Creating the Tables

1. Create and save each of the four tables for the database. Refer to the previous exercises if you can't remember how this is done. The field names, data types and relevant properties for each table are shown below. Remember to specify the primary key before you save a table. You can add additional field properties if appropriate.

Table name – CD TYPES

Field Name	Data Type	Description	Properties
CD Type	Text	Type of CD (Album, Soundtrack etc)	Primary Key

Table name – CDS

Field Name	Data Type	Description	Properties
CD #	AutoNumber	Identification number for the CD	Primary Key
CD Title	Text	Title of the CD	
CD Type	Text	Type of CD (Album, Soundtrack etc)	Default Value – Album
Label	Text	Label the CD was released by	
Released	Text	Year the CD was released	Field Size – 4
Purchased	Date/Time	Date the CD was purchased	Format – dd/mm/yy Input Mask – 99/00/00 Default Value – =Date() Validation Rule – <=Date() Validation Text
Cost	Currency	Amount paid to buy the CD	
Cover	OLE Object	Picture of the CD cover	
Description	Memo	Description of the CD	

Table name – SONGS

Field Name	Data Type	Description	Properties
Song #	AutoNumber	Identification number for the CD	Primary Key
Song Title	Text	Title of the song	
Artist	Text	Artist the song is performed by	
Genre	Text	Type of song (rock, rap, techno etc.)	
Duration	Text	Length of the song (minutes:seconds)	Field Size – 5 Input Mask – 99\:00;0;_
Track #	Text	Position of the song on the CD	Field Size – 2
CD #	Number	Number of the CD that the song is on	

Table Name - GENRES

Field Name	Data Type	Description	Properties
Genre	Text	Type of song (rock, rap, techno etc.)	

The table designs should look similar to the ones shown below.

CD TYPES

Field Name	Data Type	Description
CD Type	Text	Type of CD (Album, Soundtrack etc)

CDS

Field Name	Data Type	Description
CD #	AutoNumber	Identification number for the CD
CD Title	Text	Title of the CD
CD Type	Text	Type of CD (Album, Soundtrack etc)
Label	Text	Label the CD was released by
Released	Text	Year the CD was released
Purchased	Date/Time	Date the CD was purchased
Cost	Currency	Amount paid to buy the CD
Cover	OLE Object	Picture of the CD cover
Description	Memo	Description of the CD

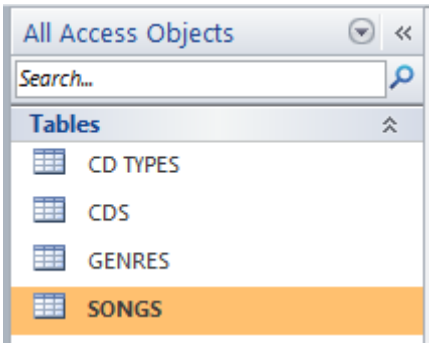
GENRES

Field Name	Data Type	Description
Genre	Text	Type of song (rock, rap, techno etc.)

SONGS

Field Name	Data Type	Description
Song #	AutoNumber	Identification number for the CD
Song Title	Text	Title of the song
Artist	Text	Artist the song is performed by
Genre	Text	Type of song (rock, rap, techno etc.)
Duration	Text	Length of the song (minutes:seconds)
Track	Text	Position of the song on the CD
CD #	Number	Number of the CD that the song is on

The **Navigation Pane** should show all four tables.

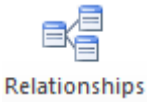


Exercise 3. Creating Relationships

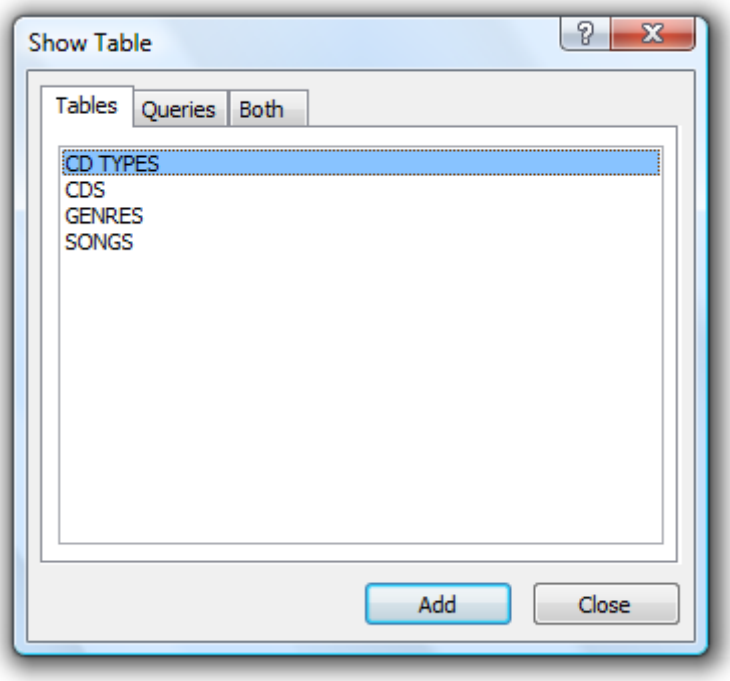
Relationships between tables can be created and managed manually using the Relationships window. Relationships can also be created automatically in some instances, such as when the lookup wizard is used. In this exercise we will manually create a relationship between the *CDS* table and the *SONGS* table.

1. Click the **Database Tools** tab on the **Ribbon**.

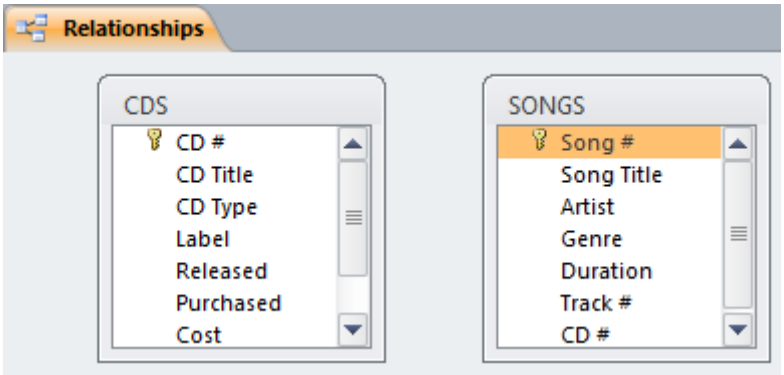
2. Click on **Relationships**.

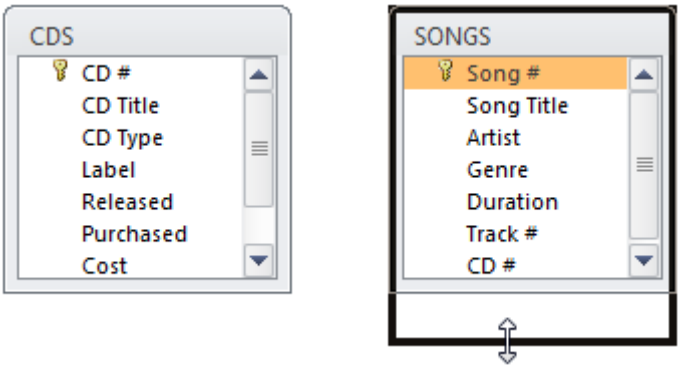


A **Show Table** dialog similar to the one for designing queries will appear.

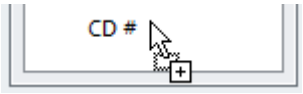


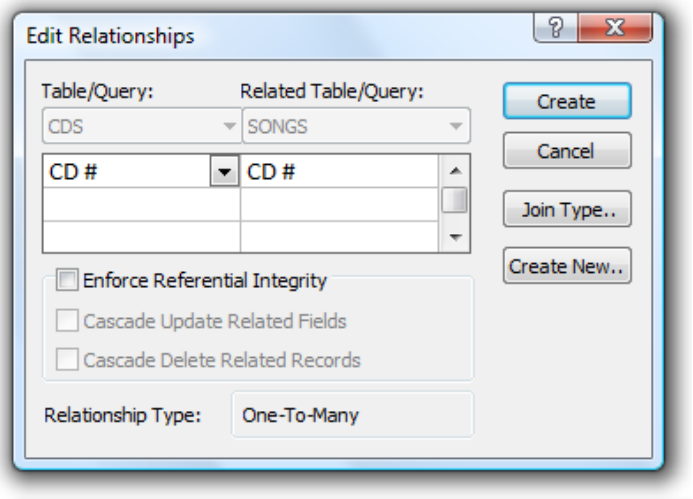
3. **Double-click** on the *CDS* table and **Double-click** on the *SONGS* table to add them both to the relationships window. Close the Show Table window when they are both added to the **Relationships** window.



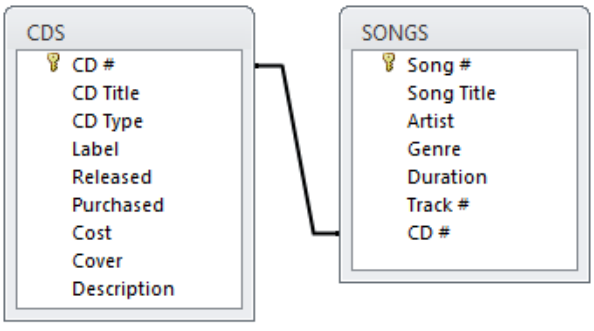


4. Move your mouse to the bottom edge of the *SONGS* table until it changes to a re-sizing arrow as shown above. Drag downwards until you can see all of the fields in the table listed. Do the same with the *CDS* table.
5. Click on *CD#* in the *CDS* table and drag it on to *CD#* in the *SONGS* table. The **Edit Relationships** dialog will appear.





6. Make sure *CD#* is selected in both tables as shown above.
7. Click the **Create** button to create the relationship.



A line will appear to indicate the relationship.

8. Close the relationships window. When you are prompted to save the changes, click **Yes**.

Later on you will see several ways that this relationship can be used in the database.

Note Fields that are related to each other need to be a similar data type, otherwise there may be problems. For example linking an auto number to a number is fine, but either one of those linked to text field could cause problems later on.

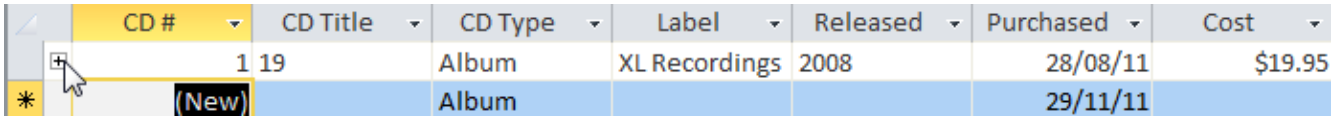
Exercise 4. Entering Records in Related Tables

1. **Double-click** the *CDS* table to open it.
2. Enter the following record in the *CDS* table (The *CD#* will be filled in by the AutoNumber).

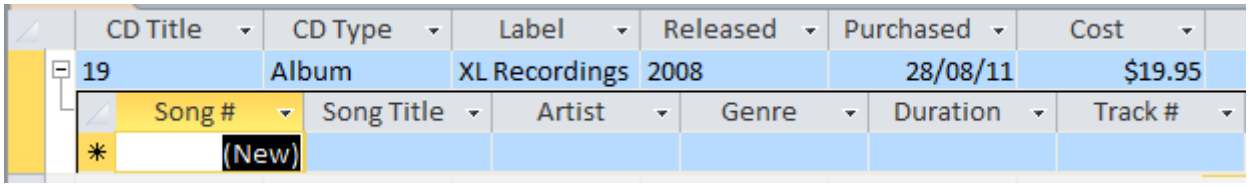
CD #	CD Title	CD Type	Label	Released	Purchased	Cost	Cover	Description
	19	Album	XL Recordings	2008	28/08/11	19.95		Includes booklet

We'll add an image for the cover later on.

When you finish entering the record, a + sign will appear to the left of the record. This occurs when there is a related table. In this case, the relationship may be used to enter records for songs that are on the album.



3. Click on the + sign to display a blank record from the related *SONGS* table.



4. Use that space to add the song records shown below. In fields like the *Artist* and *Genre* field where the information is the same for each song, remember that you can use the **[Ctrl]['']** (single quotation mark) shortcut to repeat information from the previous record.

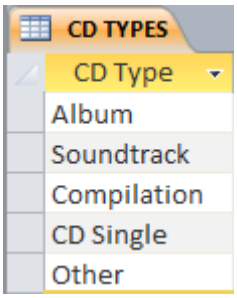
SONGS					
Song #	**Song Title**	**Artist**	**Genre**	**Duration**	**Track #**
1	Daydreamer	Adele	Pop	03:19	1
2	Best For Last	Adele	Pop	04:19	2
3	Chasing Pavements	Adele	Pop	03:31	3
4	Cold Shoulder	Adele	Pop	03:12	4
5	Crazy For You	Adele	Pop	03:28	5
6	Melt My Heart To Stone	Adele	Pop	03:24	6
7	First Love	Adele	Pop	03:10	7
8	Right As Rain	Adele	Pop	03:17	8
9	Make You Feel My Love	Adele	Pop	03:32	9
10	My Same	Adele	Pop	03:16	10
11	Tired	Adele	Pop	04:19	11
12	Hometown Glory	Adele	Pop	04:31	12

5. Close the table when complete. If you have made any changes to the table design (such as adjusting column widths to make the information fit) you may be prompted to save the changes.

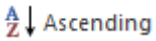
Exercise 5. Entering Information for Lookup Fields

The *CD TYPES* table and the *GENRES* table will both be used for lookup fields soon, so we will enter some data in to those fields.

1. Open the *CD TYPES* field.
2. Enter the following types.



- Album
- Soundtrack
- Compilation
- CD Single
- Other

3. Click the **Sort Ascending** icon to sort them in alphabetical order. 

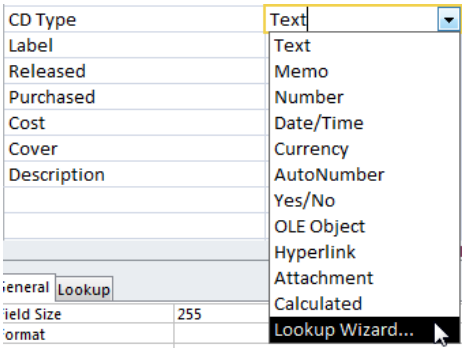
4. Close the table and save the changes when prompted.
5. Open the *GENRES* table and enter the following genres.

- Rap
- Rock
- Pop
- Kids
- Top 40 Dance
- R&B
- Club

6. Sort the records and close the table, saving changes when prompted.

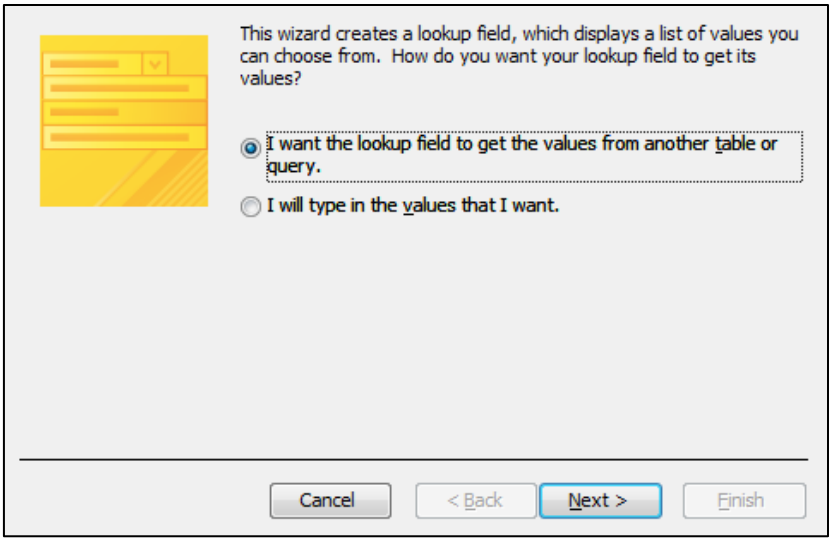
Exercise 6. Creating Lookup Lists

A lookup field is a field with a combo box (sometimes referred to as a drop-down list). This allows the user of the database to select information from a list rather than having to type information in a field. The *CD TYPES* table and the *GENRES* table used in the previous exercise will now be used to create lookup fields for the other two tables.

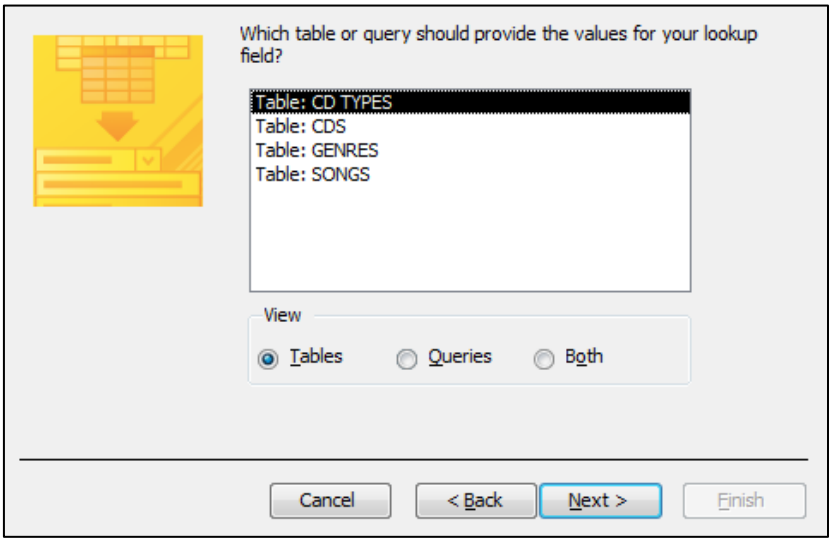


1. Open the *CDS* table in design view.
2. Select the *CD Type* field.
3. From the list of field data types, choose **Lookup Wizard** as shown to the right. The Lookup Wizard will start.

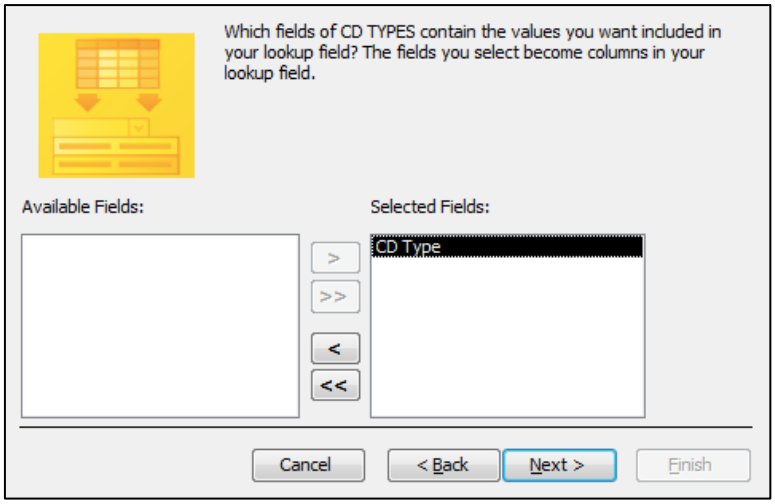
We want the options in the drop-down list to come from the *CD TYPES* table we have created.



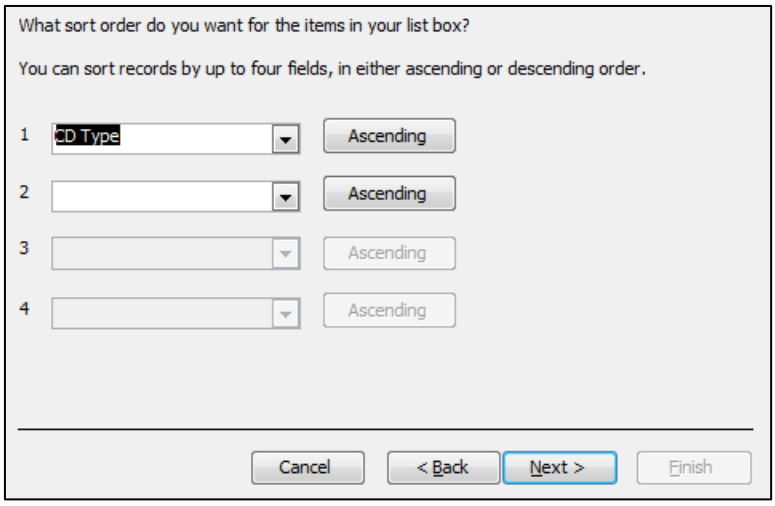
4. In the first step of the wizard, leave the first option selected and click **Next**.



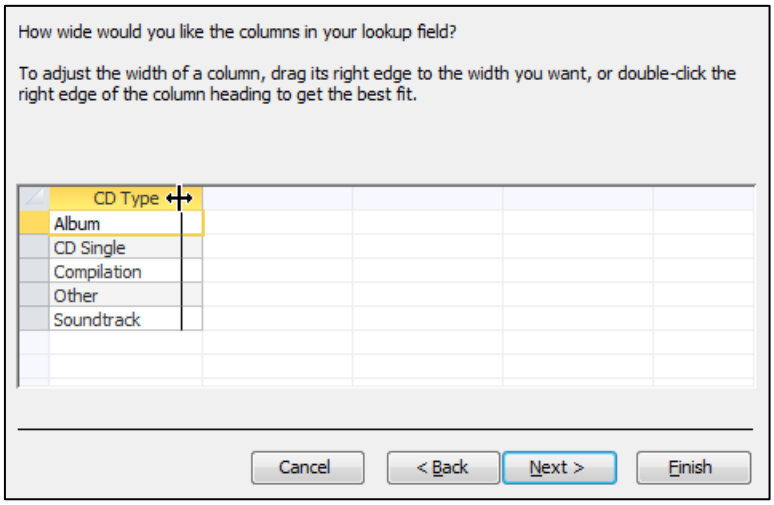
5. In the next step, make sure *Table: CD TYPES* is selected and click **Next**.



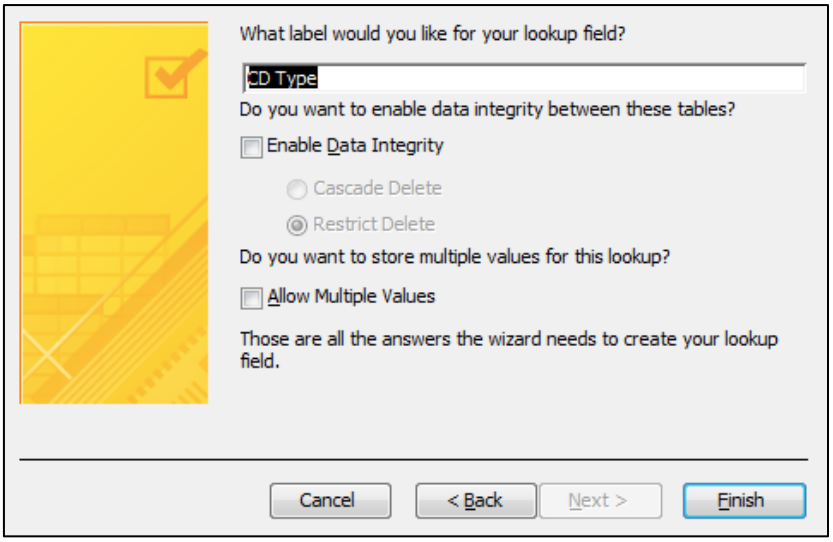
6. Select the *CD Type* field and either **double-click** it or click on the **>>** button to move it in to the **Selected Fields:** list. Click **Next** when it appears as the example above.



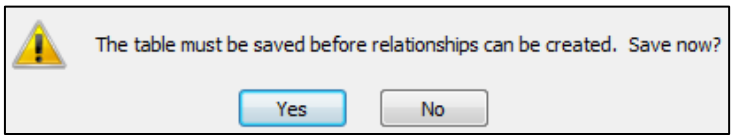
7. Here you can choose to have the *CD Types* sorted in alphabetical order as shown above. Click **Next** when ready.



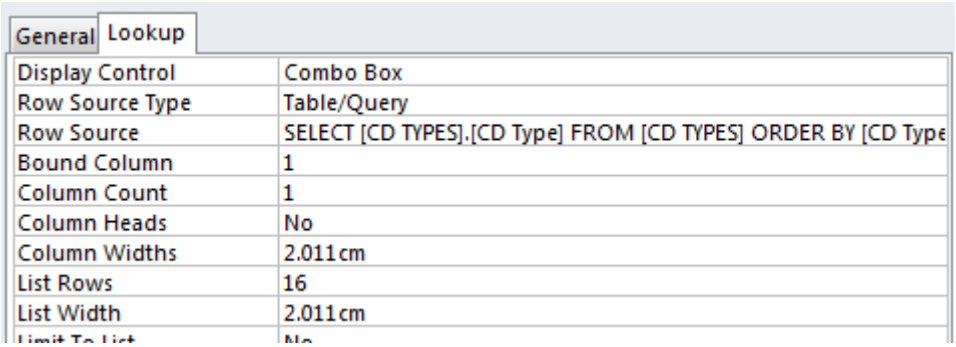
8. Adjust the width of the column if necessary. This will determine the list width. Click **Next**.



9. Leave the field name as *CD Type* and click **Finish**.



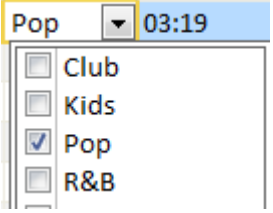
10. Click **Yes** to save the changes to the table design and to create a relationship between the *CDS* & *CD TYPES* tables.
11. The wizard has made several changes to the field properties. To see these changes, make sure the **CD Types** field is still selected and click on the Lookup tab in the properties section below.



When you become familiar with the properties shown here, you can skip the wizard and quickly create lookup fields by modifying these properties directly.

12. Close the table. The wizard should have already saved any necessary changes.
13. Open the *SONGS* table in design view.
14. Select the *Genre* field.
15. Follow the previous steps to create a lookup field for Genres (based on information from the *GENRES* table).

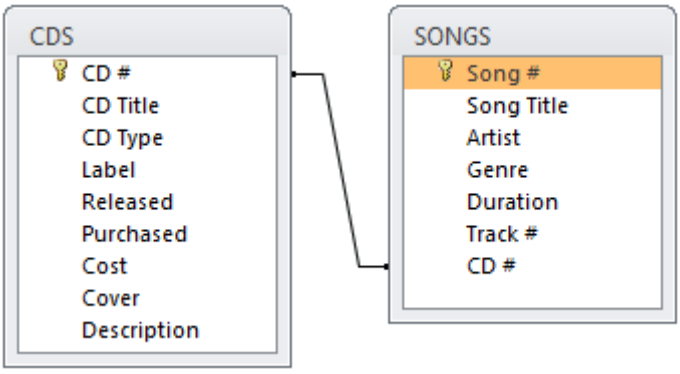
Note In the last step of the wizard there is an option to allow multiple values. This will result in a combo box where more than one option can be ticked. We won't do that for now though. Allow Multiple Values



Exercise 7. Checking Lookup Relationships

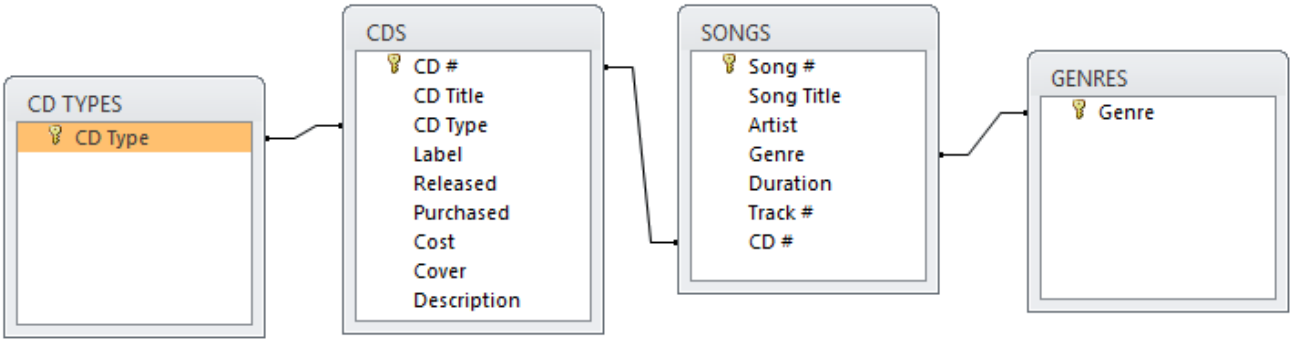
The lookup wizard would have created table relationships for both lookup fields. We can check this by looking in the relationships window.

1. Select **Database Tools** from the **Ribbon** and click the **Relationships** icon.



You will see the two tables that we created a relationship for earlier. The other relationships that have been created aren't currently visible.

2. Click the All Relationships icon.
3. Move the tables around so that it is easier to see the relationships between each table. A suggested layout is shown below.



4. Press **[Ctrl] [S]** or click the **Save** icon to save the relationship layout changes.
5. Close the relationships window.

Exercise 8. Testing the Lookup Fields

1. Double-click the *CDS* table to open it.
2. Click in the *CD Title* field below *19*.
3. Enter *Party Rock Anthem* for the new **CD Title**.
4. In the **CD Type** field there will now be a combo box (drop-down list). Use the list to select *CD Single* for the **CD type**.
5. Complete the rest of the information as follows:

CDS								
CD #	**CD Title**	**CD Type**	**Label**	**Released**	**Purchased**	**Cost**	**Cover**	**Description**
2	Party Rock Anthem	CD Single	Interscope	2011	13/09/11	$2.95		

6. Click the + to the left of the new record to view the fields from the *SONGS* table.
7. Enter *Party Rock Anthem (Album Version)* in the **Song Title** field.
8. Enter *LMFAO* in the **Artist** field.
9. Use the combo box to select Club in the **Genre** field.
10. Enter 1 in the Track # field.
11. Enter a second track as follows.

Song #	Song Title	Artist	Genre	Duration	Track #
13	Party Rock Anthem (Album Version)	LMFAO	Top 40 Dance	04:22	1
14	Party Rock Anthem (Audiobot Remix)	LMFAO	Club	06:00	2

12. Close the table when the CD and Song information is entered as shown.

Note If you want to add or edit the information that appears in the lookup lists, all you need to do is open the tables and make the necessary changes/additions to the records in those tables.