National 5

Computing Science

Database Design and Development

Pupil Notes

Name:_____

Contents

Analysis

End User and Functional Requirements

During the analysis stage of database development, the following requirements should be identified:
1 End-user requirements:

- The end users are the people who are going to be using the database.
- Their requirements are the tasks they expect to be able to do using the database.

2 Functional requirements:

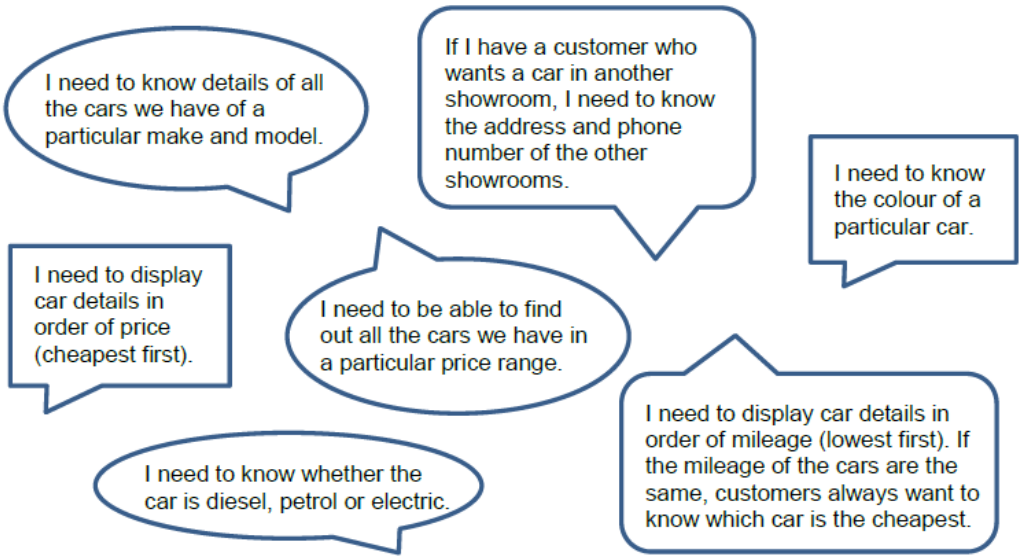
- Processes and activities that the system has to perform.
- Information that the system has to contain to be able to carry out its functions.

These requirements will help:

- clarify the design of the database
- identify the features to be implemented on the database
- evaluate whether the system is fit for purpose after development is complete

Example
A used-car dealership has six showrooms in different locations across Scotland. It wants to create a relational database to store details of cars owned by the company and details of each of their showrooms. The database will allow sales staff to view details of specific cars and to see which showroom the cars are located in.

The developers have asked some of the sales staff what they would like to see in the database. Here are a few of the comments they made.



End-user requirements

- Sales staff should be able to display details of cars, by performing a number of different searches using:
    - car make and model
    - car colour
    - range of car prices
    - type of fuel used
    -
- Search results should display:
    - car make
    - car model
    - car price
    - car fuel
    - car mileage
    - branch address
    - branch telephone number

- Users should be able to sort the search results in ascending order of mileage and ascending order of price.

Functional requirements

- The relational database will have two tables; one for car details and one for branch details:
    - Each table will require a suitable primary key field.
    - A foreign key will be used to link the two tables.

- Additional fields will be needed for:
    - car make
    - car model
    - car colour
    - car fuel — diesel, petrol or electric
    - car price
    - car mileage
    - branch address
    - branch telephone number

- Simple and complex queries will be used to search the database.
    - A complex sort will be used to order the query results.

Reading Review 1

Having read pages 4-5 answer the questions below.

1. Identify the end users and functional requirements for the below database.

   A database is required to store information on a recent F1 competition. Competitors who achieved a time of under 3 minutes in either race are eligible to proceed to the next round of the competition.

I	Team Name and Car Numl	Driver	Race Time 1 (minutes)	Race Time 2 (minutes)	Click to Add
1	McFarlane 1	Karle	03:45	02:55	
2	McFarlane 2	Druller	03:42	02:59	
3	Farlawrie 1	Yohannsen	02:59	03:11	
4	Farlawrie 2	Keller	03:28	03:12	
5	Tarden 1	Deeva	02:55	03:45	
6	Tarden 2	Vale	03:42	03:35	
7	Dauger 1	Yu	03:45	03:11	
8	Dauger 2	Haallen	03:35	03:42	
9	MACR 1	Friedriech	02:59	03:15	
10	MACR 2	Jannensen	03:11	02:59	

   End-user requirements:

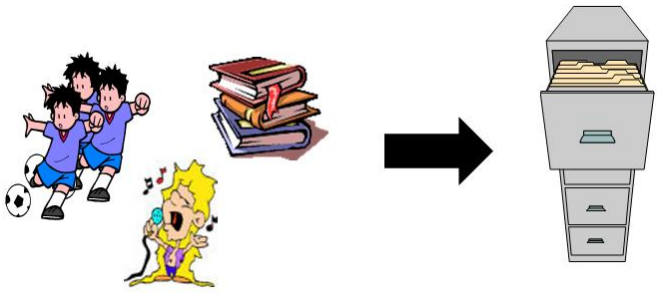
   Functional Requirements:

Design

Database Structure

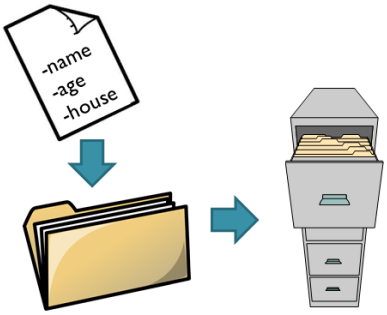
A database is a collection of **information** on a particular topic that is **structured** in some way.

For example you could have a database on football teams, CD collection or books.



A database is organised into:

- **Fields**
- **Records**
- **Files**



Field

A field is a **single piece of information** about a person or thing in the database.

A database about pupils in a school might store information such as:

First Name
Surname
Date of Birth
Year Group
House

Each item is stored in a separate Field**.**

So, we need 5 fields to store these details

A field is also known as an **attribute**.

Record

A record is a **collection of fields** about a particular person or thing.

A record would be created for each pupil in a school.

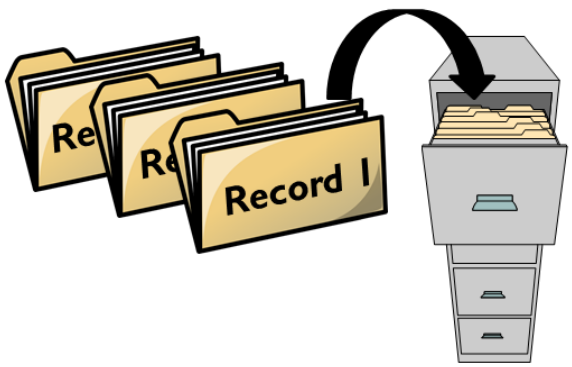
A class with 20 pupils would need 20 records

	Record 1	Record 2	Record 3
First Name	Peter	Jennifer	Cara
Surname	Jones	Smith	Brown
Date of Birth	15/03/99	21/10/98	03/01/00
Year Group	4	5	3
House	Arran	Bute	Cumbrae

File

A file is a **collection of records** on a particular topic.

A file would contain a record for **every** pupil in a school.



School Database File

Attribute Types

Each attribute in a database must be assigned a type.

Attribute types specify what sort of data the field will hold. There are several attribute types available.

Basic Attribute Types:

Fields containing both letters and numbers should have the **TEXT** field type.

Phone numbers should also be **TEXT** as a NUMBER field would drop the zero at the start.

Field Type	Example
Text	ABCDEF
Number	123456
Date	01/12/13
Time	15:40
Boolean	Yes / No

Important:

In MS Access, Date and Time fields are known as Date/Time; Boolean fields are known as Yes/No.

You **must not** use MS Access data types when designing your database or answering questions in the exam.

Actual Types	MS Access Types
Date	Date/Time
Time	Date/Time
Boolean	Yes/No

Reading Review 2

Having read pages 8-10 answer the questions below.

1. What is a field?

_____

_____

2. What is a record?

_____

_____

3. What is a file?

_____

_____

4. What is the purpose of a field type?

_____

_____

5. List five different field types giving an example for each.

_____

_____

_____

_____

Flat File Database Problems

Flat file databases are simple to create and easy to understand. However, they can cause problems that make them unreliable.

Errors in the database can happen because of:

- **Data Duplication**
- **Modification errors**

Data Duplication
The database below contains a large amount of data duplication.

Many of the books below belong to the same publisher meaning that the publisher information has had to be entered several times.

Book Title	Author	ISBN	Publisher Name	Publisher Address
The Haunted House	Hugo First	999-2-7712-3343-2	Glasgow Book Company	25 Square Road, Glasgow
Easy Money	Robin Banks	229-8-3312-0022-1	Glasgow Book Co	25 Square Road, Glasgow
Spectacles	Seymore Withem	777-3-4429-3321-0	Oxford Publishing	25 High Street, Oxford
Swimming the Channel	Frances Near	190-7-9100-2232-1	Oxford Publishing	25 High Road, Oxford
Horse Racing	Willie Winnit	987-5-3234-1212-2	Oxford Publishing	25 High Street, Oxford
Danger	Luke Out	889-1-2321-2222-6	Oxford Publishing	25 High Street, Oxford
Falling Down	Eileen Dover	972-2-3342-1001-8	Penguin Books	15 Main Place, London
Simple Dentistry	Phil McCavity	569-1-4544-2233-9	Penguin Books	14 Main Place, London
Carpet Laying	Walter Wall	122-1-7712-3312-2	Penguin Books	15 Main Place, London
The Narrow Escape	Justin Thyme	766-3-2210-9023-8	London Publishing Ltd	1 Straight Street, London

When data is duplicated, it can also lead to **inconsistency.** Several of the publisher details below have been entered incorrectly, even although they refer to the same publisher.

Book Title	Author	ISBN	Publisher Name	Publisher Address
The Haunted House	Hugo First	999-2-7712-3343-2	Glasgow Book Company	25 Square Road, Glasgow
Easy Money	Robin Banks	229-8-3312-0022-1	Glasgow Book Co	25 Square Road, Glasgow
Spectacles	Seymore Withem	777-3-4429-3321-0	Oxford Publishing	25 High Street, Oxford
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Horse Racing	Willie Winnit	987-5-3234-1212-2	Oxford Publishing	25 High Street, Oxford
Danger	Luke Out	889-1-2321-2222-6	Oxford Publishing	25 High Street, Oxford
Falling Down	Eileen Dover	972-2-3342-1001-8	Penguin Books	15 Main Place, London
Simple Dentistry	Phil McCavity	569-1-4544-2233-9	Penguin Books	14 Main Place, London
Carpet Laying	Walter Wall	122-1-7712-3312-2	Penguin Books	15 Main Place, London
The Narrow Escape	Justin Thyme	766-3-2210-9023-8	London Publishing Ltd	1 Straight Street, London

Modification Errors

Insertion problems occur when data has to be included more often than is necessary. In the example below, the publisher details must be entered every time a new book is added.

Book Title	Author	ISBN	Publisher Name	Publisher Address
The Haunted House	Hugo First	999-2-7712-3343-2	Glasgow Book Company	25 Square Road, Glasgow
Easy Money	Robin Banks	229-8-3312-0022-1	Glasgow Book Co	25 Square Road, Glasgow
Spectacles	Seymore Withem	777-3-4429-3321-0	Oxford Publishing	25 High Street, Oxford
Swimming the Channel	Frances Near	190-7-9100-2232-1	Oxford Publishing	25 High Road, Oxford
Horse Racing	Willie Winnit	987-5-3234-1212-2	Oxford Publishing	25 High Street, Oxford
Danger	Luke Out	889-1-2321-2222-6	Oxford Publishing	25 High Street, Oxford
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Simple Dentistry	Phil McCavity	569-1-4544-2233-9	Penguin Books	14 Main Place, London
Carpet Laying	Walter Wall	122-1-7712-3312-2	Penguin Books	15 Main Place, London
The Narrow Escape	Justin Thyme	766-3-2210-9023-8	London Publishing Ltd	1 Straight Street, London

It is also not possible to store details of a publisher without storing details about a book.

Deletion problems occur when deleting a single record also removes important data that is still required.

Book Title	Author	ISBN	Publisher Name	Publisher Address
The Haunted House	Hugo First	999-2-7712-3343-2	Glasgow Book Company	25 Square Road, Glasgow
Easy Money	Robin Banks	229-8-3312-0022-1	Glasgow Book Co	25 Square Road, Glasgow
Spectacles	Seymore Withem	777-3-4429-3321-0	Oxford Publishing	25 High Street, Oxford
Swimming the Channel	Frances Near	190-7-9100-2232-1	Oxford Publishing	25 High Road, Oxford
Horse Racing	Willie Winnit	987-5-3234-1212-2	Oxford Publishing	25 High Street, Oxford
Danger	Luke Out	889-1-2321-2222-6	Oxford Publishing	25 High Street, Oxford
Falling Down	Eileen Dover	972-2-3342-1001-8	Penguin Books	15 Main Place, London
Simple Dentistry	Phil McCavity	569-1-4544-2233-9	Penguin Books	14 Main Place, London
Carpet Laying	Walter Wall	122-1-7712-3312-2	Penguin Books	15 Main Place, London
The Narrow Escape	Justin Thyme	766-3-2210-9023-8	London Publishing Ltd	1 Straight Street, London

Removing *The Narrow Escape* book will also remove the only record of *London Publishing Ltd*

Reading Review 3

Having read pages 12-13 answer the questions below.

1. Problems can occur in flat-file databases. Explain the problems below:

Data Duplication

_____

_____

_____

Insertion Errors

_____

_____

_____

Deletion Errors

_____

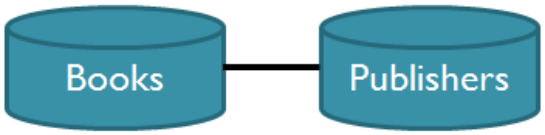
_____

_____

Relational Databases

Relational databases overcome the problems caused by flat file databases. Data is entered and stored **once**, removing errors and inconsistency caused by data duplication.

Relational databases use **linked tables** (more than one database table joined together.



The design of a relational database is mainly concerned with three things:

- **Entities** (tables)
- **Attributes** (fields)
- **Relationships** (link between tables)

Entity

An **entity** is a database table that represents a person, object or event

- e.g. Staff Member, DVD, Booking

Each entity has a set of **attributes** (or fields) which describe examples of that entity.

e.g. The product entity below has the attributes, **product ID, Description, Price, Supplier ID**

Product
Product ID
Description
Price
Supplier ID

Supplier
Supplier ID
Name
Address
Telephone

Primary Key

All entities must have a primary key. A primary key is used to uniquely identify each record in a database.

Book Title	Author	ISBN	Publisher Name	Publisher Address
The Haunted House	Hugo First	999-2-7712-3343-2	Glasgow Book Company	25 Square Road, Glasgow
Easy Money	Robin Banks	229-8-3312-0022-1	Glasgow Book Company	25 Square Road, Glasgow
Spectacles	Seymore Withem	777-3-4429-3321-0	Oxford Publishing	25 High Street, Oxford
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The value entered in the primary key field should **never** be repeated in another record.

Common primary keys are:

DVLA	Car Registration	SA60 ABC
Government	National Insurance Number	MN 23 84 96 K
Banks	Account Number	02994812
Online Retail	Order Number	EX782990
NHS	NHS Number	943 476 5919

Primary keys narrow down search results to a single record.

Normalisation

Normalisation involves removing the **repeating items**.

Book Title	Author	ISBN	Publisher Name	Publisher Address
The Haunted House	Hugo First	999-2-7712-3343-2	Glasgow Book Company	25 Square Road, Glasgow
Easy Money	Robin Banks	229-8-3312-0022-1	Glasgow Book Company	25 Square Road, Glasgow
Spectacles	Seymore Withem	777-3-4429-3321-0	Oxford Publishing	25 High Street, Oxford
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Carpet Laying	Walter Wall	122-1-7712-3312-2	Penguin Books	15 Main Place, London
The Narrow Escape	Justin Thyme	766-3-2210-9023-8	London Publishing Ltd	1 Straight Street, London

From the 10 records above, there are actually only 4 different publishers.

We now have separate entities for Books and Publishers.

Book Title	Author	ISBN
The Haunted House	Hugo First	999-2-7712-3343-2
Easy Money	Robin Banks	229-8-3312-0022-1
Spectacles	Seymore Withem	777-3-4429-3321-0
Swimming the Channel	Frances Near	190-7-9100-2232-1
Horse Racing	Willie Winnit	987-5-3234-1212-2
Danger	Luke Out	889-1-2321-2222-6
Falling Down	Eileen Dover	972-2-3342-1001-8
Simple Dentistry	Phil McCavity	569-1-4544-2233-9
Carpet Laying	Walter Wall	122-1-7712-3312-2
The Narrow Escape	Justin Thyme	766-3-2210-9023-8

Publisher Name	Publisher Address
Glasgow Book Company	25 Square Road, Glasgow
Oxford Publishing	25 High Street, Oxford
Penguin Books	15 Main Place, London
London Publishing Ltd	1 Straight Street, London

But there is no obvious primary key for our new entity.

Adding an ID field to our publishers entity gives us a unique field to use as the primary key.

ID	Publisher Name	Publisher Address
001	Glasgow Book Company	25 Square Road, Glasgow
002	Oxford Publishing	25 High Street, Oxford
003	Penguin Books	15 Main Place, London
004	London Publishing Ltd	1 Straight Street, London

Foreign Key

Foreign keys are used to **link** entities in a relational database.

Book Title	Author	ISBN	Publisher ID
The Haunted House	Hugo First	999-2-7712-3343-2	001
Easy Money	Robin Banks	229-8-3312-0022-1	001
Spectacles	Seymore Withem	777-3-4429-3321-0	002
Swimming the Channel	Frances Near	190-7-9100-2232-1	002
Horse Racing	Willie Winnit	987-5-3234-1212-2	002
Danger	Luke Out	889-1-2321-2222-6	002
Falling Down	Eileen Dover	972-2-3342-1001-8	003
Simple Dentistry	Phil McCavity	569-1-4544-2233-9	003
Carpet Laying	Walter Wall	122-1-7712-3312-2	003
The Narrow Escape	Justin Thyme	766-3-2210-9023-8	004

Foreign Key

ID	Publisher Name	Publisher Address
001	Glasgow Book Company	25 Square Road, Glasgow
002	Oxford Publishing	25 High Street, Oxford
003	Penguin Books	15 Main Place, London
004	London Publishing Ltd	1 Straight Street, London

A **foreign key** is an attribute in one entity that is the **primary key** of another entity.

Book Title	Author	ISBN	Publisher ID
The Haunted House	Hugo First	999-2-7712-3343-2	001
Easy Money	Robin Banks	229-8-3312-0022-1	001
Spectacles	Seymore Withem	777-3-4429-3321-0	002
Swimming the Channel	Frances Near	190-7-9100-2232-1	002
Horse Racing	Willie Winnit	987-5-3234-1212-2	002
Danger	Luke Out	889-1-2321-2222-6	002
Falling Down	Eileen Dover	972-2-3342-1001-8	003
Simple Dentistry	Phil McCavity	569-1-4544-2233-9	003
Carpet Laying	Walter Wall	122-1-7712-3312-2	003
The Narrow Escape	Justin Thyme	766-3-2210-9023-8	004

Any publisher ID entered here.

Must exist here

ID	Publisher Name	Publisher Address
001	Glasgow Book Company	25 Square Road, Glasgow
002	Oxford Publishing	25 High Street, Oxford
003	Penguin Books	15 Main Place, London
004	London Publishing Ltd	1 Straight Street, London

Referential Integrity is used by the database to make sure that values entered in the foreign key field on the many side have a matching value in the primary key of the one side.

Relationships

A relationship is a link between two entities.

It describes how the two entities are related and can be thought of a connection between them.

Entity Relationship Diagrams

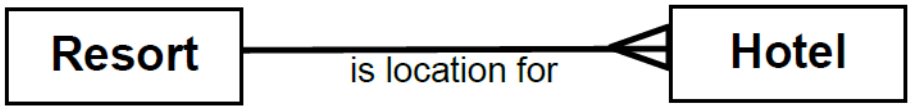
An entity-relationship diagram is a graphical representation of the entities in a system. It is used to illustrate the relationship that exists between two or more entities.

One-to-many relationships

In this type of relationship, <u>every</u> record in one entity is linked with **several** records in another entity.

This entity relationship diagram shows a one-to-many relationship *(crow's feet at the many end).*

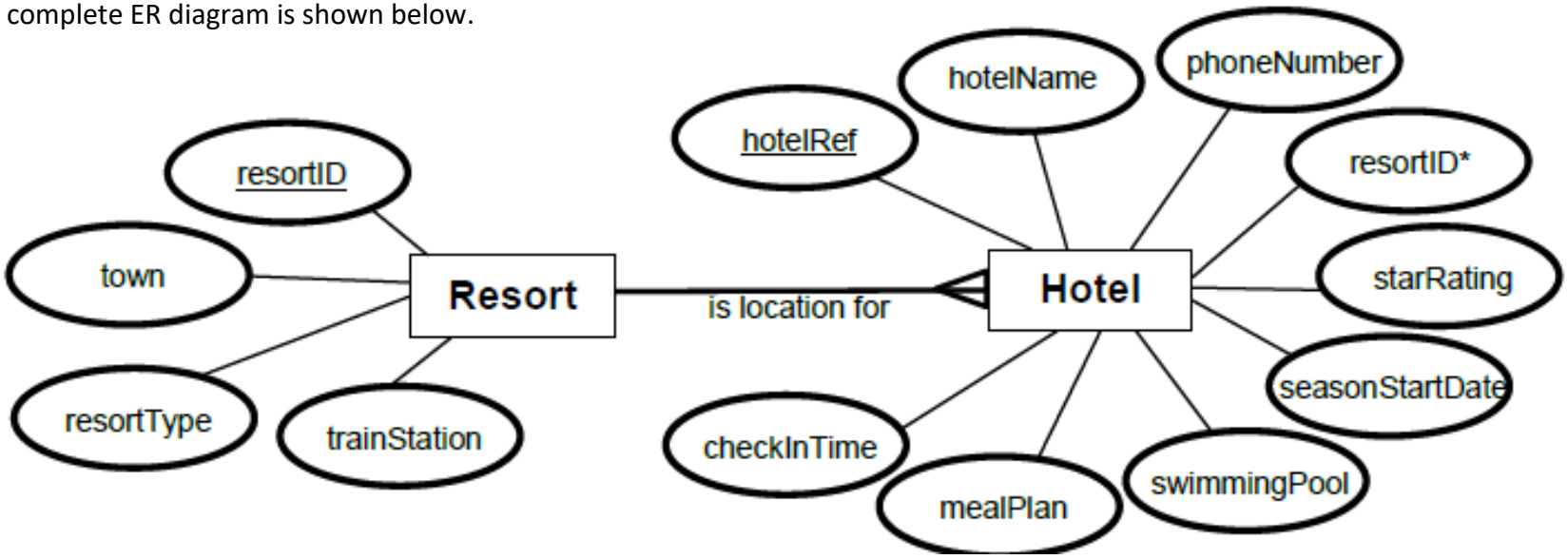
Each school can have several teachers but each teacher belongs to just one school.



Each resort can have several hotels but each hotel belongs to just one resort.

Complete ER Diagram

A complete ER diagram is shown below.



Entities – Square box containing table name

Attributes – Oval box containing field name

Relationship – Line showing one side and many side (crows feet)

Primary key – Attribute that is underlined

Foreign key – Attribute with and asterisk (*)

Reading Review 4

Having read pages 15-20 answer the questions below.

1. Relational databases overcome the problems caused by flat file databases. Data is entered and stored **once**, removing errors and inconsistency caused by data duplication. Explain the purpose of the following terms:

   Primary Key

   _____

   _____

   Foreign Key

   _____

   _____

2. Draw an entity relationship diagram for the below scenarios.

   a) An airline can fly many flights, but each flight is flown by only one airline.

   b) Each football team can have many players. Each player can play for only one team.

Validation

Validation is used to make sure that the data entered into fields is in the correct format (does it make sense).

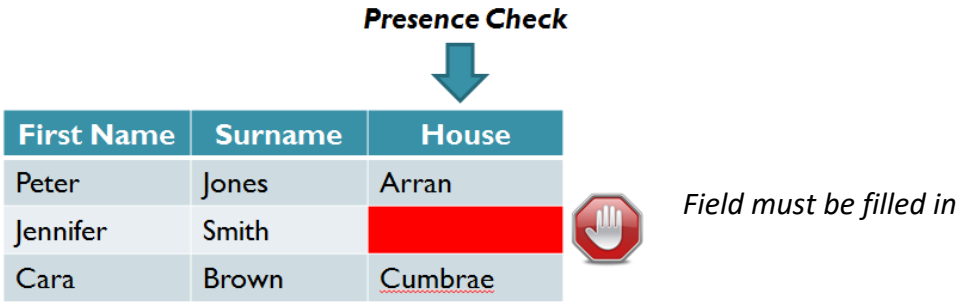
The database can be set up to automatically check data using validation rules:

- **Presence Check**
- **Restricted Choice**
- **Length Check**
- **Range Check**

Presence Check

A presence check is used to make a field a 'required field'.

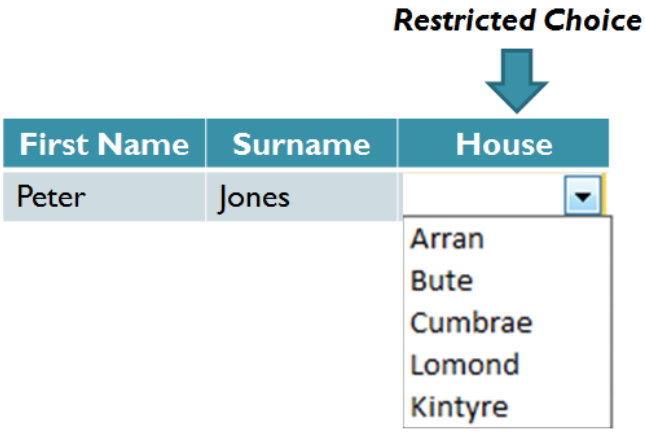
This means that for each record, data **must** be entered into that field'



Restricted Choice

A restricted choice makes users select information for a field from a pre-defined list.

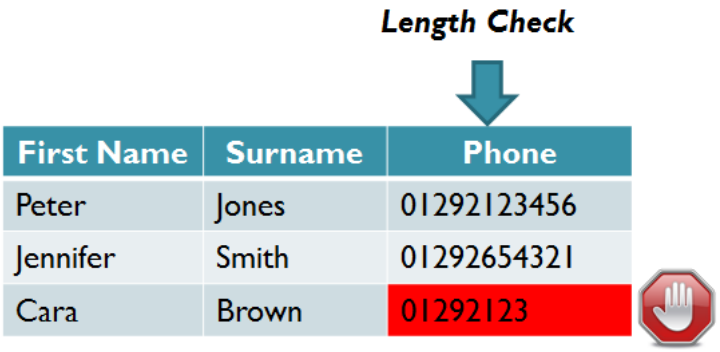
This means that only certain pieces of information can be entered into a field.



Length Check

A length check makes sure that the number of characters entered into a field is of a set length.

This is useful in fields containing codes or phone numbers that are always the same size.

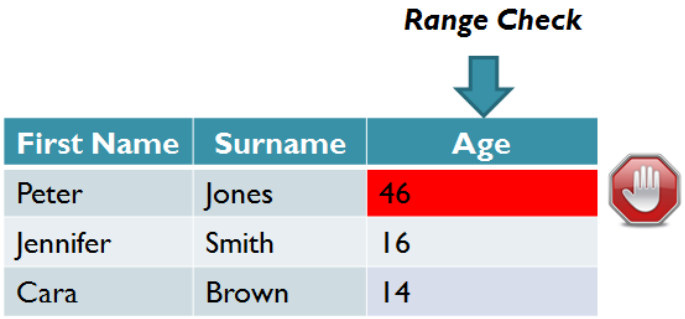


Field must be 11 characters

Range Check

A range check makes sure that the value entered into a field falls with upper and lower limits.

This is useful in number fields where the expected range is known.



Field must be 11 to 18

Search and Sort

Searching and Sorting are operations that can be performed on a database in order to arrange information in different ways.

Search reduces the number of records displayed to those matching a set criteria.

Sort arranges displayed records alphabetically (A-Z), numerically (1-10) or chronologically (Jan-Dec).

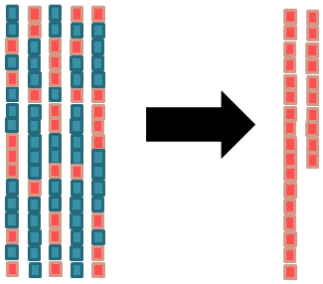
Simple Search

A simple search is when a search criteria uses **one field** to **find** matching records.

Only records that contain data **matching the criteria** are displayed.

This **reduces** the overall **number of records** displayed.

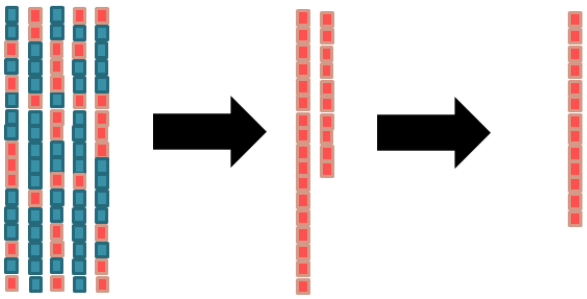
Criteria: Gender = "female"



Complex Search

A complex search is when a search criteria uses **more than one field** to find matching records.

Criteria: Gender = "female" **AND** Age > 14



Simple Sort

Records can be arranged in two ways:

A simple sort is when records are arranged in order using **one** field.

First Name	Surname	House	Age
Peter	Jones	Arran	15
Jennifer	Smith	Bute	16
Cara	Brown	Cumbrae	14
Adam	White	Kintyre	16
Lucy	Campbell	Lomond	13

*Sort in **Ascending** order by **House***

First Name	Surname	House	Age
Jennifer	Smith	Bute	16
Adam	White	Kintyre	16
Peter	Jones	Arran	15
Cara	Brown	Cumbrae	14
Lucy	Campbell	Lomond	13

*Sort in **Descending** order by **Age***

Complex Sort

A complex sort is when records are arranged in order using **more than one** field.

*Sort in **Descending** order by **Age** and then **Ascending** order by **House***

First Name	Surname	House	Age
Jennifer	Smith	Bute	16
Ben	Green	Bute	16
Adam	White	Kintyre	16
Peter	Jones	Arran	15
Eve	Smith	Bute	15
Andrew	Jones	Arran	14
Chloe	McDonald	Kintyre	14
Daniel	Morris	Kintyre	14
Lucy	Campbell	Lomond	14

Reading Review 5

Having read pages 22-25 answer the questions below.

1. Validation is used to ensure the data entered into a field is in the correct format. Name and explain the four types of validation that can be applied to a database.

   a) _____

   _____

   b) _____

   _____

   c) _____

   _____

   d) _____

   _____

2. Explain the difference between a **simple search** and a **complex search**.

   _____

   _____

   _____

3. Explain the ways in which data can be **sorted**.

   _____

   _____

   _____

Data Dictionary

A **data dictionary** is used to record details about the database. It provides a description of the constraints or rules that apply to each of the attributes of each entity in the system.

A data dictionary is simply a large table that stores **metadata** – in other words, it stores data about data.

The structures needed to store data in the database are **planned** using a data dictionary.

Entity: Resort					
Attribute Name	**Key**	**Type**	**Size**	**Required**	**Validation**
resortID	PK	Number		yes	
town		Text	20	yes	
resortType		Text	20	yes	Restricted choice: coastal, city, island
trainStation		Boolean		yes	
Entity: Hotel					
Attribute Name	**Key**	**Type**	**Size**	**Required**	**Validation**
hotelRef	PK	Text	4	yes	length=4
hotelName		Text	20	yes	
phoneNumber		Text	11	yes	length=11
resortID	FK	Number		yes	Existing resortID from Resort table
starRating		Number		yes	Range: >=1 and <=5
seasonStartDate		Date		no	
swimmingPool		Boolean		yes	
mealPlan		Text	17	yes	Restricted choice: RO, BB, HB, FB
checkInTime		Time		yes	Range: >=14:00 and <=16:00

- Each row provides details about **one attribute** in the system
- Each column **specifies a rule** or restriction that applies to the attributes.

Each row of the data dictionary is completed by stating the appropriate value or rule for each column

Where no rules apply, the column value is left empty.

- **PK/FK** (Is the field a primary key / foreign key – a field can be both)
- **Data Types** (Text, Number, Boolean, Date/time Object, Link)
- **Size** (Maximum number of characters /digits)
- **Required** (Mandatory or Optional. Primary key must be required)
- **Validation** (Presence/Length/Range checks, restricted choice)

Reading Review 6

Having read page 26-27 answer the questions below.

1. A publishing company stores details about books and customer orders. The entities and attributes stored in the system are shown below where primary keys have been underlined and foreign keys are indicated using an asterisk *.

Customer Entity	Order Entity	Book Entity	Author Entity
Customer Number	Order Reference	ISBN	Author ID
Customer Name	Order Date	Book Title	Author Name
Customer Address	ISBN *	Price	Author Address
Customer Town	Quantity	Author ID *	Author Town
Customer Postcode	Customer Number *		Author Postcode

Sample customer orders and book details are shown below.

Customer Orders

Customer Number:	00782
Customer Name:	Inverclyde Books
Customer Address:	52 High Street
Customer Town:	Gourock
Customer Postcode:	PA19 1UX

Order Date	ISBN	Quantity
12/03/2014	0901714564X	9
16/03/2013	7289192000	15
27/03/2013	0901714564X	20
04/04/2013	3781972928	12
11/04/2013	1217292921	9

Book

ISBN:	0901714564X
Book Title:	Weather Time
Price:	£15.99
Author Code:	87281
Firstname:	Julie
Surname:	Adams
Address:	15 West Street
Town:	Greenock
Postcode:	PA19 7XE

Complete the data dictionary for these entities on the next page

Entity	Attribute Name	Key	Type	Size	Required	Validation

Queries

Queries are used to:

- **search** the tables in order to retrieve sets of data that match the requirements
- **sort** the data in the tables into ascending or descending order
- **insert** new information
- **update** existing information in multiple records
- **delete** existing information

Before creating a query, the developer should plan:

- what tables are needed
- what fields to use
- field order for a complex sort – the most important field must be listed first

Planning the design of a query before creating the SQL code is good practice.

This gives the developer time to think carefully about the fields that are required, which in turns, helps them to identify the table or tables that will be needed.

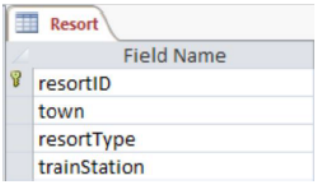
It also allows developers to consider the purpose of the query (search and/or sort), together with any required search criteria and/or sort order.

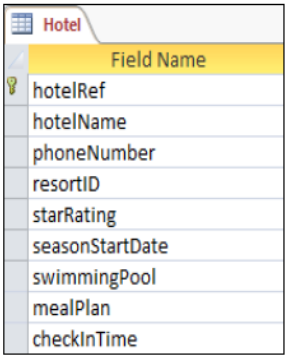
Planning ahead helps to reduce the errors that developers may otherwise encounter when working with the SQL code.

Example

A relational database is used by a travel agency to store details of Scottish holiday resorts and hotels in each resort.

The resort and hotel details are arranged in two separate tables called **Resort** and **Hotel**. The structure of the tables is shown below:





Example 1

Design a query to list the town name and train station details of all resorts that have a train station.

Field(s)	town, trainStation
Table(s)	Resort
Search criteria	trainStation = true
Sort order	

Example 2

Design a query to list the hotel name and phone number, together with the star rating and swimming pool details for all hotels with a swimming pool that have a rating of at least 4 stars.

Field(s)	hotelName, phoneNumber, starRating, swimmingPool
Table(s)	Hotel
Search criteria	swimmingPool = true AND starRating >= 4
Sort order	

Example 3

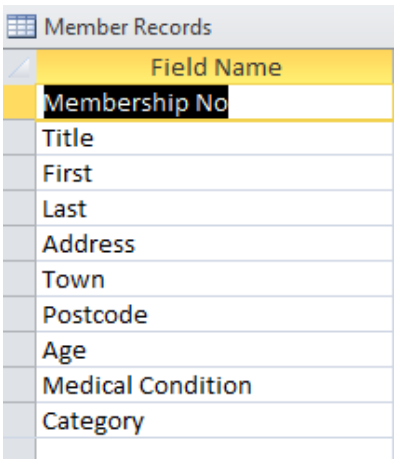
Design a query to list the hotel name and its star rating, together with the town, resort type and check-in time, of all hotels that allow check in before 15:00. These details should be displayed so that the hotel with the highest rating is listed first; hotels with the same star rating should be listed in alphabetical order of town name.

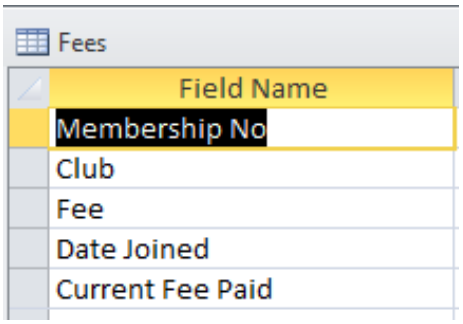
Field(s)	hotelName, starRating, town, resortType, checkInTime
Table(s)	Hotel, Resort
Search criteria	checkInTime < 15:00
Sort order	starRating DESC, town ASC

Reading Review 7

Having read page 30-31 answer the question below.

The structures of database tables are shown below:





1. Design a query to list the Membership No and Medical Condition of all members that are age 30 and over.

Field(s)	
Table(s)	
Search Criteria	
Sort Order	

2. Design a query to list the membership no, first, last and address of all members that belong to a clubs that is gym clubs. These details should be displayed so that the membership no with the highest number is listed first.

General Data Protection Regulation (2016)

The GDPR is used to control how **information that is stored on computer** is handled.

It gives **legal protection** to anyone whose personal data is held on computer by a company or organisation.

It is the **responsibility of the company** holding the personal data to ensure that all the requirements of the law are met.

The **data subject** is the person whose data is being stored. The data subject must provide consent for their data to be stored.

The **data user** or data processor is usually an employee of the company who can access and use the information stored about the data subject.

The data controller is the person who is wholly responsible for holding the data. They are usually the company boss/manager or owner.

Implications for businesses and individuals

Main Consideration	How is this achieved
Prior consent of the data subject	• The data subject must give consent that their data can be processed in the way the business would like.
Accuracy of the data	• Data only used for specified purposes (reason given). • Data collected is adequate, relevant and not excessive. • Data is not kept longer than is necessary • Data is fairly and lawfully processed.
Data used for limited, specifically stated purposes	• Data must be accurate and kept up to date.
Data kept safe and secure	• Data is not shown to anyone except the subject • Data is kept safe and secure to prevent hacking. • Data is not transferred to other countries without adequate protection

Reading Review 8

Read page 33, answer the questions below.

1. Explain the purpose of the data protection act. Give two examples of how companies should comply with the data protection act.

_____

_____

_____

_____

2. Describe two rights of the data subject.

_____

_____

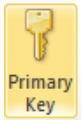
_____

Implementation

When building a database it is important to ensure it matches the design (data dictionary).

Implementing Primary Keys

Open each table in design view. Select a field and click the Primary Key option.



TutorGroup

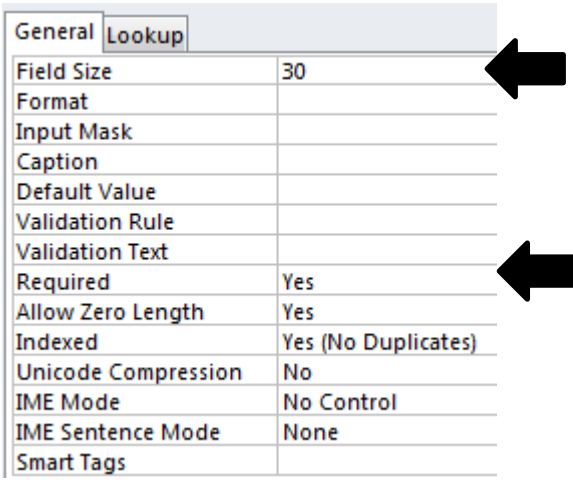
Field Name	Data Type
TGCode	Text
Tutor	Text
Room	Text
Day	Text
Time	Text

Student

Field Name	Data Type
StudentNo	Number
Forename	Text
Surname	Text
Address	Text
Town	Text
Postcode	Text
TGCode	Text

Setting Field Size and Required

Select each field in turn (for each table) and change the size, required and indexed settings to match the data dictionary requirements.



Size:
Set the maximum number of characters allowed here. (Text fields only)

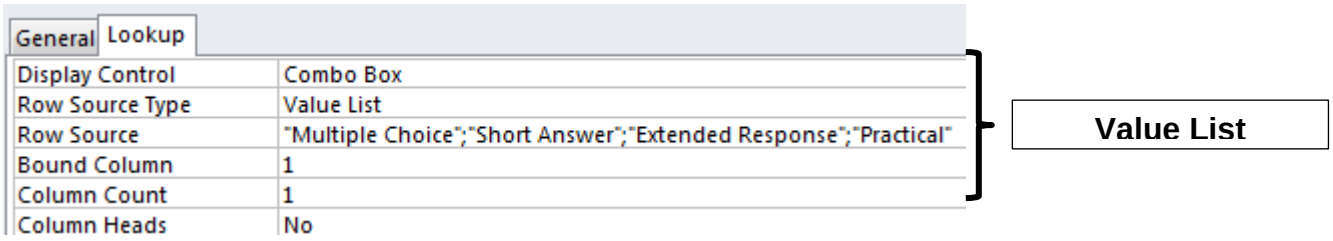
Required (Presence Check):
Set required to Yes or No.

Validation Rules

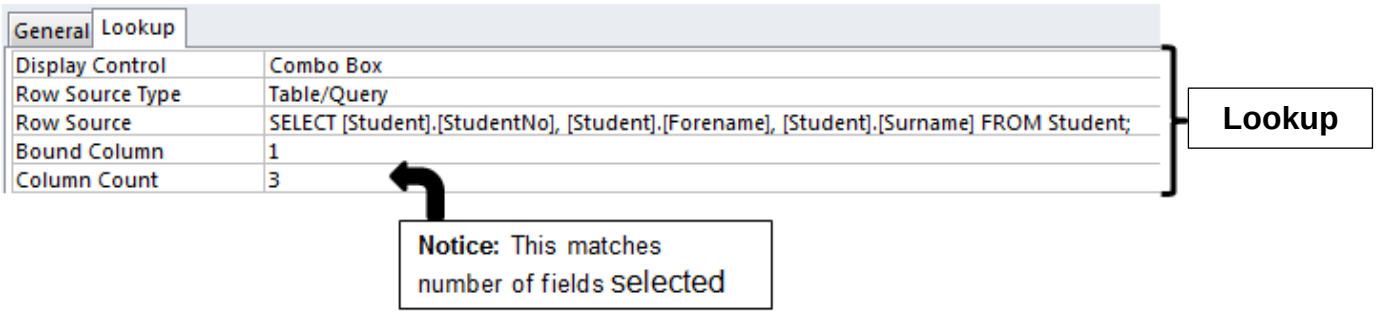
Add the validation rules for the fields indicated on the data dictionary

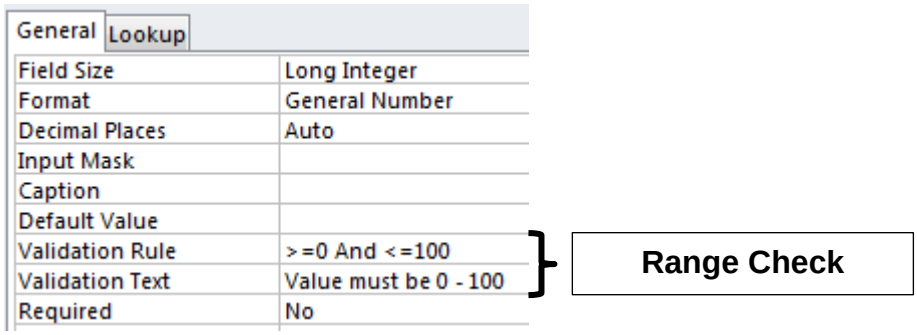
Restricted choice

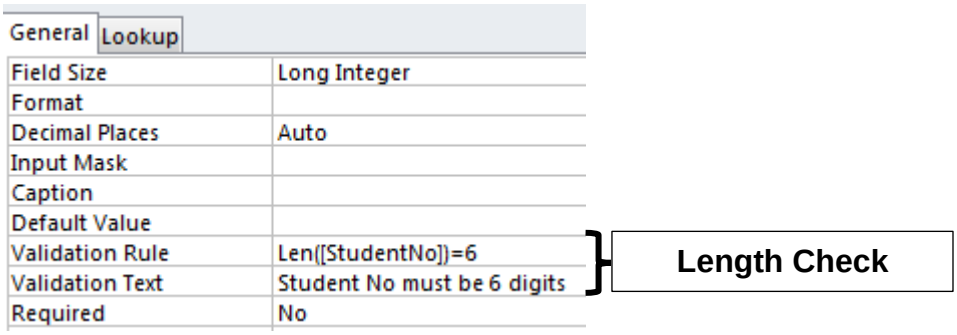
A **value list** should be used where there are set options for a particular field.



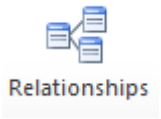
A **lookup** should be used for foreign key fields. This requires an SQL query.







Creating Relationships (Implementing Relational Database)

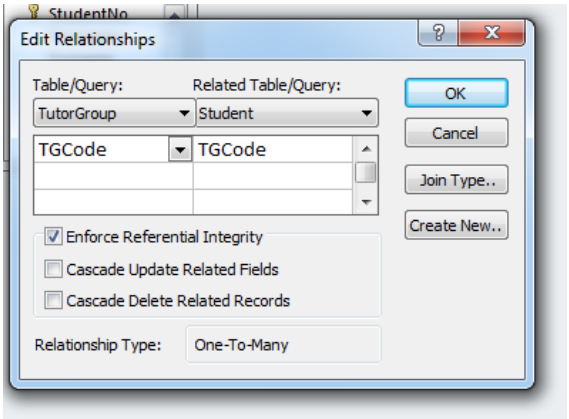


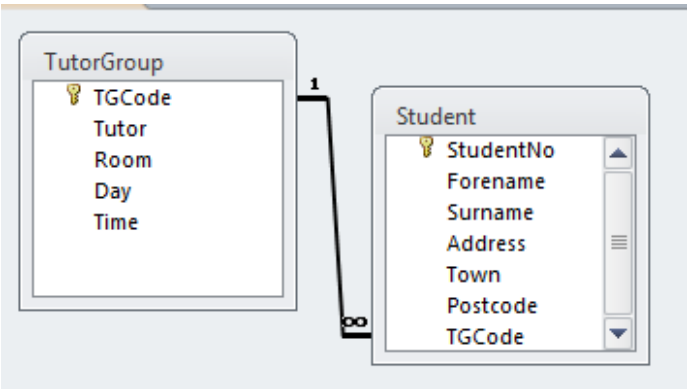
Make sure all tables are closed.

Open the relationships option (from the Database Tools menu).

Add the two tables and create the relationships shown in the entity-relationship diagram.

Click on the **primary key** in the main table and drag your mouse over to the foreign key in the other table. Tick the box to **Enforce Referential Integrity**. Click create.





Referential Integrity

By ticking the referential integrity box, the database will prevent a foreign key value in the many side from being entered unless there is a matching primary key value in the 1 side of the relationship.

Creating Queries

SQL stands for **Structured Query Language** and it is used for creating queries.

Queries are used to:

- **search** the tables in order to retrieve sets of data that match the requirements
- **sort** the data in the tables into ascending or descending order
- **add, remove** and **change** information in the database

The main SQL statements you will use are:

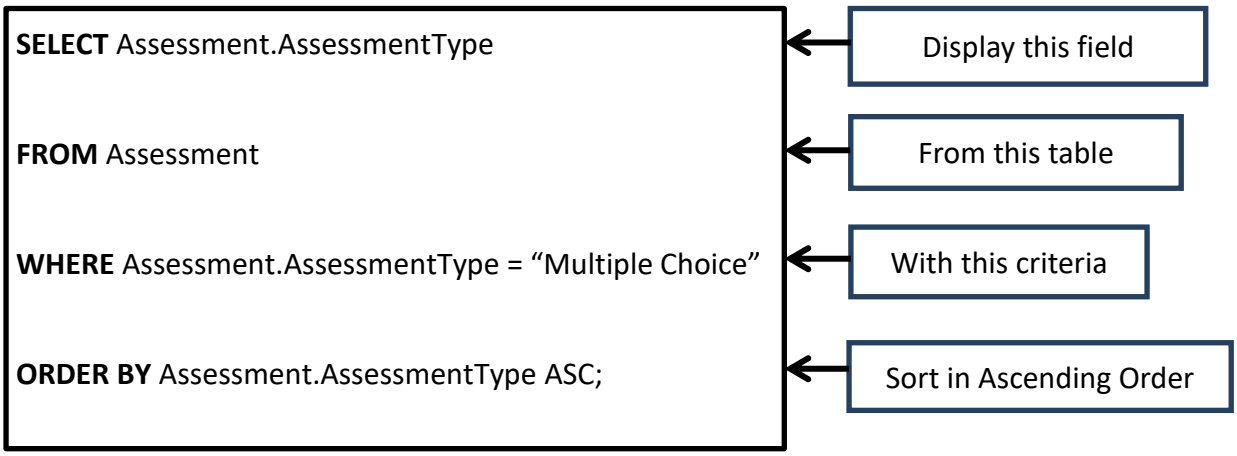
SELECT – Choose fields to be displayed as part of a query

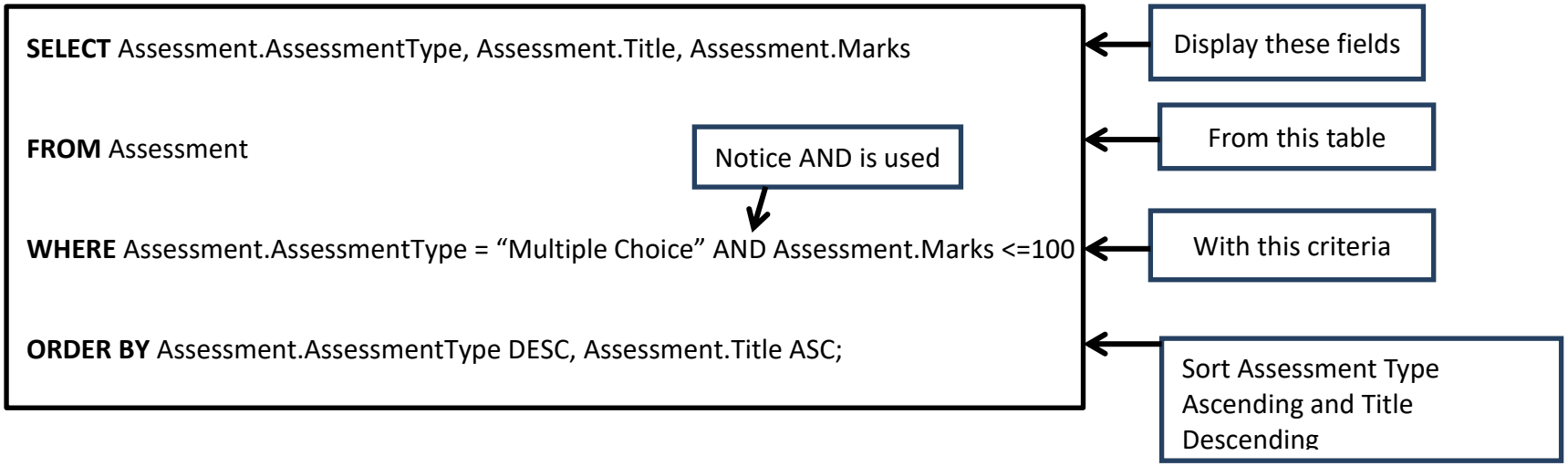
INSERT – Add new data to a table (add records)

UPDATE – Amend data in a table (update records)

DELETE – Remove data from a table (remove records)

Select Queries



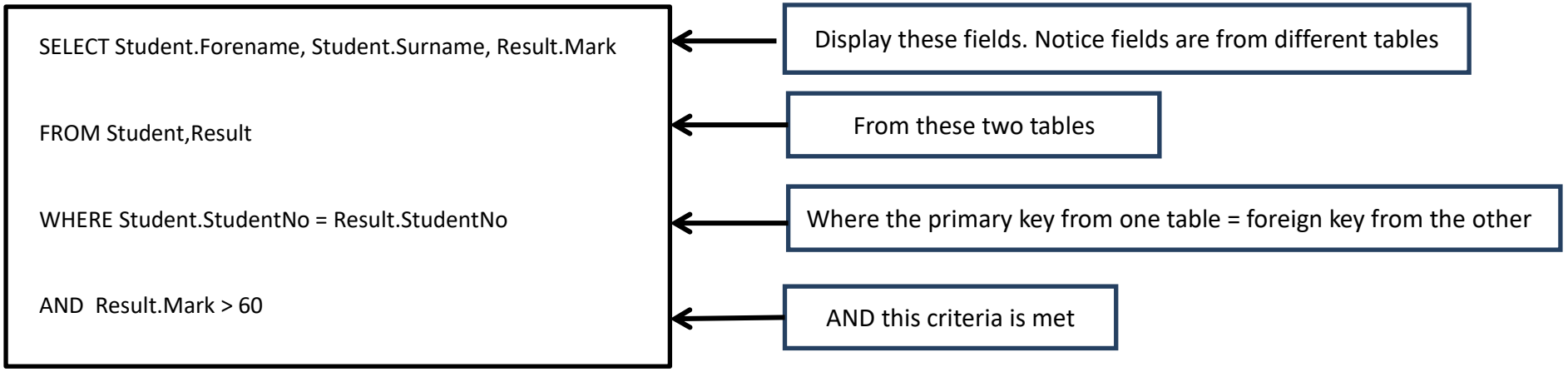


When creating a query there can be multiple fields used for the criteria and >, <, =, >=, <= can be used in the criteria. E.g.

```
WHERE Assessment.AssessmentType = “Multiple Choice” AND Assessment.Marks <=100
```

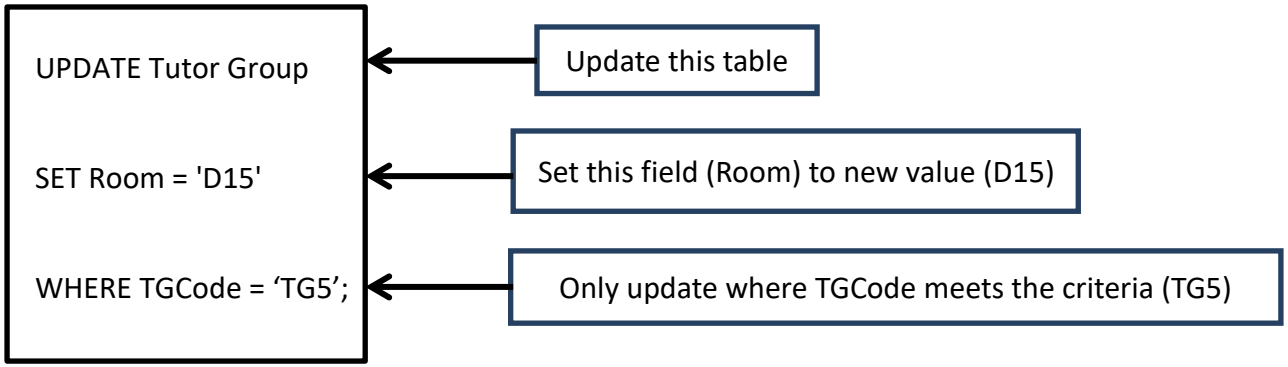
```
WHERE Assessment.AssessmentType = “Multiple Choice” OR Assessment.Marks >50
```

Select Queries (Equi-Join)

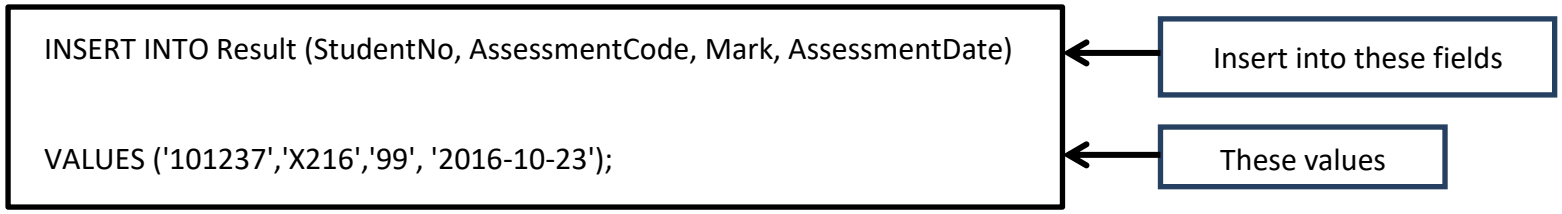


Update Queries

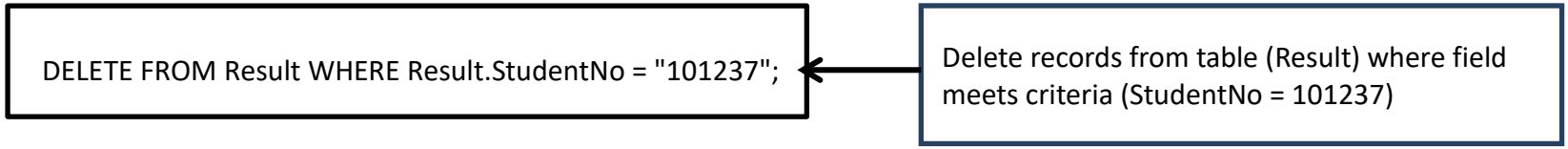
Unconditional



Insert Queries



Delete Queries



For more help with SQL queries visit https://www.w3schools.com/sql/

Reading Review 9

Having read page 36-43 answer the question below.

1. Write an SQL query to display the first name, surname and age from a table called student details. The query should only display students who are older than 11 years old and should be ordered by first name in ascending order.

2. Write an SQL query that would add a record to a database called Products. The field names and information to be added is shown below.

Product Name	Pencil
Price	15.99
Department	Stationary

3. Write a query that will update a table called School Houses. The table should set the guidance teacher to Miss Smith when the House name is Ayr.

4. Write a query that will delete any records where the Employee department is Insurance from the table called Employee Information.

Testing and Evaluation

Testing

It is important to test your database queries to ensure the **expected output** matches the **actual output**. Below is an example of how we should test a database:

Consider the **Customer** table shown below.

custo	foreName	surname	street	town	package	directDebit	paymentDu
101	Lauren	Calder	2 Paisley Street	Wemyss Bay	Premier	☑	12/04/2016
102	Abigail	Cameron	16 Paisley Street	Wemyss Bay	Standard	☐	12/04/2016
103	Ryan	Collins	17 Dunoon Drive	Gourock	Premier	☑	19/05/2016
104	Nicole	Rutherford	5A Panama Place	Port Glasgow	Large	☐	13/04/2016
105	Justine	O'Docherty	7 High Street	Kilmacolm	Premier	☑	18/04/2016
106	Shelby	Sweeney	3 Paisley Road	Port Glasgow	Premier	☑	26/05/2016
107	Donald	McAndrew	1 Big Hill Avenue	Inverkip	Standard	☑	01/08/2016
108	Rowan	Hastings	6 Clydeview Crescent	Gourock	Large	☑	05/05/2016
109	Grant	Donaldson	9 Dunoon Drive	Gourock	Premier	☐	07/04/2016
110	Christine	Flowers	63 Hamilton Drive	Greenock	Large	☑	19/04/2016
111	Ross	Lambie	12 Paisley Road	Kilmacolm	Standard	☑	27/03/2016
112	Paul	McGill	3C Cow Lane	Kilmacolm	Premier	☐	10/04/2016
113	Jack	Shields	4 Brookside Close	Port Glasgow	Large	☐	10/05/2016
114	Pauline	Milne	32 High Street	Kilmacolm	Premier	☑	09/05/2016
115	Margaret	Rice	5 Drumchapel Square	Greenock	Standard	☐	14/04/2016

Query testing

A query is required to display the full name and town of all customers who live in Gourock. The details should be listed in alphabetical order of customer surname.

Expected output

This table shows the output predicted from the query.

Expected output	Forename	Surname	Town
Details of customer listed **first**	Ryan	Collins	Gourock
Details of customer listed **last**	Rowan	Hastings	Gourock

Actual output

This is the output from the query used to perform the task.

surname	town
Collins	Gourock
Donaldson	Gourock
Hastings	Gourock

Comparing the answer table with the predicted output, it is possible to evaluate the query.

The query output is accurate because it displays details of the three customers who live in Gourock however it does not display the correct fields so it is not fit for purpose.

Evaluation

When evaluating a completed database system, there are two aspects to consider:

- Fitness for purpose
- Accuracy of output

Fitness for purpose

This is concerned with reviewing whether or not the completed solution carries out all of the functional requirements identified in the initial analysis.

If the solution does not do everything it was supposed to do (and that the user requires) then it is not fit for purpose.

Accuracy of Output

If the SQL queries do not produce the correct results then the database is unreliable. This prevents the database from being an effective and trustworthy system.

It is vital that thorough testing of SQL queries is carried out to ensure that they produce accurate output every time.

See the testing stage on page 46 for more information on this.

Reading Review 10

Having read page 44 answer the question below.

1. Why is it important to test your database?

_____

_____

_____

_____

2. Explain the difference between expected output and actual output.

_____

_____

_____

_____

3. Explain the term fit for purpose in relation to databases.

_____

_____

_____

_____

4. Explain the term accuracy of output in relation to databases.

_____

_____

_____