INFORMATION SYSTEM DESIGN & DEVELOPMENT

Outcomes and Assessment Standards

Outcome 1

The candidate will:

1   Develop information systems using appropriate development tools by:

1.1   Applying contemporary design and development methodologies
1.2   Creating a complex structure with links
1.3   Incorporating good user interface design
1.4   Writing code
1.5   Integrating different media types
1.6   Identifying and rectifying errors
1.7   Testing against appropriate criteria

Outcome 2

The candidate will:

2   Consider the factors involved in the design and implementation of an information system by describing in detail its:

2.1   Functionality, range and types of users
2.2   Technical implementation (hardware and software requirements)
2.3   Technical implementation (storage and connectivity)
2.4   Security risks and precautions
2.5   Legal and environmental implications
2.6   Economic and social impact

Information Rich & Poor

We live in an age where information and knowledge are so important that society can be divided up into two groups. These are "information rich" and "information poor".

If you are information rich you have access to many TV and radio channels, books, newspapers, magazines, journals, and of course access to the World Wide Web.

Those who are information poor tend to not have access to the Web and probably find it difficult to access relevant books and journals. Even in general conversations a discussion about a TV programme shown on satellite TV will be lost on people who only have 4 or 5 free view channels.

To help us remember all the information that we need we use an Information System, which is a combination of hardware and software which is used to input, process and store data, and then output information.

What is a Database?

A database is an organised collection of information or data. Putting information into a computer database gives you far more flexibility in organising, displaying and printing that information.

Almost everyone who uses a computer will use a database system for something:

- Banks use a database package for storing customers' accounts information
- Your school will use a database package to store information on all the pupils in the school
- Police use databases to keep information on people with criminal records

Why Use Databases?

To the right is a picture of a paper filing cabinet. These are still used today in offices but not as much as they used to be.

Computerised databases are now much more popular and widely used. There are many reasons for this. Paper filing cabinets were **big and bulky** and needed **a lot of organisation** to make sure everything was stored correctly. A **computerised database doesn't take up lots of room and can be easily edited** without having to re-print things.

Computerised databases also have other advantages such as it is much **quicker to search** for a certain pieces of information rather than having to trawl through hundreds of records. It is also **easier to sort** a database for example by a person's surname which previously in a paper based database would have taken a long time to manually sort the database on a different field.

How is a Database Organised?

There are three key terms you must know:

- The whole set of data in a database is called the **file**
- The set of information on one single subject (for example, one pupil in your school) is called a **record**
- Each separate heading of information inside a record (for example, your date of birth) is called a **field**
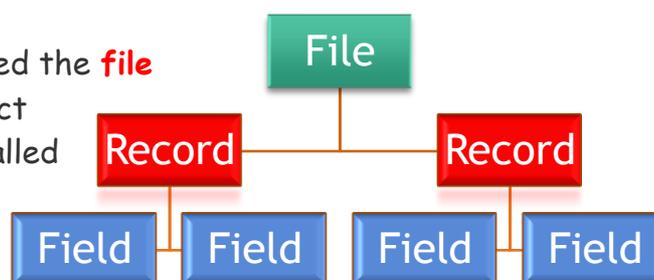
To create a database requires the user to define the file structure. This involves **creating fields** by enter each field name and its appropriate field type.

In this unit you will learn about eight different **field types**. These include **text, numbers, date, time, graphics, calculated, link and Boolean.**

Flat File Database

Flat file databases **only have one table and each row of the table is unique.**

Flat-file databases have a number of problems:

- **Data can be duplicated**.
- Duplicating data **increases the chance of human error when typing in the same data** a number of times. It can then be hard to be sure which the correct entry is.

Relational Database

Within a database, **tables are linked to prevent duplication of data within a row of a table.**

Looking at a basic 2 table database storing information about criminals – one criminal may be arrested a number of times. The first table would store information about the criminal: name, DOB, height, address etc. The second table would store information about the conviction: date, arresting officer, crime, location etc. Taking it a step further you may have the following 4 table structure:
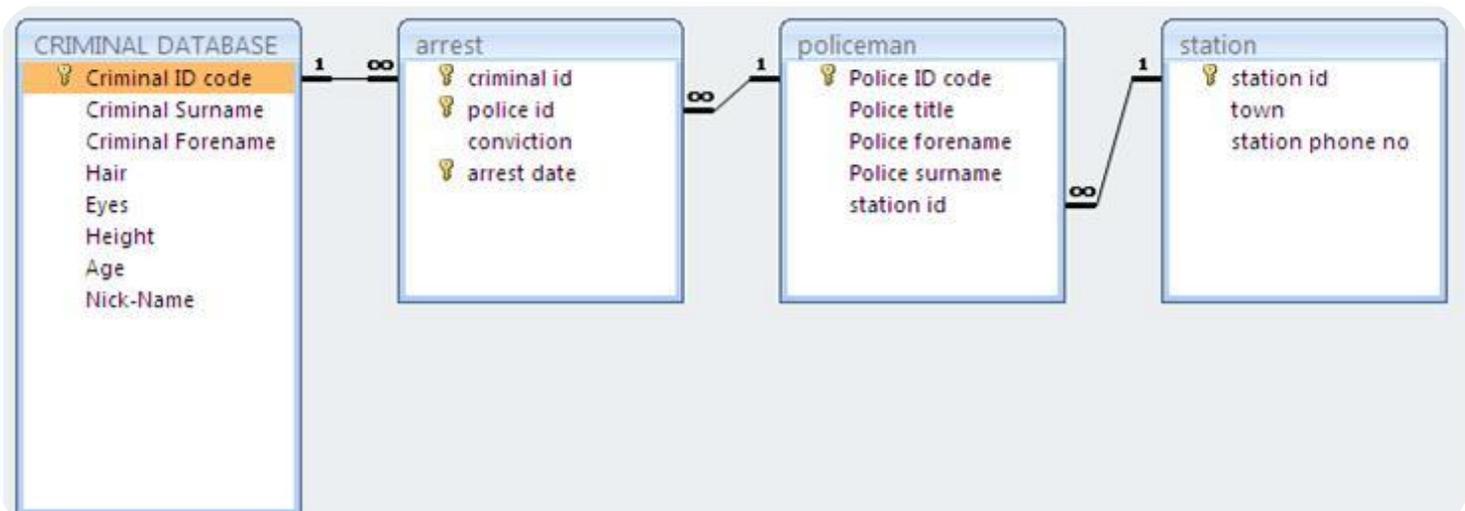
Validation

Validation is done to ensure data entered is allowable & sensible. You need to know about these different types of validation.

Range check

Ensures the data entered in the field is between a lower and upper limit.

e.g.   Cost   >£0   AND <£100
        Time   >1 min   AND <5 mins

Restricted choice

Gives the user a list of options to choose from.
Prevents user from typing errors.

Length check

Ensures the data entered in the field has a restricted number of characters;

e.g.   PIN   =   4 chars
        Password   >=   6 chars
        Comments   <   200 chars
        Or a combination of the above

Presence check

Ensures the field is not left blank

Unique check

Ensures the data entered in the field is different from any other record.

Data Dictionary Example

When creating a database it is important to make sure the information it stores is valid and relevant. To do this we use different types of validation to make sure the user enters valid and correct information.

Below is an example of a data dictionary for a database storing information about a car collectors club.

Field Name	Field Type	Validation	Presence Check
Forename	Text	Length <=20	Yes
Surname	Text	Length <=20	Yes
Address	Text	Length <=35	Yes
Town	Text	Length <=30	Yes
Postcode	Text	Length <= 8	No
Contact No	Text	Length = 11	No
Date of Birth	Date	**Restricted** DD/MM/YYYY	Yes
Car Owner	Boolean	Restricted Yes No	No
Previous Cars	Number	Range 0-20	Yes
Car Make	Text	**Restricted** Volkswagen Ford BMW Audi Renault	Yes

Key Fields: Primary & Foreign Keys

Primary Key

Imagine what would happen if Mrs Smith telephoned the school to ask the secretary to pass on a message to her daughter Charlotte.

If there were nothing to uniquely identify the students' records, the secretary would have to search for all of the 'Charlotte Smiths' in school and then say, 'sorry to keep you waiting Mrs Smith, could you just tell me if your daughter is in S1, S2, S3, S4, S5 or S6? And if she is in S2, which one of these five girls is she?'

Therefore, it is important that **every single record** in a database has something to **uniquely identify** it and this is called the 'Primary Key' or sometimes the 'Key Field'.

When you started school, you were given a **'student ID'** or an, 'office number' (primary key).

Foreign Key

A foreign key is used to link tables together and create a relationship. It is **a field in one table that is linked to the primary key in another table.**
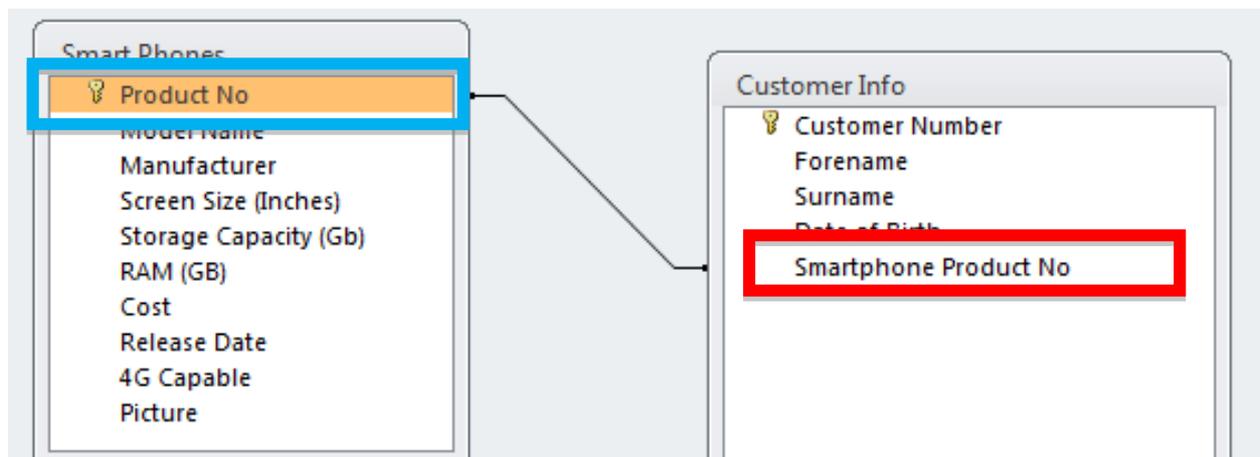
|	
(blue box)	= Primary Key
(red box)	= Foreign Key

Compound Keys

A compound key **combines more than one field to make a unique value**.

Sometimes **one field is not enough to uniquely identify a certain record.**

For example think about a pack of cards. There are four suits and a single primary key would not uniquely identify a card just upon the suit. There are also 13 values from the Ace to the King and again this would not uniquely identify a card.

The solution is to make a compound key out of the suit and the card value fields then every card in the pack could be uniquely identified.

| Value	Suit	Times Played
Four	Diamonds	5
Five	Clubs	2
Jack	Hearts	4
Queen	Spades	7
Ace	Hearts	1
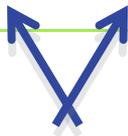
One is not enough to uniquely identify a record.
Both combined make a unique value.

Database Relationships

A relationship works by **matching data in key columns** — **usually columns with the same name in both tables**. In most cases, the relationship matches the primary key from one table, which provides a unique identifier for each row, with an entry in the foreign key in the other table. For example, book sales can be associated with the specific titles sold by creating a relationship between the title_id column in the titles table (the primary key) and the title_id column in the sales table (the foreign key).
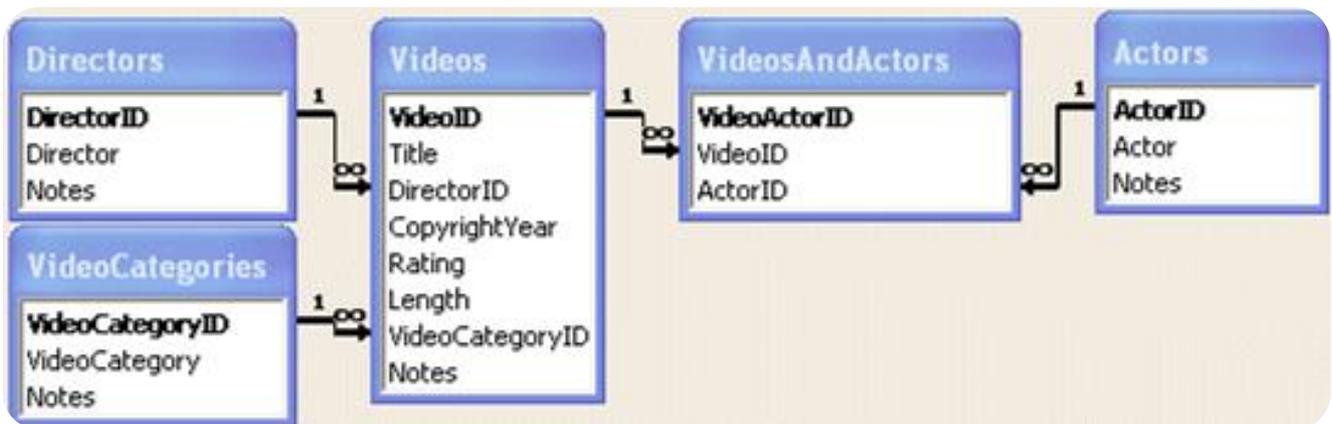
One-to-one

In a one-to-one relationship, a row in table A can have **no more than one matching row in table B, and vice versa**. A one-to-one relationship is created if both of the related columns are primary keys or have unique constraints.

Think about a husband and wife.
- A husband can only have one wife.
- A wife can only have one husband.

This type of relationship is not common because most information related in this way would be all in one table. You might use a one-to-one relationship to:
- Divide a table with many columns.
- Isolate part of a table for security reasons.

One-to-many

A one-to-many relationship is the **most common type of relationship**. In this type of relationship, **a row in table A can have many matching rows in table B, but a row in table B can have only one matching row in table A**. For example, the publishers and titles tables have a one-to-many relationship: each publisher produces many titles, but each title comes from only one publisher.

Think about a mother and her children. A mother can have many children. A child can have only one mother.

Dog Walkers is a company that walks dogs when their owners are at work. The company has a database to store details of the dogs, their owners and the walkers. The data is stored in the following tables.

Dog	Owner	Walk	Walker
Dog ID	Owner ID	Walk ID*	Walker ID
Dog name	Owner name	Dog ID*	Walker name
Dog type	Owner address	Walker ID*	Walker phone number
Gender	Owner phone	No. of days per week	
Walks well with others		Cost	
Photo			
Owner ID*			

The one-to-many relationships that exist between the tables are:

- Walker and Walk
  - There is only one walker to many walks. For example **a dog walker can do many different walks.**
- Dog and Walk
  - There is one dog to many walks. For example **one dog can go on many different walks.**
- Owner and Dog
  - There is one owner to many dogs. For example **one owner may have many different dogs.**

Many-to-many

In a many-to-many relationship, **a row in table A can have many matching rows in table B, and vice versa.** You create such a relationship by defining a third table, called a junction table, whose primary key consists of the foreign keys from both table A and table B.

Think about DVDs in a hire shop and the shops customers.
- A DVD can be hired by many customers
- Customers can hire many DVDs

DVDs ⟩———⟨ Customers ✗
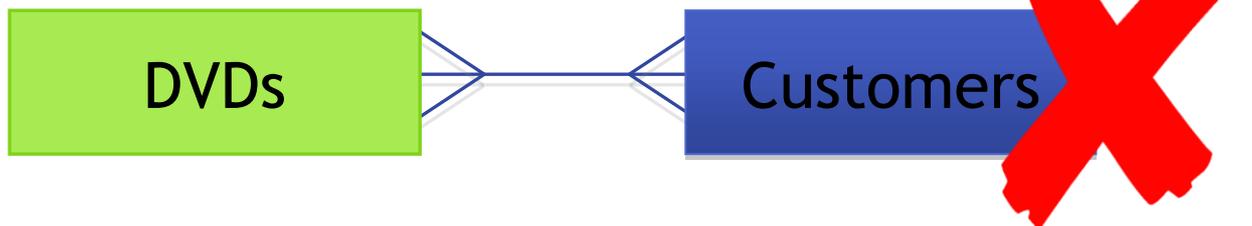
A **many-to-many relationship is not a good idea** when designing a database. They are inefficient and managing all the records tied to each side of the relationship can be awkward. To overcome this a new table is created which allows the relationship to become a one-to-many relationship.

A third table could be called rental. Therefore the relationship becomes.
- Customers can have many different rentals
- A rental belongs to one customer

AND

- A DVD can be rented many times
- Many rentals can contain that DVD

DVDs ————⟨ Rental ⟩———— Customers ✓

Database Forms

Database forms are basically forms through which you can **enter information in your database**. On the right is an example of a basic form to enter information for a cycling competition.

Some database software like Microsoft Access enable you to create forms for your database automatically, so that **entering data becomes very easy in your database**.

One benefit of using database forms is **reducing data entry errors**, as correct data will go in correct field
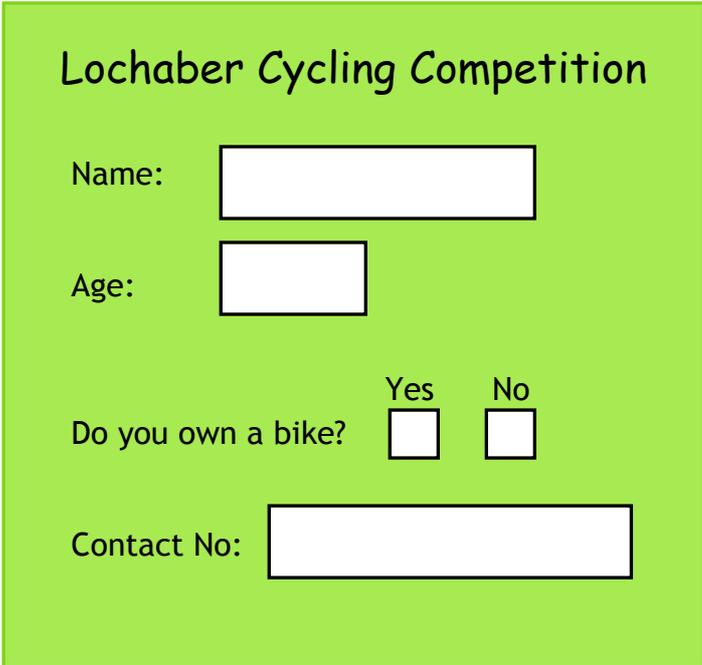
Lochaber Cycling Competition

Name:

Age:

Yes   No

Do you own a bike?

Contact No:

Database Queries

What is a query?

A query is a **request for information from a database** that matches a set of criteria.

You use queries all the time when you use a search engine such as Google. You type in the term that you want some information about and click 'search'. The search engine looks through its database and displays a list of results that match the term that you used.

If you are setting up a query directly to a database, for example the coding that goes on behind the scenes many web sites, then the developer will most likely use a formal language called **SQL** (Structured Query Language) to set up the query.

Simple Search

Team Name	Area	Coach	Cups Won	Players Registered
KHS Machines	Lochaber	Mr Stewart	6	43
LHS Monsters	Lochaber	Mr Jordan	4	122
AHS Crazies	Strontian	Mr Brown	3	34
IHS Attackers	Inverness	Mr Macdonald	6	76
MHS Tanks	Mallaig	Miss Rodger	5	12
Stron ACE	Strontian	Mrs Budge	2	7

A simple search is when you **only search on one field**.

EXAMPLE QUESTION:
How could you find out what teams Mr Stewart is the coach for?

EXAMPLE ANSWER:
Do a simple search on the coach field for Mr Stewart.

Complex Searches

Manufacturer	Item	Colour	Available	Price
Spingfast	Phones	Blue	Yes	£112
Alcafuz	Tablets	Black	Yes	£156
Mac Prods	Consoles	Pink	No	£342
iFuture	Phones	Green	No	£444
Stewson	Smart Watch	Black	Yes	£522

A complex search is when you **search on more than one field**.

EXAMPLE QUESTION:
How could you find out what manufacturer sells phones for under £150?

EXAMPLE ANSWER:
Do a complex search on the item field for phones AND on the price field for <
£150

Multiple Table Query Example

Dog Walkers is a company that walks dogs when their owners are at work. The company has a database to store details of the dogs, their owners and the walkers. The data is stored in the following tables.

Dog	Owner	Walk	Walker
<u>Dog ID</u>	<u>Owner ID</u>	<u>Walk ID*</u>	<u>Walker ID</u>
Dog name	Owner name	Dog ID*	Walker name
Dog type	Owner address	Walker ID*	Walker phone number
Gender	Owner phone	No. Of days per week	
Walks well with others		Cost	
Photo			
Owner ID*			

Perform a query to find the following information. All of the dogs called "Olly", dog type and gender, the walker name and walker phone number?

Create a query with the following fields.
- Dog.dog name and criteria = "Olly"
- Dog.dog type
- Dog.gender
- Walker.walker name
- Walker.walker phone number

The above solution shows you **how to set out an answer in an exam** if you are asked to explain how a query was performed.

Dog.dog name and criteria = "Olly"

Table name   Field name   Search criteria
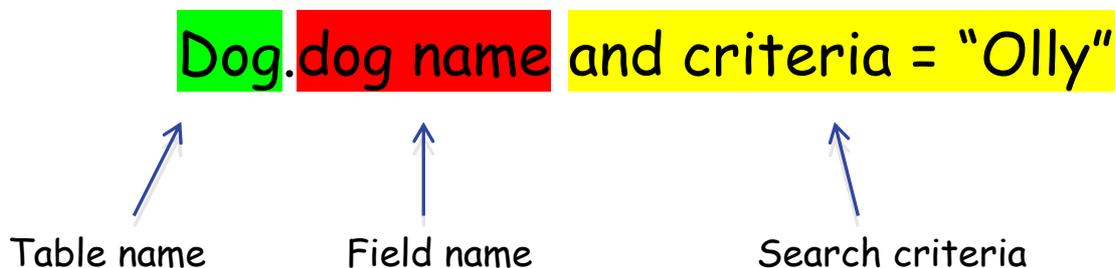
Database Reports

Reports are what you **use to summarise and present data in the tables.**

A report usually answers a specific question, such as "How much money did we receive from each customer this year?" or "What cities are our customers located in?"

Each report can be **formatted to present the information in the most readable way possible.** Reports can be printed from the database to **view information quickly and easily**.

Employees Report 🔍

First Name	Last Name	Gender	Birth Date
Nancy	Davolio	F	08-Dec-1968
Andrew	Fuller	M	19-Feb-1952
Janet	Leverling	F	30-Aug-1963
Margaret	Peacock	F	19-Sep-1958
Steven	Buchanan	M	04-Mar-1955
Michael	Suyama	M	02-Jul-1963
Robert	King	M	29-May-1960
Laura	Callahan	F	09-Jan-1958
Anne	Dodsworth	F	02-Jul-1969
Male Employees:		4	
Female Employees:		5	

Database Driven Website

A database driven website is a **web page that grabs information from a database** (the web page is connected to the database by programming) and inserts that information into the web page each time it is loaded.

If the information stored in the database changes, **the web page connected to the database will also change accordingly (and automatically) without human intervention.**

This is commonly seen on online banking sites where you can log in (by entering your user name and password) and check out your bank account balance. Your bank account information is stored in a database and has been connected to the web page with programming thus enabling you to see your banking information.

Database driven sites can be built using several competing technologies, each with it's own advantages. Some of those technologies/tools include:

- PHP
- JSP
- ASP
- PERL
- Cold Fusion

RELEVANT DATA IS ADDED TO THE WEBSITE DATABASE

THE DATA IS STORED AND ACCESSED BY THE WEBSITE USER

www.TeachComp.co.uk

Amazon - Database Driven Website Example

Below is a screenshot from Amazon. A user called Stephen has logged in to their account. The sections highlighted in blue contain information that is held in a database. For example the users first name is used, in this case "Stephen", to create a more personalised experience whilst browsing Amazon.

At the bottom is a large section highlighted showing the user certain products that may be of interest to them. These suggested products of interest are based on what the user has searched for or bought from Amazon before. **All of the searches and pages viewed will be stored in a database and will be analysed to build up a picture of what products may be more of an interest to you**. This creates a dynamic experience on Amazon that **every time you log in and view more items it will suggest different products** that you may be interested in purchasing.

HTML Web Design

This is short for **Hyper Text Markup Language**.

HTML is a coding language that was developed in order to lay out (markup) web pages. **HTML is made up of a series of 'tags' that tell the Web browser how to display the text and images on a web page**.

Below is a simple webpage created in HTML.

```
<!DOCTYPE html>
<HTML>
  <HEAD>
    <TITLE>My first web page</TITLE>
  </HEAD>
  <BODY>
    <P>Hello world!</p>
  </BODY>
</HTML>
```

CSS - Cascading Style Sheets

Cascading Style Sheets (CSS) was developed to **allow the designer to define the way a web page is formatted**, for example there are CSS commands for the **colour and size of text, the positions of images and the width of text** blocks.

CSS are stored in a separate file to the web page or the commands may be part of the web page file itself.

HTML, CSS & JavaScript

HTML, CSS & JavaScript all form the building blocks for most websites. If a website were a person, you could think of:

| **HTML as the structure/skeleton**	**CSS as the presentation/clothin**	**JavaScript as the action/movement**

HTML, CSS & JavaScript example

The below example shows how HTML, CSS and JavaScript work together to create a website.

HTML is used to write text

CSS is used to choose the font and color
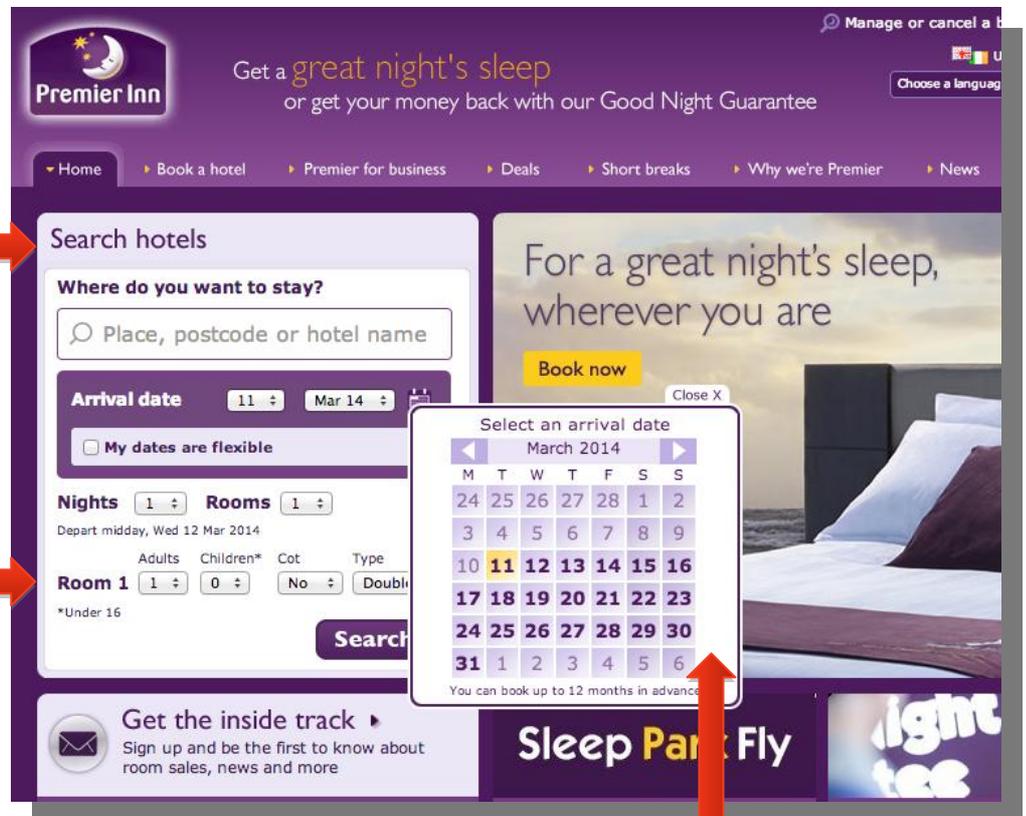
JavaScript allow a calendar to appear when clicked

Activity – HTML & CSS

You are going to learn how to use HTML & CSS. These languages used together can create websites.

Use CodeAcademy to work your way through tutorials on HTML & CSS.

Go onto www.codecademy.com and choose HTML & CSS.

HTML Page Structure

Head

The <head> and </head> tags identify the document's head area. **The information between these two tags is not visible on your page**. This element must include a title for the document, and can include scripts, styles, Meta information, and more.

Title

The title element creates the **page title that is seen in the title bar of the web page**.
The <title> element:

- Defines a title in the browser toolbar
- Provides a title for the page when it is added to favourites
- Displays a title for the page in search-engine results

In the above picture you see the title for each webpage. For example Apples website would have <title> Apple </title>

Body

The <body> element **contains all the contents of an HTML document**, such as text, hyperlinks, images, tables, lists, etc.

```
<HTML>
    <HEAD>
        <TITLE></TITLE>
    </HEAD>

    <BODY>


    </BODY>
</HTML>
```

Meta Tags

Meta Tags are common in web page code. They communicate information to the browser and some search engines. You can use the HTML **Meta tags to specify information about the web document**. Meta tags are not visible in the normal browser view.

Meta elements are typically used to specify page description, keywords, author of the document, last modified, and other metadata.

Below is an example of meta tags being used. In this example they are describing a construction business called DMD Construction based in Fort William.

```
<head>
<meta name="description" content="DMD Construction">
<meta name="keywords" content="Fort William, Construction, Builder, DMD">
<meta name="author" content="John Smith">
<meta charset="UTF-8">
</head>
```

Nevis Range is a snow sport resort. Below is the Meta tag information from it.

```
<title>Nevis Range Mountain Resort, Near Fort William, Scotland | Mountain Viewpoints, Gondola Rides, Mountain Biking and Winter Snowsports</title>

<meta name="keywords" content="Skiing, Snowboarding, Mountain Resort, Scotland, Nevis Range, Climbing, Fort William, Aonach Mor, Gondola, Mountain Biking, Downhill, World Cup, Scottish Highlands, Ski-ing" />

<meta name="description" content=" Nevis Range is a year round mountain ski resort in the The Highlands of Scotland near Ben Nevis and Fort William. Skiing and snowboarding in winter sightseeing and gondola rides in summer with spectacular views. Mountain biking and world cup events" />
```

Request Website
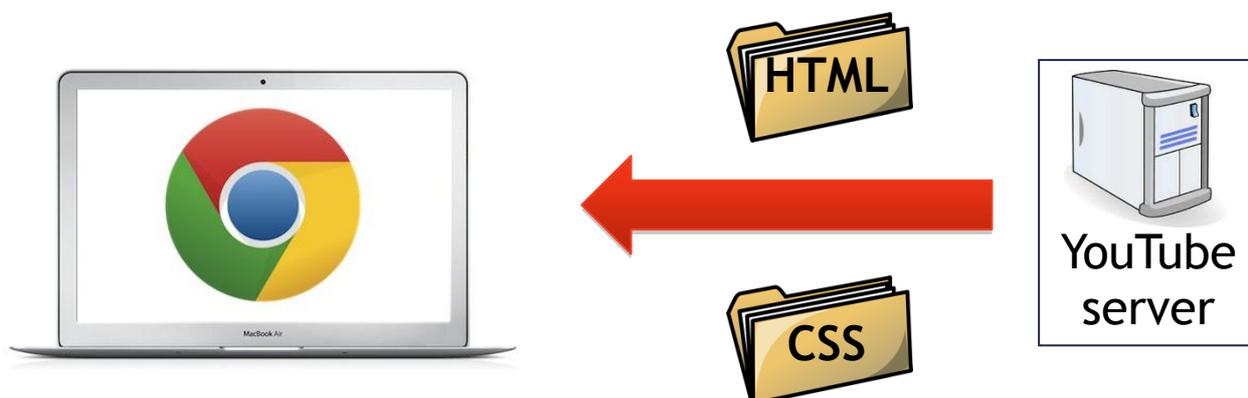
Above is a diagram showing that when you **request a YouTube page two files are sent, the HTML and the CSS**.

If you were to receive just the HTML files, you would see a simple version of the site

If you received both HTML and CSS, you would see the full website
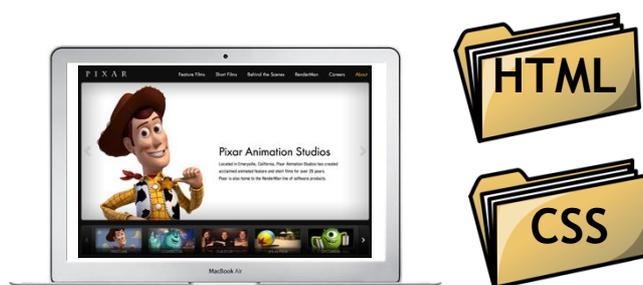
If you only received the CSS files, you would not see the website at all. You cannot add style to a page that has no structure.

Separate HTML & CSS

There are three main reasons why do we separate HTML and CSS files.

Saves time by reusing code

Most websites have more than one page and want to **keep a consistent theme across all pages so developers often reuse CSS code**. This way they can share layouts, font sizes, background colours and other elements.

Below is a screenshot of YouTube, you will notice CSS has been reused to style the pages so there is a consistent theme across the website.
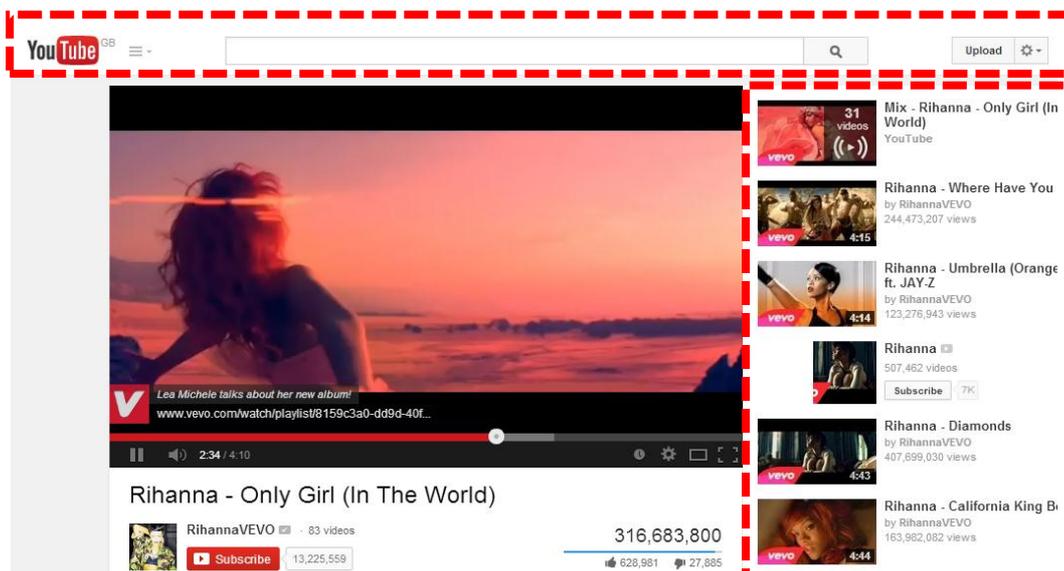
Find errors quicker

If you make an error on a website then you will need to find and fix the mistakes. As a web designer you want to be able to **find the mistakes and sort them as quick as possible** so it's important that the code is easy to read and review.

If the HTML and CSS files were combined this would result in bloated code. **Bloated code is harder to spot mistakes**, as it is harder to read.

HTML mixed with CSS

```
<html>
<head>
    <style type="text/css">
        body {text-align: center;}
    </style>
</head>
<body>
    <p style="color: green;">
        Don't bloat code!
    </p>
</body>
</html>
```

This is bloated code

HTML only

```
<html>
<head>
</head>
<body>
    <p>Don't bloat code!</p>
</body>
</html>
```

CSS only

```
body {
    text-align: center;
    p {color: green;}
}
```

More organised

If the CSS and HTML files are separated then **different teams can work on separate sections**. For example one team could focus on changing the CSS styling and another could work on the HTML structure.

Cascading Style Sheets (CSS) Coding

Heading tags are an important part of any HTML document. Search engine spiders read HTML and understand the relevance of heading tags, so when heading tags are used appropriately search engines give more weight to text that is inside a heading tag.

To be able to **edit the text style on an entire website you would edit the heading styles in the CSS file.**

H1 Heading
H2 Heading
H3 Heading
H4 Heading
H5 Heading
H6 Heading

Below is a diagram showing the HTML file with a <h1> tag around it. This tag would be assigned a style from the CSS file. You can see the styling that the h1 tag has been given from the CSS block of code.

```
<body>
<h1>This is heading 1</h1>
</body>
```
HTML

```
<style>
h1 {
font-family : Ariel;
font-size : 30px;
color : green;
font-weight : bold
}
</style>
```
CSS

This is heading 1
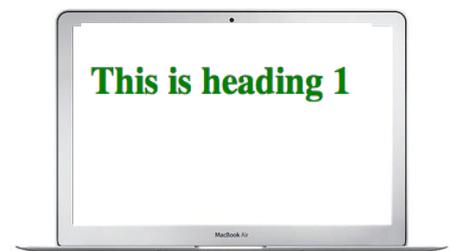
Web Page

CSS Code

If you wanted to change the styling of the text you would edit the CSS code. To the right is some CSS code for a h1 heading. The **areas highlighted in green are changeable**.

- Font-family: will let you decide what font you would like (Ariel, Tahoma, Verdana)
- Font-size: will let you change the size of the font
- Color: this will let you change the colour of the text. **Colour is spelt in the American form**.
- Font-weight: this will let you change the thickness of the text. For example it could be bold, normal or a number.

```
h1 {
font-family : Ariel;
font-size : 30px;
color : green;
font-weight : bold
}
```

Static v Dynamic Websites

Static Website

A web site, or individual web page, can be static or dynamic. A static website contains **information that does not change**. It remains the same, or static, for every viewer of the site. If the user were to reload a static website, they would **see the exact same content every time**. Static websites can only really be updated by someone with a knowledge of website development. **Static websites are the cheapest to develop and host**, and many smaller companies still use these to get a web presence.

Static Website

Dynamic Website
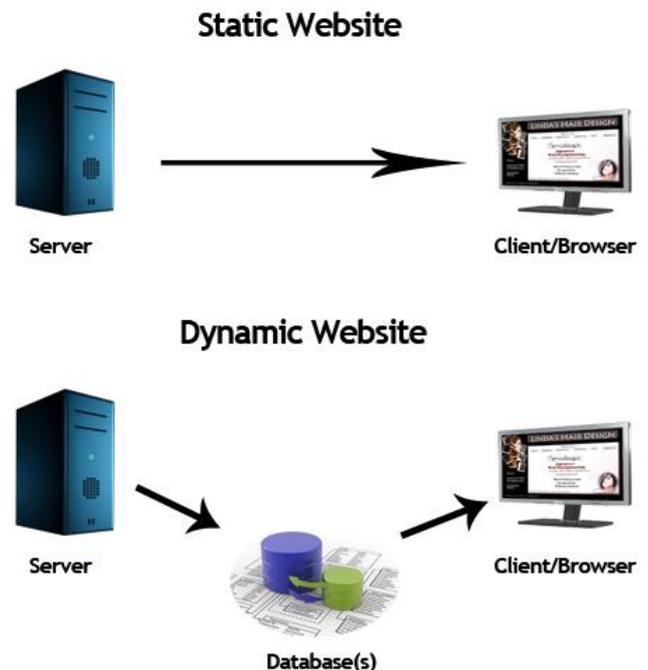
Advantages of Static Websites	Disadvantages of Static Websites
• Quick to develop • Cheap to develop • Cheap to host	• Requires web development expertise to update site • Site not as useful for the user • Content can get stagnant

Dynamic Website

A dynamic website **contains information that changes**, depending on the viewer of the site, the time of the day, the time zone, the native language of the country the viewer is in or many other factors. Dynamic sites on the other hand can be more **expensive to develop initially**, but the advantages are numerous. At a basic level, a dynamic website can give the website owner the ability to simply update and add new content to the site. For example, news and events could be posted to the site through a simple browser interface.

Advantages of Dynamic Websites	Disadvantages of Dynamic Websites
• Much more functional website • Much easier to update • New content brings people back to the site and helps in the search engines	• Slower / more expensive to develop • Hosting costs a little more

Interactive Websites

An interactive website **allows the user or visitor to participate and edit the content on it**. A good interactive website is defined by its ability to **engage the user in an immersive experience** that delivers satisfaction. These web pages are created by **integrating JavaScript** in their coding or by embedding flash content into the website.

Some of the websites below are designed to give you information in a more interactive and engaging manner. Try out some of them.

Every Last Drop	http://www.everylastdrop.co.uk/
Hello Sour Sally	http://www.hellosoursally.com/
Quake Quiz	http://www.quakequizsf.org/
Pop Bubble Wrap	http://www.virtual-bubblewrap.com/popnow.shtml
I Could Not Stop	http://www.dhteumeuleu.com/i-could-not-stop
String Spin	http://www.zefrank.com/memory/stringspin/spin_1.html
Elastic Enthusiastic	http://www.angeloplessas.com/elasticenthusiastic/

Navigation

Linear

Think of a PowerPoint slideshow. Each slide is linked in order. They show one after the other. This is called **linear linkage**.

Slide 1	→	Slide 2	→	Slide 3	→	Slide 4	→	Slide 5

Hierarchical

This type of navigation is used in many websites. The pages are **organised in a tree-like structure** where the presentation has branched paths.

The user starts at page one. Once the user has **chosen a path to follow**, movement through the following pages follows a 'pre-determined route'. **They cannot deviate from their path** nor can they 'jump' to another section.
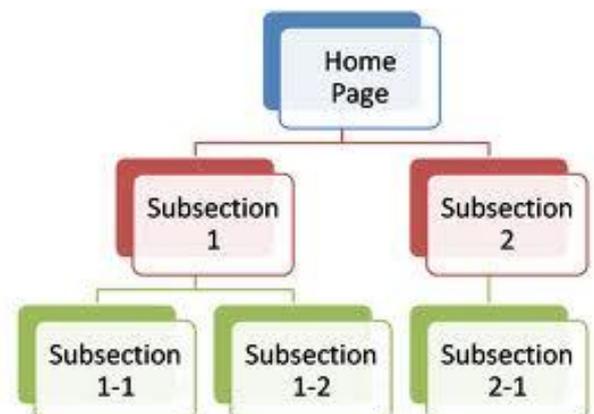
Multi-Level Navigation
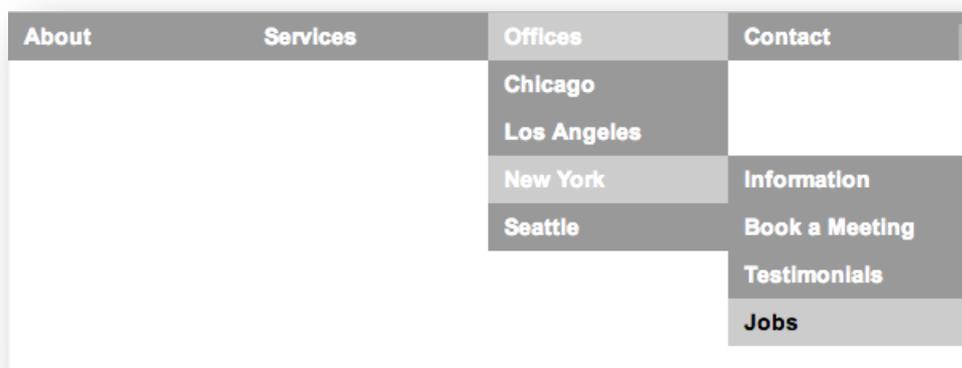
Multi-level navigation allows you to have multi-level functionality with **different pages nested into sub sections**. This keeps the **website structure tidy and organised**. This can be very useful for **websites with lots of content**.

Below is a screenshot of the Adidas website. The user has highlighted the dropdown section "woman". This has then shown the multilevel navigation structure below it.
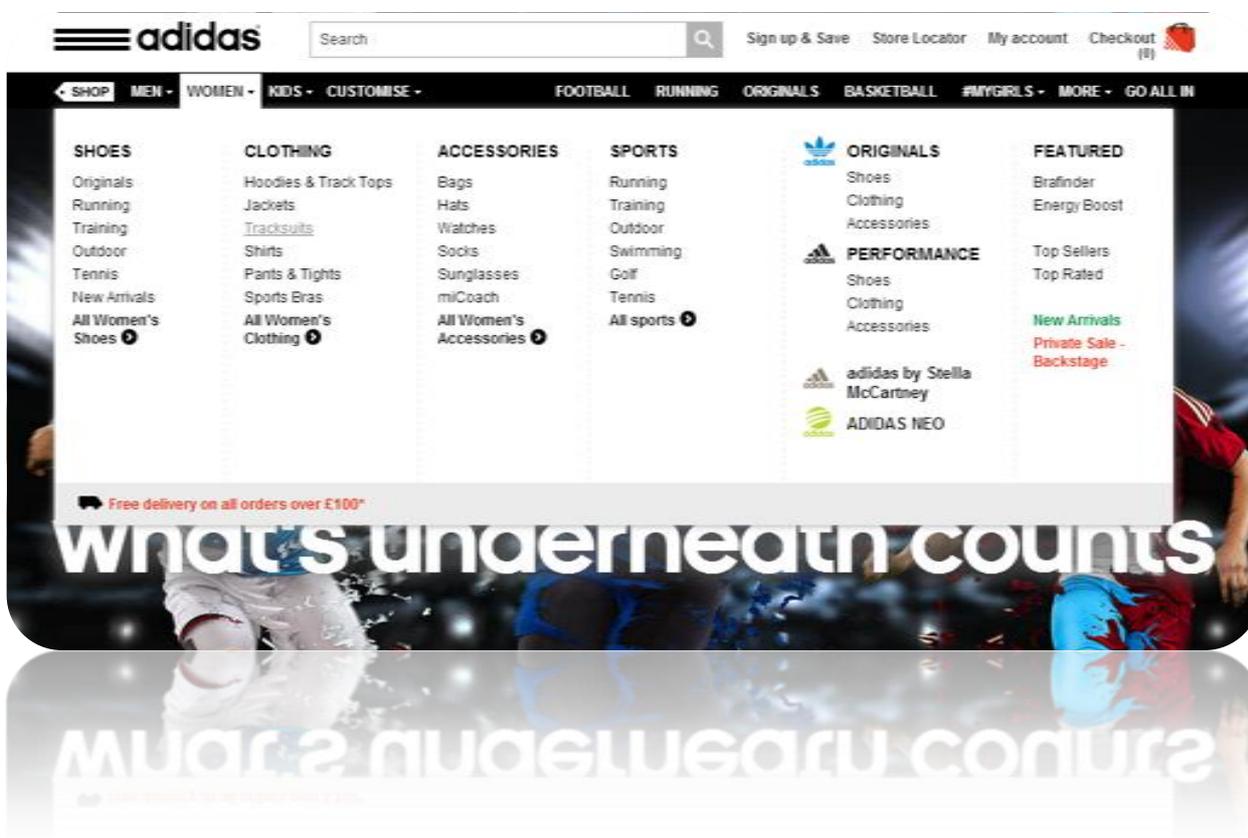
User Interface
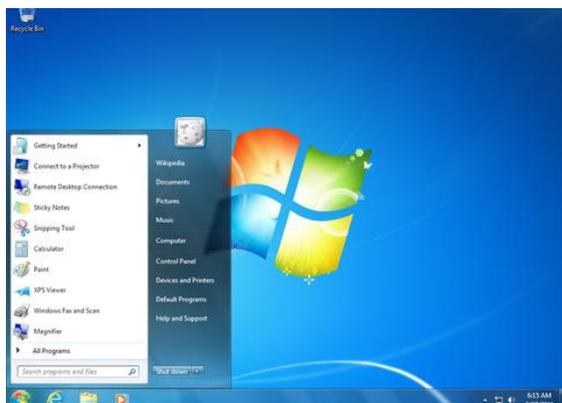
The user interface is the space where **interaction between humans and machines occurs**. In the above picture you will see two different interfaces, Windows 7 and Windows 8, these are very different.

Windows 7 has been designed for to be used with a mouse and a keyboard whereas Windows 8 has been with large icons called live tiles which let you see information at a glance and is designed for ease of use by using touch, although it still can also be used with a mouse and keyboard.

www.TeachComp.co.uk
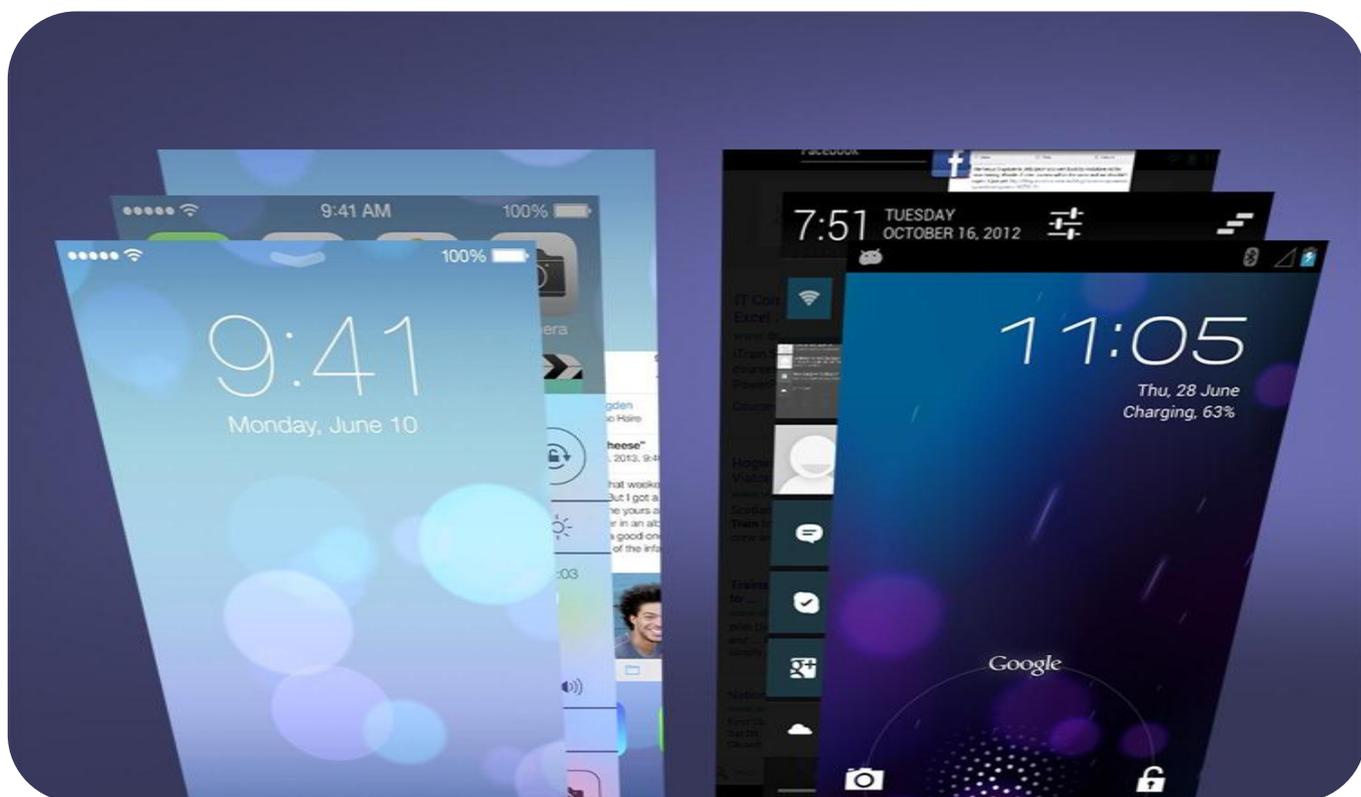
User Interface Usability

Usability is the **ease of use and learnability of a human-made object**. In this example you are looking at the usability of an information system.

The headings below are what you need to be able to comment on when judging the usability of a website or piece of software.

Fit for Purpose
Does the software do all the things it is supposed to do? This involves going back and checking that all of the features the customer wanted have been implemented.

Robust
The program should be **able to cope with errors** when the website is running and not crash.

Efficient
The website should be able to **solve the problem or do the job** without using too much memory, processing time and/or bandwidth.

Maintainable
The website should be able to **have alterations made at a later date** easily.
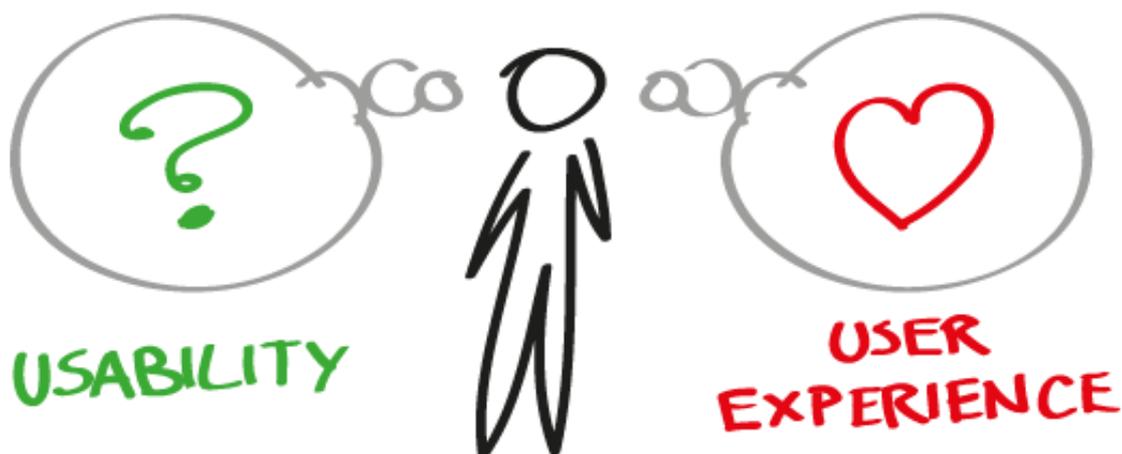
Users

Users are the **people who interact with the information system**. Users can be divided up on how competent they are.

Expert User

These types of users are **very experienced** in using the system. They are more likely to **use the more advanced features** and will explore the system and try new things. These types of user sometimes also have **more customisation options**.

Novice User

These types of user are **new to the system** and will need to have a simple interface so they can learn how to do tasks. These users are **more likely to use wizards** to be able to perform common tasks.

A software wizard or setup assistant is a user interface type that presents a user with a **sequence of dialog boxes that lead the user through a series of well-defined steps**. Tasks that are complex, infrequently performed or unfamiliar may be easier to perform using a wizard.

Age Range

When creating an information system or piece of software it is important to think about the **age range of people that will use it**. For example you may have more graphical and **interactive content for younger users**. For **older users you may have some accessibility features** such as larger fonts available.
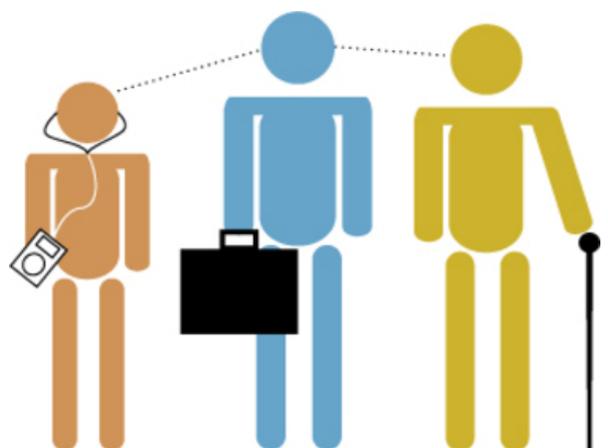
Information System Purpose

The definition of purpose is, the **reason for which something exists**. You will have to analyse an information system and decide on its purpose. You would of done this at National 5. At Higher level you need to **explain the purpose of an information system in more depth**.

For example below is a screenshot of BBC iPlayer.
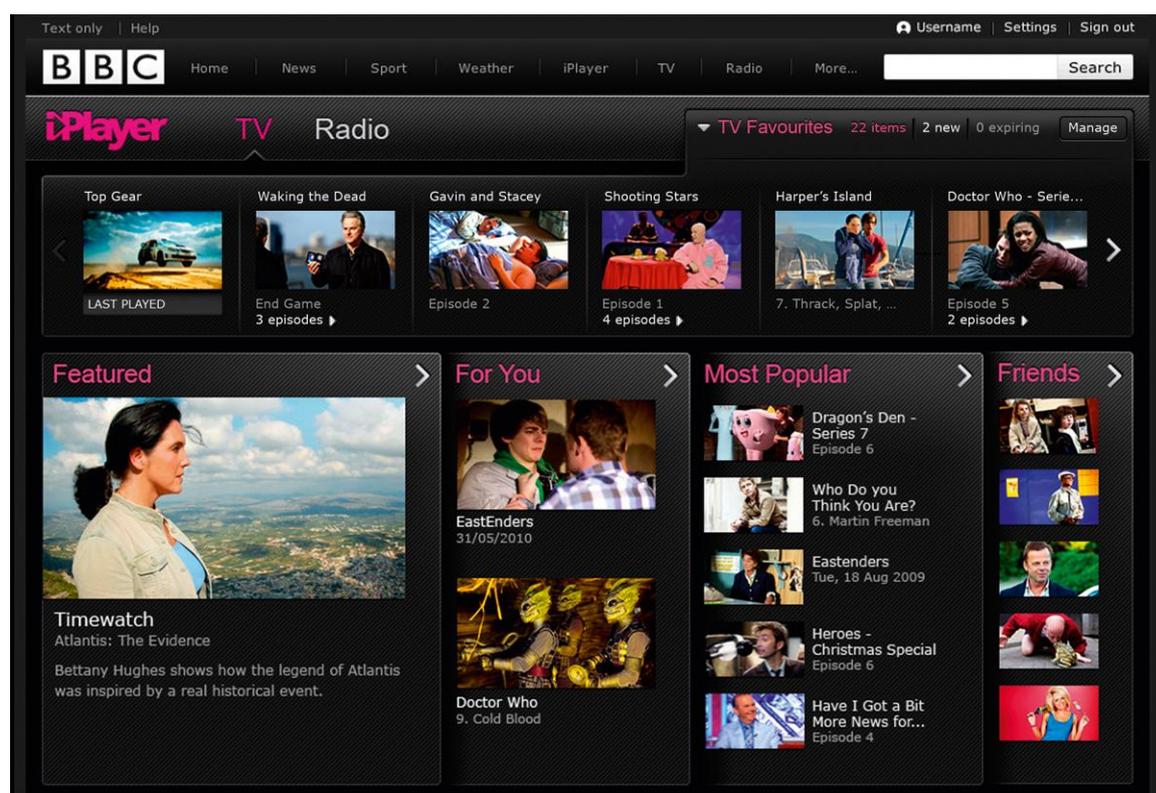
The purpose of BBC iPlayer is to let you have access to TV and radio shows on demand when it is most convenient to you.

Here is another example on Google Earth.

The purpose of Google Earth is to let users be able to explore the world and see areas from above or even at street view level. Google Earth also helps people with navigation.

Page 34

Target Audience

When developing a website, the developer must consider **who the website is intended for** – i.e. the **target audience**

- Consider the type of users – expert, novice, age-range, class e.g. Business person
- Different media types that could be used
- Balance of media types
- Different navigation features
- Accessibility – different colours/text size/audio

Below is a screenshot of a children's website called CBeebies. This website has a target audience of children aged roughly between two and ten. The use of audio to read aloud words and the colourful simple layout have all been considered to make the website usable by its target audience.

Visual Layout

A user interface should have well designed visual layout that makes it **easy for a user to locate what they require**.

- Pages should look **appealing** to all users
- Avoid information **overload**
- Ensure a **balance** between graphics and text
- **Accessibility** features
- Target audience
- Clutter
- Use of colour/White space

Interactivity

When the user interacts with a page, what **changes might happen** in response **to** the user other than navigation?

- Level of difficulty
- Information on particular topic
- Audio
- Dialogue e.g. Error reporting

To the right is a car racing game that requires the user to interact with it.

When a user plays the game they are responding to events. This is a good example of interactivity.

Navigation

Consideration must be given to how the user will **navigate** the information system.

- Browser buttons – back, forward, home
- Hyperlinks – blue and underlined, hover over and pointer changes to a hand
- Hotspot - hover over and pointer changes to a hand, action is invoked
- Pop-up menu
- Search feature

Below is a screenshot of Nevis Range, a snow sports resort in the Highlands. When users visit a website they are looking for something specific. In this example it might be snow conditions or prices. The **navigation of the website should stand out and be simple and easy to use**.
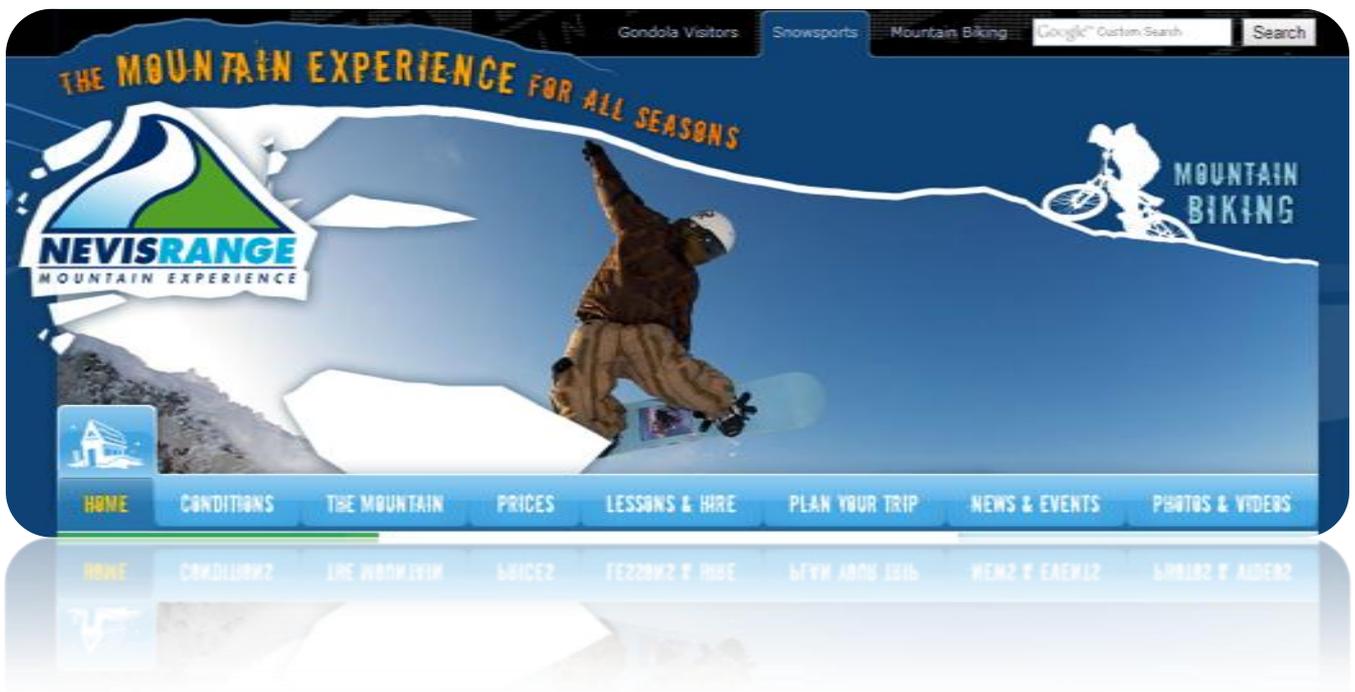
Selection

Consideration must be given to **how the user will interact** with and make choices within the information system.

- Menu selection
- Form fill
- Radio button
- Hotspot

Selection also includes drop down menus. Look at the screenshot below, you will see the user has clicked on "Clothing" and a dropdown menu has appeared.
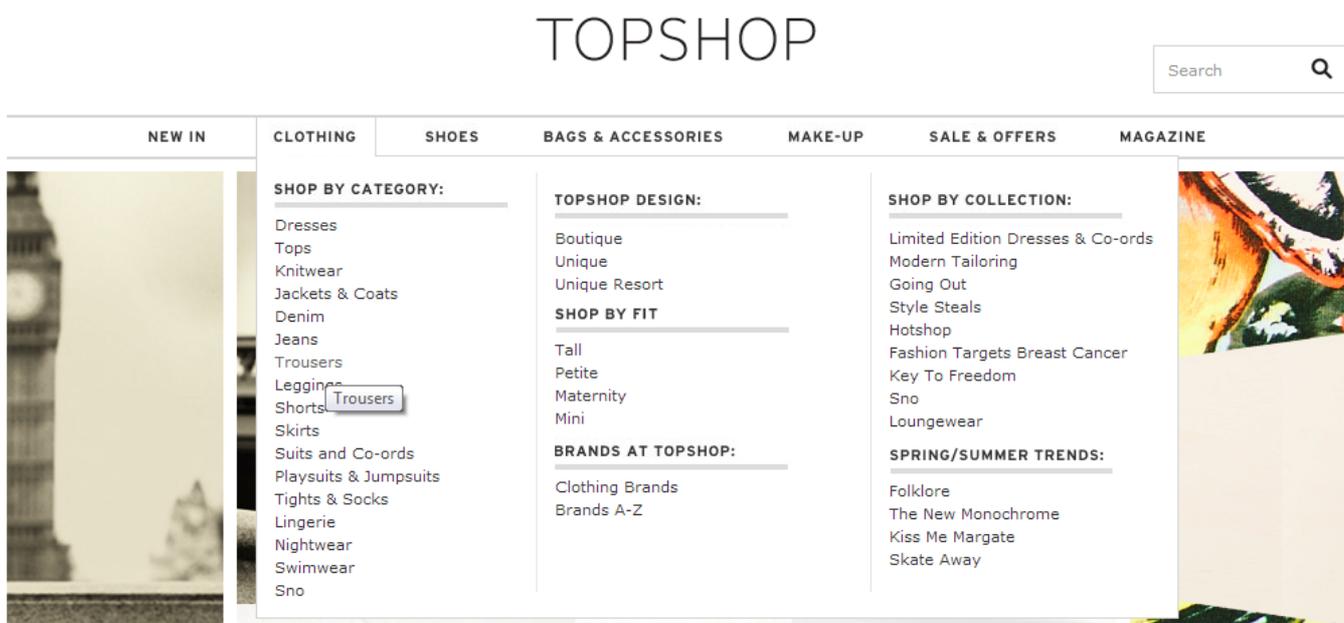
Readability

Readability is the ease in which text can be read and understood.

- Is it **easy to pick out the required information**?

Consistency

Pages should have a **consistent appearance** throughout the information system

- Text style, font, colour
- Use of colour
- Page balance
- Navigation features

Below are two screenshots of YouTube. The layout of the website is consistent; the only things that change are the sections highlighted in the red boxes. This **consistency helps the user understand the information system and be able to use it with ease**.
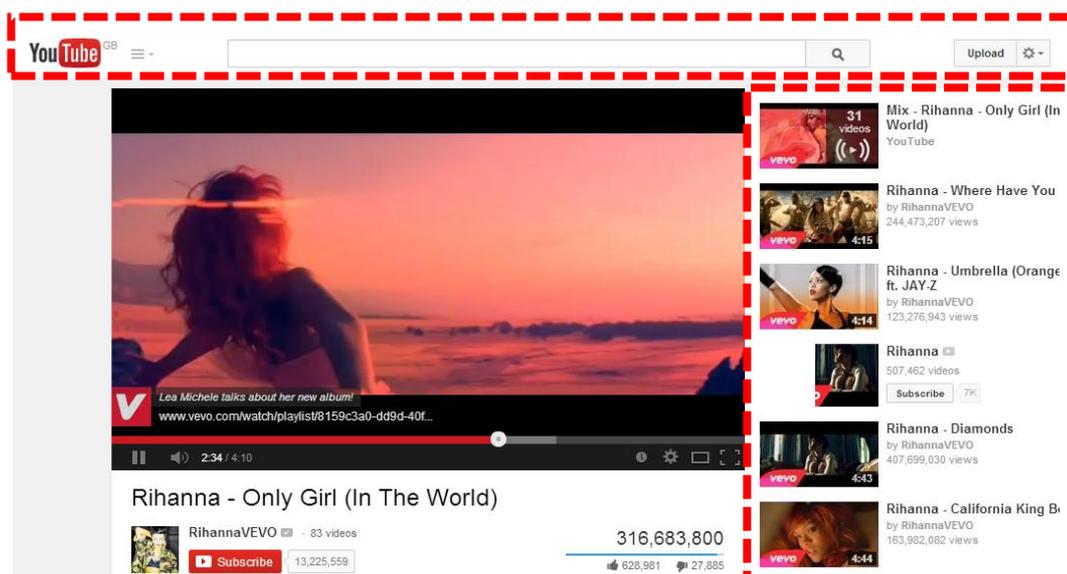
Accessibility

Web accessibility refers to the **inclusive practice of making websites usable by people of all abilities and disabilities**. When sites are correctly designed, developed and edited, all users can have equal access to information and functionality.

Some accessibility issues to think about:

- When **text and images are large** and/or enlargeable, it is easier for **users with poor sight** to read and understand the content.
- When **links are underlined** (or otherwise differentiated) as well as coloured, this ensures that colour-blind users will be able to notice them.
- When **clickable links and areas are large**, this helps users who cannot control a mouse with precision.
- When pages are coded so that users can **navigate by means of the keyboard alone**, or a single switch access device alone, this helps users who cannot use a mouse or even a standard keyboard.
- When **videos are closed captioned (subtitles) or a sign language version** is available, deaf and hard-of-hearing users can understand the video.
- When **flashing effects are avoided or made optional**, users prone to seizures caused by these effects are not put at risk.
- When content is written in plain language and **illustrated with instructional diagrams and animations**, users with dyslexia and learning difficulties are better able to understand the content.

Alt Image Tags

Images need alternative, or ALT, text assigned to them. This is because screen readers can't understand images, but rather **read aloud the alternative text** assigned to them. In Internet Explorer we can see the ALT text, simply by hovering your mouse over an image and looking at the yellow tooltip that appears.

The HTML for inserting ALT text is:
<img src="ben_nevis.jpg" alt="Picture of Ben Nevis in the winter">

When alt text is provided, the **information is available to everyone**. To people who are blind, as well as to people who turned off images on their mobile phone to lower bandwidth charges, people in a rural area with low bandwidth who turned off images to speed download, and others. It's also **available to technologies that cannot see the image, such as search engines**.

Keyboard Input

Some people cannot use a mouse, including many older users with limited fine motor control. An accessible website does not rely on the mouse; it **provides all functionality via a keyboard**. Then people with disabilities can use assistive technologies that mimic the keyboard, such as speech input.

Transcript for Audio and Video

Just as images aren't available to people who can't see, audio files aren't available to people who can't hear. P**roviding a text transcript makes the audio information accessible** to people whom are deaf or hard of hearing, as well as to search engines and other technologies that can't hear.

YouTube allows users to t**urn on closed captions (subtitles) on videos** so they can understand the content.

User Interface Optimisation

Smartphone / Tablet Optimisation

When designing an information system it is important to think about how it will be **optimised to run on a different device such as a smartphone or tablet**. More and more people are using these devices to surf the web so it is important to make sure their experience is just as good as on a desktop or laptop computer.

Smartphones and tablets now take the view that you will load the standard version of a website unless it redirects you to a mobile version. Most likely your website will work on a smartphone or tablet without needing any significant changes.

Good design will make your website work on multiple devices. **CSS rules are created for different devices/screen widths**. This means that when you load a website on a certain device the **best optimised version for you will load**.

There are still technology issues for example:

- iPhones/iPads do not handle flash at all
- Some webpages have to be zoomed into and scroll around to be able to read the content because of screen size.
- Fancy effects like drop down menus tend not to work well
- Most images on your website are likely to be too large for the small screens as they are not shrunk by default

Putting these technology problems aside the smart mobile phones do an excellent job of browsing most websites. However the screen size (combined with the touch screen method of selecting links etc.) is the problem and **can make it impractical to use your site effectively on a mobile**.

Mobile Optimised Versions

Mobile optimised sites have become common with the growth of smartphones and tablets. When designing a **mobile optimised website here are some things to think about.**

- **Be brief** and to the point
- Keep it **easy to navigate** and quick to access material with minimal taps
- **Fast loading** (there are download speed issues such as no 3G/4G)
- **Easy to use on a small screen**
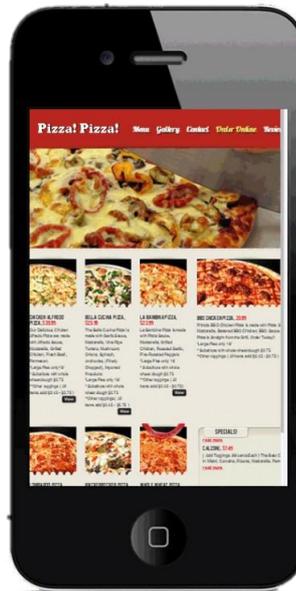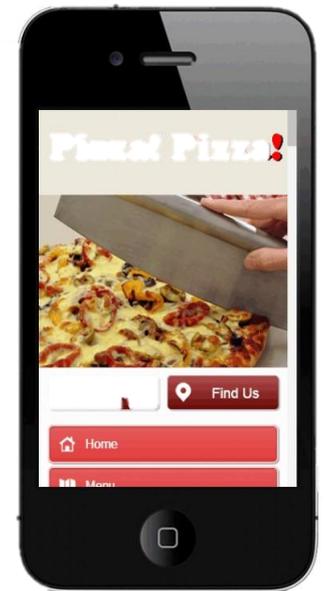
Standard   Mobile

Mobile browsers are unlikely to be looking for any in-depth material, or want to read much, or look at large pictures, or animations. So, if this is right we want a stripped down, no frills version of your site with only the briefest of content.

Load Time Optimisation

Users **expect a website to load quickly** so they can get on and do a specific job. Web pages need to **optimised for fast load times** to keep the user on your website. This is done in varies ways.

Below is an example of a websites source code.

Some optimisations that could be made for faster load times.

- Create a **CSS file to hold the CSS rules** so that less data is delivered with main page.
- **Merge the JavaScript files into one** and include file to reduce fetches from the server.
- **Merge the images into one image** and use CSS rules to display only the relevant area of the image. This reduces the number of fetches from server.
- **Webpages can be compressed into a smaller file size** on the server. When the browser received the file then it will be uncompressed and displayed.

```
<body>
<script src="http://home.com/js/jquery.js"></script>
<script src="http://home.com/js/jquery.once.js"></script>
<script src="http://home.com/js/drupal.js"></script>
<script <src="http://home.com/js/panels.js"></script>
<style>
.center_div
{
border:1px solid gray;
margin-left:auto;
margin-right:auto;
width:90%;
background-color:#d0f0f6;
text-align:left;
padding:8px;
}
</style>
<img src="boat1.gif" alt="Big Boat">
<img src="logo.gif" alt="logo">
<img src="boat2.gif" alt="Big Boat2">
<img src="welcome.gif" alt="Welcome Message">
</body>
```

Wire Framing

A wireframe is a **visual guide that portrays how a page or screen of a website or system may look.** Wireframes can range from very unfinished and 'sketchy' in appearance, to very polished looking and reflective of how the system will look at 100% completion.
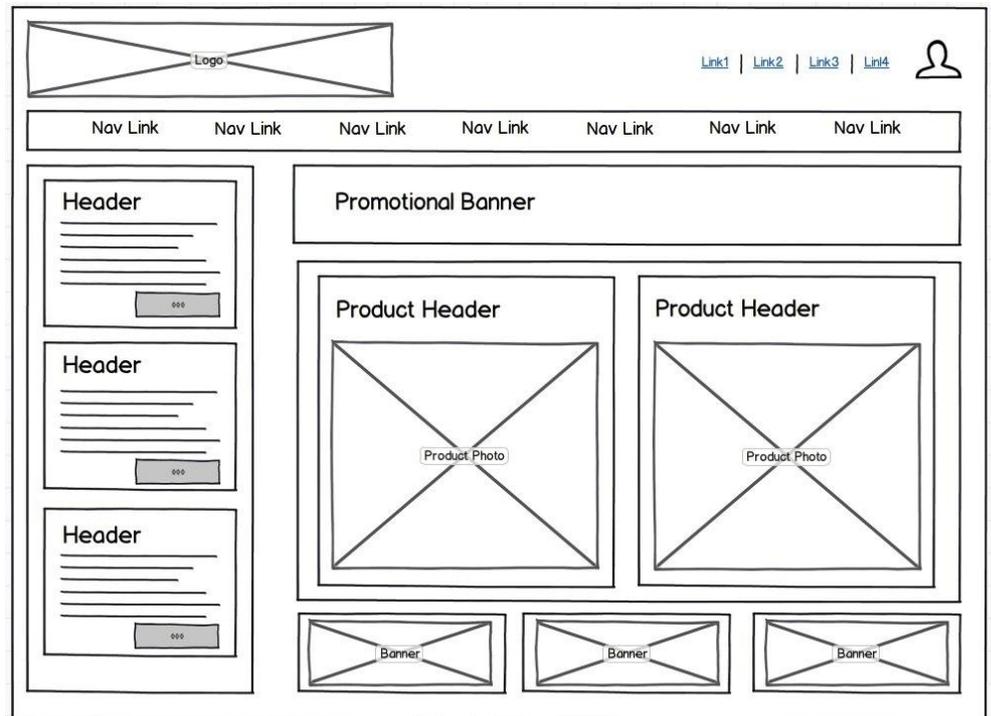
Using wireframes can help determine:

- **The layout/presentation of content**
  - o The wireframe will help determine the **placement of objects on the page**. This will make involve thinking about the **priority of certain objects** so the user can access the content quickly. For example if the page has an important video then priorities this above the text.
- **Navigational structure**
  - o This will determine the relationships between the links and **what navigation structure will be used**. Will it have a navigational sidebar or will it use global links visible on all pages?
- **Interface design**
  - o This will determine **what hardware is needed to communicate with the page**. For example will it be a mobile or desktop website.

Wireframes can also be very useful in communicating the specification of a system or website to a client.

Compression

Compression means to **reduce the size of a data file** for example a document, video, image, sound file etc.

It is a good idea to **compress large files because they can take up a lot of storage space** on your hard disk. They will also take a long time to send as an attachment by email. Compressed files can be downloaded from the Internet quicker.

Lossy Compression

Lossy compression techniques compress data with a **certain amount of visual loss when restored**.

Audio, video and some imaging applications can tolerate loss, and in many cases, it may **not be noticeable to the human ear or eye**. In other cases, it may be noticeable, but not that critical to the application. The more tolerance for loss, the smaller the file can be compressed, and the faster the file can be transmitted over a network. Examples of lossy file formats are MP3, AAC, MPEG and JPEG.

Lossy compression is **never used for business data and text**, which demand a perfect 100% restoration.

Lossless Compression

Lossless compression is a technique that decompresses data **back to its original form without any loss**. The decompressed file and the original are identical. **All compression methods used to compress text, databases and other business data are lossless**. For example, the ZIP archiving technology is the most widely used lossless method.

Lossless Compression
- WAV
- PNG
- Text

Lossy Compression
- MP3
- JPEG
- MP4

Lossless Compression

Original	→	Compressed	→	Restored

Lossy Compression

Original	→	Compressed	→	Partially Restored

Audio Compression

MP3 audio files are compressed using a technique called perceptual noise shaping. It's "perceptual" partly because the MP3 format uses characteristics of the human ear to design the compression algorithm.

For example:

- There are **certain sounds that the human ear cannot hear**.
- There are certain sounds that the human ear hears much better than others.
- If there are two sounds playing simultaneously, we hear the louder one but cannot hear the softer one.

Using facts like these, **certain parts of a song can be eliminated** without significantly hurting the quality of the song for the listener. Compressing the rest of the song with well-known compression techniques shrinks the song considerably -- by a factor of 10 at least. When you're done creating an MP3 file, what you have is a "near-CD-quality" song. The MP3 version of the song does not sound exactly the same as the original CD song because some of it has been removed.

Video Compression

A video is compressed frame by frame removing some data that will not affect the picture too much. Some compression techniques will look at an individual frame and the compare it to the next frame. The difference between the frames will be kept and the rest of the content in the frame that has not changed will not be saved again.

In the below video example you will notice that the cow moves to the right however the background does not change. When compression this video using a lossy compression technique the movement of the cow (the difference between the frames) will be kept and the rest of the content (the background) will be re-used.

In areas of video with more motion, the compression must encode more data to keep up with the larger number of pixels that are changing. Commonly during explosions, flames, flocks of animals, and in some panning shots, the high-frequency detail leads to a decrease in video quality.

Graphic Compression

Graphics such as JPEGs are compressed by grouping colours of a similar shade into the same colour. When this is done you lose some of the detail. This is why it is called lossy compression. Look at the picture below, you will notice that as the quality goes down the detail in the yellow goes down and becomes pixelated. You will also notice the detail in the goggles becomes pixelated.

Page 48
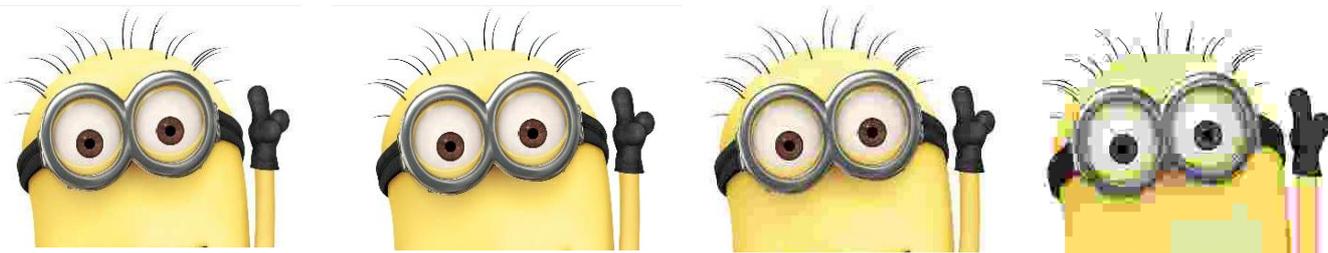
Client Side Scripting

Client side scripts **run on the client side** of a client-server system. For example, on the World Wide Web, **JavaScript scripts are client-side because they are executed by your browser (the client).** This type of computer programming is an important part of the dynamic website concept, enabling web pages to be scripted; that is, to **have different and changing content depending on user input**, environmental conditions (such as the time of day), or other variables.

Web authors write client-side scripts in languages such as **JavaScript**.

How does it work?

Client-side scripts are often **embedded within an HTML document** (hence known as an "embedded script"), but they may also be **contained in a separate file**, which is referenced by the document that uses it. Upon request, the necessary files are sent to the user's computer by the web server on which they are stored. The user's **web browser executes the script and then displays the document, including any visible output from the script**. Client-side scripts may also contain instructions for the browser to follow in response to certain user actions, (e.g., clicking a button). Often, these instructions can be followed without further communication with the server.

Due to security restrictions, client-side scripts may not be allowed to access the user's computer beyond the web browser application.

Activity - Learn JavaScript

You are going to learn how to use JavaScript. This is an example of a client side scripting language.

Use CodeAcademy to work your way through tutorials on JavaScript.

Go onto www.codecademy.com and choose JavaScript.
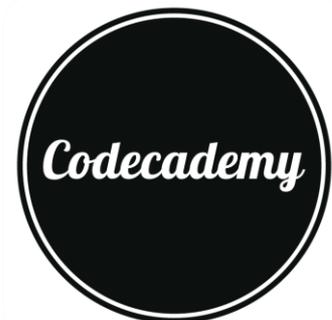
Server Side Scripting
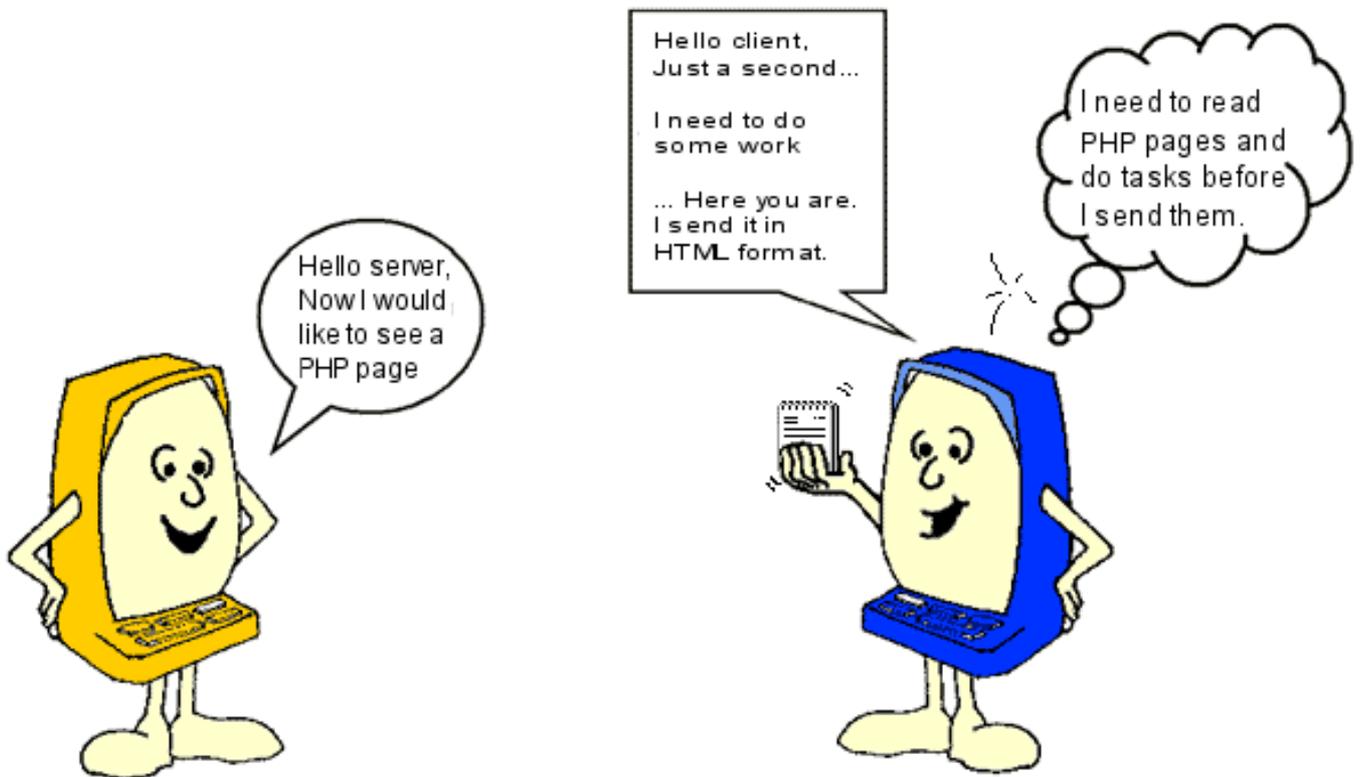
Server-side scripting is a web server technology in which a **user's request is fulfilled by running a script directly on the web server to generate dynamic web pages.** They produce output in a format understandable by web browsers (usually HTML), which is then sent to the user's computer. Some examples of server side scripting languages include **PHP,** Perl and ASP.

Server-side scripting is usually used to provide an interface and to limit client access to proprietary databases or other data sources. This is different from client-side scripting where scripts are run by the viewing web browser, usually in JavaScript. The primary advantage to server-side scripting is the **ability to highly customise the response** based on the user's requirements, access rights, or queries into data stores.

How does it work?

Server side scripts are completely **processed by the servers** instead of clients. When **clients request a page containing server side scripts then that server processes the scripts and returns an HTML page to the client**. For example, a PHP page is not processed by the browser; instead it is interpreted by the server which can process PHP scripts and return an HTML page to the client.

From security point of view, **server-side scripts are never visible to the browser** as these scripts are executes on the server and emit HTML corresponding to user's input to the page.

Below is a diagram explaining what happens when the user requests a login.php page.
- Page is requested from the web server.
- If the contains server side scripts then they are interpreted on the web server.
- A HTML page is then sent back to the client with requested content.
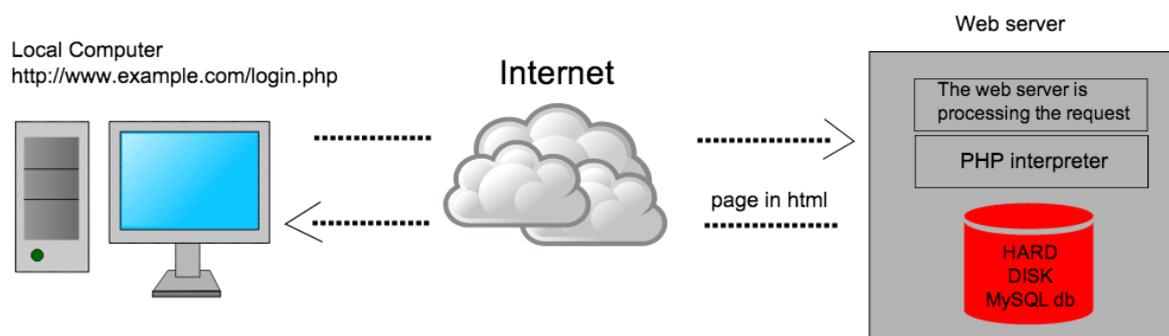
Activity – Learn PHP

You are going to learn how to use PHP. This is an example of a server side scripting language.

Use CodeAcademy to work your way through tutorials on PHP.

Go onto www.codecademy.com and choose PHP.

Web Browsers

A web browser is a software application that provides a way to **view and interact with pages on the World Wide Web**.

All browsers will have a back, forward and a refresh button. They let you view your history and save bookmarks for frequently visited websites.

There are many browsers available. The most popular ones are:
- Google Chrome
- Internet Explorer
- Mozilla Firefox
- Safari

Search Engines

A search engine is a **database on the World Wide Web that helps us to quickly and easily find web pages we want.**

The user **enters "key words" or phrases** on the subject that they are interested in. The search engine searches its database looking for references to the key words. It then **returns web pages with links to the relevant websites** it found.

The most popular or most visited websites are usually put near to the top of the results page.

Click here to find out more about how Google works.

Search Engine Optimisation (SEO)

Search engine optimisation is a methodology of strategies, techniques and tactics used to **increase the amount of visitors to a website by obtaining a high-ranking placement in the search results page** of a search engine such as Google, Bing, Yahoo and other search engines.

It is common practice for Internet users to not click through pages and pages of search results, so where a site ranks in a search is essential for directing more traffic toward the site. The higher a website naturally ranks in organic results of a search, the greater the chance that that site will be visited by a user.

Web Crawlers

Search engines crawl the Web to see what is there. This task is performed by a piece of software, called a crawler or a spider (or Googlebot, as is the case with Google).

Spiders **follow links from one page to another and index everything they find on their way.** Having in mind the number of pages on the Web (over 20 billion), it is impossible for a spider to visit a site daily just to see if a new page has appeared or if an existing page has been modified, sometimes crawlers may not end up visiting your site for a month or two.

After a page is crawled, the next step is to index its content. The **indexed page is stored in a giant database, from where it can later be retrieved**. Essentially, the process of indexing is **identifying the words and expressions that best describe the page** and assigning the page to particular keywords.

Crawlers are not humans and they do not see images, Flash movies, JavaScript, frames, password-protected pages and directories. If they are not viewable, they will not be indexed on a search engine.

How to optimise a website for search engines

- Ensure that the **title tag contains a concise description** of the website's content
- Create a **new title tag for each web page**
- Use the **description meta tag** to add more detail about the page
- Use URLs that are as concise as possible
- Do not use generic titles for URLs, page titles or meta data, eg page1, etc
- Create an **XML sitemap** for submission to the software company managing the crawler

Beta Testing

Beta testing is carried out on a piece of software or an information system **prior to commercial release**. Beta testing is the last stage of testing, and normally can involve **sending the product to beta test sites outside the company for real-world exposure**.

The process of delivering a beta version to the users is called beta release and this is typically **the first time that the software is available outside of the organisation that developed it**. It generally begins when the software is feature complete. Software in the beta phase **will generally have bugs** in it that will hopefully be fixed for the final release. Other issues such as speed/performance **may still cause crashes or data loss** during the beta phase.

The users of a beta version are called beta testers. They are usually customers or prospective customers of the organisation that develops the software, willing to test the software without charge, often receiving the final software free of charge or for a reduced price. Beta version software is often **useful for demonstrations and previews** within an organisation and to prospective customers.

Beta testers will **feedback information about bugs or error reports** to the development team who can use that to debug the system.

For example Apple will release a Beta version of their iOS operation system months before the final release. This is so that developers can test their Apps with the new operating system and make sure it works before releasing them to the public.

Usability Testing

Usability testing measures the usability, or **ease of use, of a specific object.**

Usability testing is a technique used in user-centred interaction design to evaluate a product by **testing it on users**. This can be seen as an irreplaceable usability practice, since it gives direct input on how real users use the system. Examples of products that commonly benefit from usability testing are web sites or web applications, computer interfaces, computing devices and many other systems.

Setting up a usability test involves carefully **creating a scenario, or realistic situation, wherein the person performs a list of tasks using the product being tested while observers watch and take notes.**

For example, to test the attachment function of an e-mail program, a scenario would describe a situation where a person needs to send an e-mail attachment, and ask him or her to undertake this task. The aim is to observe how people function in a realistic manner, so that developers can see problem areas, and what people like.

Techniques popularly used to gather data during a usability test include **think aloud protocol, co-discovery learning and eye tracking**.

Think Aloud Protocol

Think-aloud protocols involve participants thinking aloud as they are performing a set of specified tasks. Users are asked to **say whatever they are looking at, thinking, doing, and feeling as they go about their task.** This enables observers to see first-hand the process of task completion.

Co-discovery Learning

During a usability test, **two test users attempt to perform tasks together while being observed**. They are to help each other in the same manner as they would if they were working together to accomplish a common goal using the product. They are encouraged to explain what they are thinking about while working on the tasks. Compared to thinking-aloud protocol, this technique makes it more natural for the test users to verbalise their thoughts during the test.

Eye Tracking

Eye tracking is the process of **measuring where a person is looking**. Eye tracking offers the ability to analyse user interaction between the clicks and how much time a user spends between clicks. This provides valuable insight into which features are the most eye-catching, which features cause confusion and which ones are ignored altogether. Specifically, eye tracking can be used to assess search efficiency, branding, online advertisements, navigation usability, overall design and many other site components.

In the above picture are the results of an eye-tracking test on YouTube. The **red areas are where the user has looked at most**.

Compatibility Issues

Compatible software would be **able to exchange information readily and easily with another**. When a new program or information system is created it will be tested to **make sure it is compatible and will run on the users system**. When doing this you can sometimes run into some problems. Below are some issues that you may run into:

Memory (RAM)

Imagine you had a database that held millions of records about patient's medical history. You used this information system to run complex queries and be able to produce in depth reports on the users data. Doing all of this multitasking can require a lot of RAM. To make sure your system will not be slow when using the database or a new piece of software you should **make sure you have the required amount of RAM.**

Storage Requirements

Some programs such as games or design software such as AutoCAD can require a large amount of backing storage. To be able to run the piece of software your computer system should **have the required amount of backing storage**. This is normally specified when you are buying or downloading the software.

Operating System

Software is designed to be compatible on certain operating systems. For example some software is designed to work on Windows OS and others could be designed for Apples OS X. When you are downloading or buying some software **make sure it is compatible on your computer system**.

iTunes Requirements

To the right are the system requirements to be able to install iTunes on a Windows computer. Highlighted are the 3 areas you need to know for compatibility.

Before you download some software it is worth checking to make sure it is compatible with your computer system.

iTunes System Requirements

- **PC with a 1GHz Intel or AMD processor and 512MB of RAM**
- **400MB of available backing storage**
- **Windows XP Service Pack 2 or later, 32-bit editions of Windows Vista, Windows 7, or Windows 8**

Computer Systems: Hardware

For the exam you need to know about:
- Input & output devices
- Processor type, number and speed (Hz)
- Memory (RAM, ROM, cache)
- Device type (desktop, laptop, tablet and smartphone)

Input Devices

An input device is a piece of hardware that lets you **put information onto or into a computer** to be processed.

- Keyboard
- Mouse
- Microphone
- Digital Camera
- Scanner
- Webcam
- Touch Screen

Output Devices

An output device is a piece of hardware that **provides the user with information**.

- Monitor
- Printers
- Loudspeakers

Processor Type & Speed

Processors were originally developed with only one core. There are different types of processors in today's markets. Dual-core and Quad-core are the most common in many products today. If a processor has multiple cores it can **run multiple instructions at the same time**, increasing overall speed for programs.

Dual-core processor has **two** cores (e.g. AMD Phenom II X2, Intel Core Duo)

Quad-core processor contains **four** cores (e.g. AMD Phenom II X4, Intel's quad-core processors, see i3, i5, and i7 at Intel Core)

Processors are measured in Hz (Hertz). In most modern computer systems processors are in GHz (GigaHertz). Below is an example of a typical processor type and speed.

Apple iMac	Processor
	2.9GHz quad-core Intel Core i5 processor (Turbo Boost up to 3.6GHz) with 6MB L3 cache

Memory: RAM & ROM

People often get confused between main memory and backing storage, they are **not** the same. **Main memory is located inside the computer system**. It can either be RAM or ROM. **Backing storage is outside the main processor**, e.g. Hard Drives, CD/DVD drives, USB Flash Memory (Pen Drives). Main memory in today's computers is on average around 4-6 Gb of RAM. Backing Storage is much bigger with average computers having around 500 Gb or more.

ROM (Read Only Memory)

ROM is used to store a small part of the operating system called the bootstrap loader.

- Data is **stored permanently in ROM**,
- Data is **not lost when the power goes off**
- Data in ROM cannot be changed

RAM (Random Access Memory)

This is where the operating system is stored; it also **holds all programs and data.** You can purchase additional RAM chips and install them in your desktop computer, which normally speeds up multi-tasking.

- The processor **can write to and read from RAM** at high speed
- Data held in RAM can be changed
- **All data in RAM is lost when the power is switched off**

Cache Memory

Cache memory is an area of **fast access memory**. It is located either on the processor chip or relatively close to it. It is normally a **small amount of memory for example up to 6 Megabytes.** This is used to **temporarily store data and instructions that are used frequently**.

Since the cache stores frequently used data and instructions it **saves the computer reading from main memory, which is much slower.**

Page 61

Device Type

You need to know about the following devices:
- Supercomputer
- Desktop
- Laptop
- Tablet
- Smartphone

Supercomputer

- A very large computer
- **Very powerful** processors with large memory capacity and large capacity backing storage
- Often has many other computers connected to it which allows many people to use the system at the same time
- Banks, Universities, NASA and other very **large organisations use them**.

Desktop

- Typical systems consists of a CPU, Monitor, Keyboard, Mouse and a printer.
- The clock speed of the processor is used as the main indicator of processing power.
- Hard core heavy gamers may still use a desktop.
- They have a variety of backing storage devices – hard disk, CD and DVD Drives.

Laptop

- Processor speed similar to a desktop
- **Portable**
- Large capacity hard drive
- **DVD-RW and CD-RW drive**
- Input devices – touchpad, keyboard, fingerprint recognition
- Output devices – LCD screen, built in speakers

Tablet

- Large display
- **Portable**
- Low storage capacity compared to a laptop or desktop
- **Touch screen input**
- Can **connect wirelessly to the internet** over 3G/4G

Smartphone

- **Portable**
- Low storage capacity compared to laptop or desktop
- Touch screen input
- Can install Apps to do certain jobs
- **Can make phone calls**
- Can connect to the internet over 3G/4G

Operating Systems

What is an Operating System?
An operating system is a large program that **manages the hardware and software of the computer system**. Windows 7, Windows 8, OS X, Android and iOS are examples of operating systems.

File Management
Manages the files saved on disc and deleted from disc. Keeps track of the hierarchy directory structure of all the folders and files on the system.

Memory Management
Allocates programs and data files to the space available in main memory. Also manages the placement of programs and data files so that they do not overwrite each other.

Input / Output
The operating system is responsible for performing **data transfers between the CPU and peripherals** such as keyboards and printers.
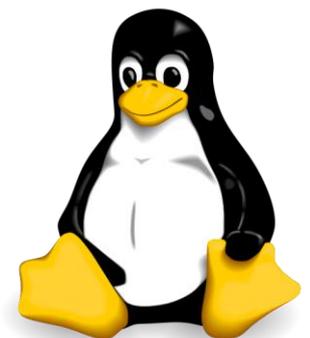
Software Licensing

Software licensing **allows an individual or group to use a piece of software**. Nearly all applications are licensed rather than sold. For example programs such as Photoshop or Microsoft Office all require a license to use after the trial period ends.

There are a **variety of different types of software licenses**. Some are based on the number machines on which the licensed program can run whereas others are based on the number of users that can use the program.

Single License

Grants **one user the right to use a software package**. It may grant the user the right to install the software on only one machine, or it may authorise installation on any number of machines as long as that same licensee is the only user.

Multiple Licenses

Allows **more than one person** to use the software.

Site License

This is a license to **use software within a facility such as a school or office**. It provides authorisation to install the software on all or some number of servers for a specified number of users at specified locations

Freeware

Software that is **distributed free of charge** and may be redistributed without charge by its users.

Shareware

Shareware is a type of software that is **distributed free of charge to prospective customers in a limited format**. A full software version is distributed for a **trial period** (usually 30 days), or a trial version is distributed with disabled features.

Proprietary v Open Source

Proprietary Software (Closed Source)

Proprietary software is developed by companies who typically **charge a license fee for the right to use their software**. The source code for proprietary commercial software is usually a **closely guarded secret**.

Some examples of proprietary software are below:
- Microsoft Office
- Google Earth
- iOS
- Skype

Open Source Software

Open source software is developed, marketed and **distributed by a community of individuals and is available for free**. The source code can be viewed and downloaded by anyone and then **modified** to suit the individuals or organisation's needs.

The most well known example of open source software is the Linux operating system, but there are open source software products available for every conceivable purpose.

Some examples of open source software are below:
- Google Chrome
- Android
- VLC Media Player
- Mozilla Firefox
- BitTorrent
- Gimp
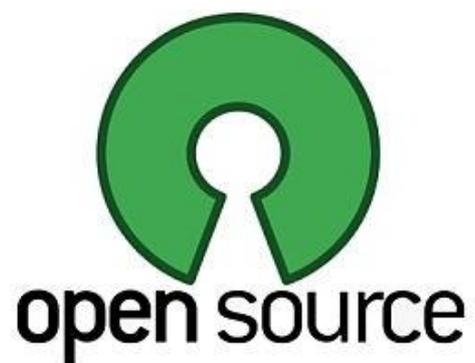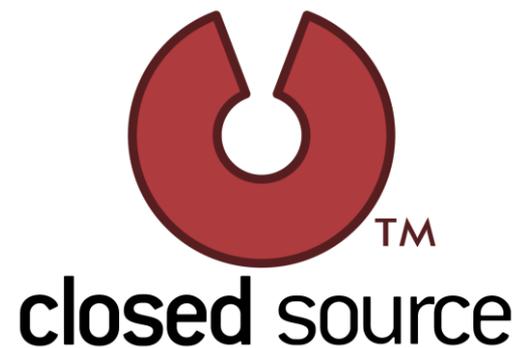
Portability

Portability is a measure of **how easily an application can be transferred from one computer environment to another**. An application is considered portable to a new environment if the effort required adapting it to the new environment is within reasonable limits.

The phrase "to port" means to modify software and make it adaptable to work on a different computer system.

For example some games have been "ported" onto smartphones that used to be old console games.

Trends in Operating System Design

Chrome OS

Google Chrome OS is a lightweight open source operating system based on Linux. This means it won't take up much memory, so it will have much smaller hardware requirements. It will also boot up faster.

Because the operating system is designed to mainly let you browse the web, it won't be clogged down with a bunch of features that are rarely used but take up precious resources. This design will also make it simpler to use, with a streamlined interface **designed to get you on the web quickly. None of your files are stored locally on the device running Chrome OS; they are all stored in the cloud.**

The Google Chrome OS is pointed directly at netbooks, laptops and desktop PCs. Because it is a lightweight operating system without stiff requirements, it can be run on less expensive equipment, thus helping to **drive down the price of computers.** Chrome OS demonstrates the trend that users want simplicity, quick access and consistency when using a computer system.

Cloud Operating Systems

Cloud Computing means Internet-based computing where your data and the software are present on the Web, and the application is used as a service rather than standalone software. You can run a virtual application or operating system within a browser that preserves your user session and your data. It's like travelling with your own computer but without carrying its hardware.

With a cloud operating system (also known as a Web OS), you can manage your office work; prepare projects, etc similarly to how you do on your desktop. The beauty of the idea is that **everything is stored on the Internet and hence available everywhere you go!**

Portable Desktop / Portable Operating System

The biggest weakness to desktop productivity is the lack of consistency.

As a result, personal computing is now in an incredibly fragmented state. As PC sales decline it's clear that mobile computing has redefined the way we interact with technology. Users now **expect the same powerful tools and applications on the go as they do at home or in the office.**

Ultimately, **the device shouldn't dictate functionality since portability is no longer seen as a barrier** to how work is done. Function is instead firmly in the hands of the user, a trend which will only grow stronger if you look at the recent focus on wearable technology.

The one consistency that binds all modern devices and operating systems is the Internet browser. Web applications are something that most of us are familiar with, and their key asset is their ability to offer a consistent user experience regardless of what device or operating system you are using.

HTML5 is quickly becoming the industry standard as it provides endless app development possibilities. Increasingly more and more of our applications, files and data are moving to the cloud. It stands to reason that a web-based desktop is the next logical progression in maintaining consistency.

Since the desktop could be accessed from any browser it removes the desktop from the OS for the average user. The web desktop will be instantly familiar, with the same functions and features available to the user, irrespective of what kind of device they log in from.

Microsoft tried to unify its native desktops by dropping the 'start' button to give it synergy with the Windows Phone operating system.

Although the intention was to provide a consistent experience across both mobile and desktop, it resulted in adopters becoming confused. As a result Microsoft quickly U-turned and reinstated the button on Windows 8.1.

A possible reason for Microsoft's failure to unify native desktops is that, below the exterior, they are very different beasts with non-compatible applications. An HTML5 browser-based desktop could succeed where Windows didn't because, by the very nature of a web app, **it will run anywhere, on any device with the same functionality.**

As more and more applications become delivered via the web, or are web born, it stands to reason that users will want a single online desktop that offers a consistent experience which can be accessed from anywhere in the globe.

Ultimately consistency promotes productivity; a web desktop offers the opportunity to log in instantly from any device, bringing the user to an environment that they are familiar with and is set up to suit their needs.

Web desktops also mean users can dynamically add new applications; seamlessly pull in news and sync social feeds. **The user is in full control of their entire experience.**

The desktop no longer belongs to the OS – the desktop now belongs to the user. We must set the desktop free of the OS, enabling us to get the most out of our experience, be it at our desks or on the move.

Storage Devices

When we talk about 'storing' data, we mean putting the data in a known place. We can later come back to that place and get our data back again.

'Writing' data or 'saving' data are other ways of saying 'storing' data.

'Reading' data, 'retrieving' data or 'opening' a file are ways of saying that we are getting our data back from its storage location.

Magnetic Storage

Magnetic	Capacity
Hard Drives	500Gb – 1Tb
Magnetic Tapes	
Floppy Disk	1.44Mb
Zip Drive	750Mb

Hard-drives have a very large storage capacity. They can be used to store vast amounts of data, sometimes used to store all types of films, including huge files such as movies. Data access speeds are fast.

Solid State Storage

Solid State	Capacity
USB Memory Stick	1Gb-64Gb
SSD Drive	512Gb
SD Card	1Gb-32Gb

The term 'solid-state' essentially means 'no moving parts'.

In summary solid-state storage devices are
- Re-writable
- Ultra-Portable (fits in your pocket)
- Good capacity size for transferring files such as large documents or photos.
- Data access speeds can be very fast

Optical

Optical	Capacity
CD-ROM	700Mb
CD-R	700Mb
CD-RW	700Mb
DVD-ROM	4.7Gb
DVD-R	4.7Gb
DVD-RW	4.7Gb
Blu-Ray	25-50Gb

Read-Only storage devices such as **CD-ROM, DVD-ROM and Blu-Ray** have data written onto them when they are manufactured. This data **cannot** be changed.

CD-ROMs are used to distribute all sorts of data: software (e.g. office applications or games), music, electronic books (e.g. an encyclopaedia with sound and video.)

DVD-ROMs are used in the same way as CD-ROMs but, since they can hold more data, they are also used to store high-quality video.

Blu-Ray discs are used in the same way as DVD-ROMs but, since they can hold more data, they are also used to store very high-quality, high-definition (HD) video.

Writeable storage devices such as **CD-R and DVD-R** can be written to. For example you could **burn some music onto a CD-R or write your holiday video to a DVD-R.**

Rewriteable storage devices such as **CD-RW and DVD-RW** allows you to **re-write data to the disk multiple times**. This means you could burn a CD-RW with some music then a few months later use the same disc to rewrite new songs onto it.

Portable Hard Drive

A portable hard-drive is one that is placed into a small case along with some electronics that allow the hard-drive to be **accessed using a USB** or similar connection.

Portable hard-drives allow **very large amounts of data to be transported** from computer to computer.

Units of Storage

We use these terms to measure a computers storage capacity.

1 Bit		Binary digit: a single 1 or 0
1 Byte	=	8 Bits
1 Kilobyte	=	1024 bytes
1 Megabyte	=	1024 Kilobytes
1 Gigabyte	=	1024 Megabytes
1 Terabyte	=	1024 Gigabytes
1 Petabyte	=	1024 Terabytes

Bit
Byte
Kilobyte
Megabyte
Gigabyte
Terabyte
Petabyte
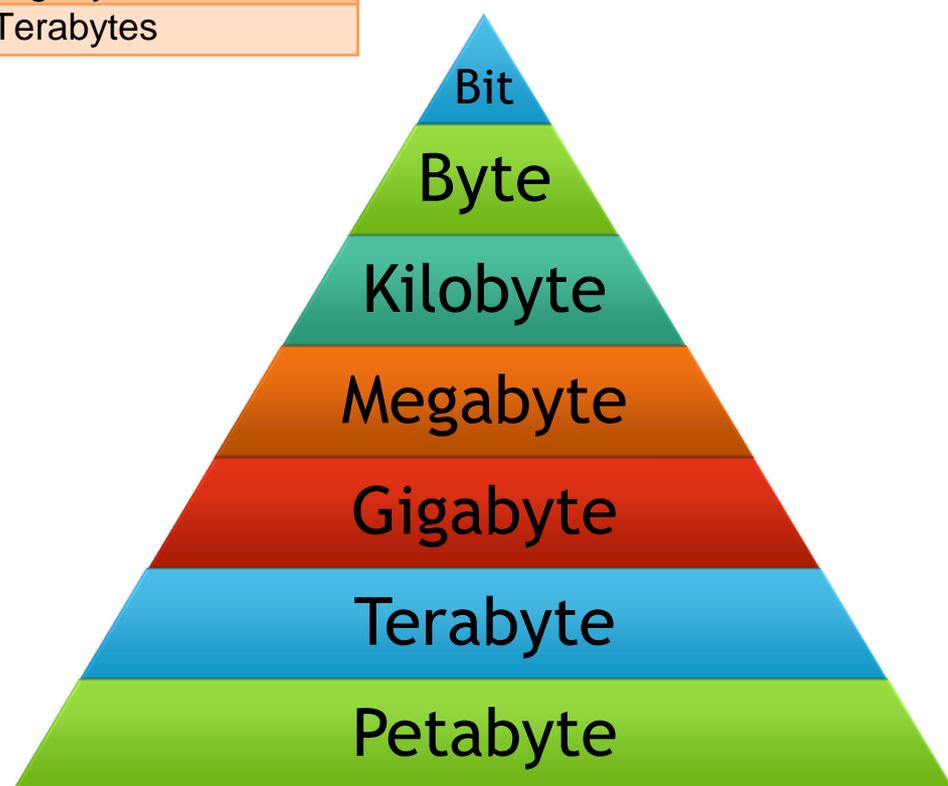
Interface Type & Data Transfer Rate

The data transfer rate is commonly used to measure **how fast data is transferred from one location to another**. In general, the greater the bandwidth of a given path, the higher the data transfer rate. For example, a hard drive may have a maximum data transfer rate of 480 Mbps, while your ISP may offer an Internet connection with a maximum data transfer rate of only 1.5 Mbps.

Data transfer rates are typically measured in **bits per second** (bps) as opposed to bytes per second, which can be understandably confusing. Because there are eight bits in a byte, a sustained data transfer rate of 80 Mbps is only transferring 10MB per second. While this is confusing for consumers, Internet service providers must enjoy measuring data transfer rates in bps since it makes their Internet access speeds sound 8x faster than they really are.

Interface Type	Data Transfer Rate
USB 2.0	480 Mbps
FireWire 800	800 Mbps
USB 3.0	5 Gbps
Thunderbolt	10 Gbps

56% Loaded

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# Distributed Storage

Distributed storage is where **data is stored in more than one location**. For example data could be stored in **multiple sites around a city or country**.

The picture to the right shows how data can be stored in different locations but can **still be accessible from any of the locations**.
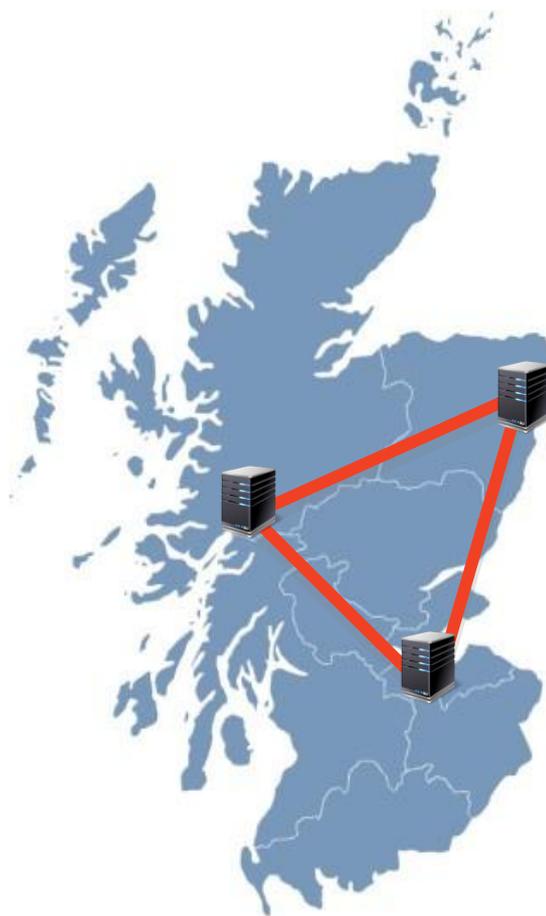
Offline Storage

Offline storage is any kind of **storage that is removable and cannot be accessed by the computer once removed**.

A good example of off-line storage is a USB Pen Drive. Off-line storage allows a user to store information that will not be affected by computer viruses or hardware failure.

Backup Systems

Backing up data is to save **guard against data loss is very important.** Nearly all business and schools have backup systems that will archive the systems data so that it can be restored back if for example something was corrupt, deleted by accident or there was a **disaster such as a fire or flood and the data was unrecoverable**.

There are different approaches to backing up data and you need to know about a few of these.

Full Backup

Full backup is the **starting point for all other types of backup** and contains all the data in the folders and files that are selected to be backed up. Because full backup stores all files and folders, **frequent full backups result in faster and simpler restore operations.**
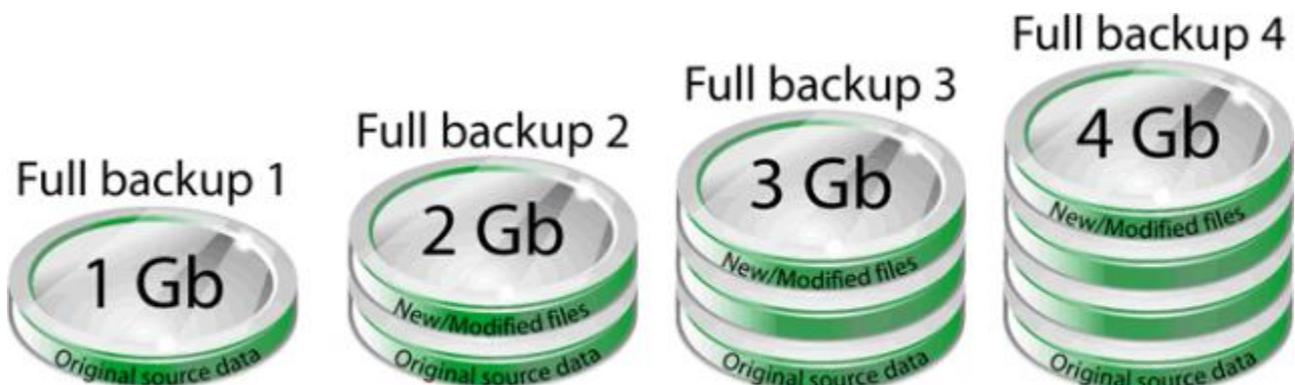
Note: Full Backup will always back-up the entire source data. If you don't delete/exclude sources (only add/modify) it will always grow in size because it backs up everything.

Advantages	Disadvantages
• **All files from the selected drives and folders are backed up to one backup set**. • In the event you need to restore files, they are **easily restored from the single backup set.**	• A full backup is **more time consuming** than other backup options. • Full backups require **more disk, tape, or network drive space**.

Differential Backup

A differential backup provides a **backup of files that have changed since a full backup was performed.** A differential backup typically **saves only the files that are different or new since the last full backup**, but this can vary in different backup programs. Together, a full backup and a differential backup include all the files on your computer, changed and unchanged.

In the image below you can see an example on how a differential backup would look like for a backup job that runs four times:

Note: Each differential backup includes all new/modified files since the last full backup.
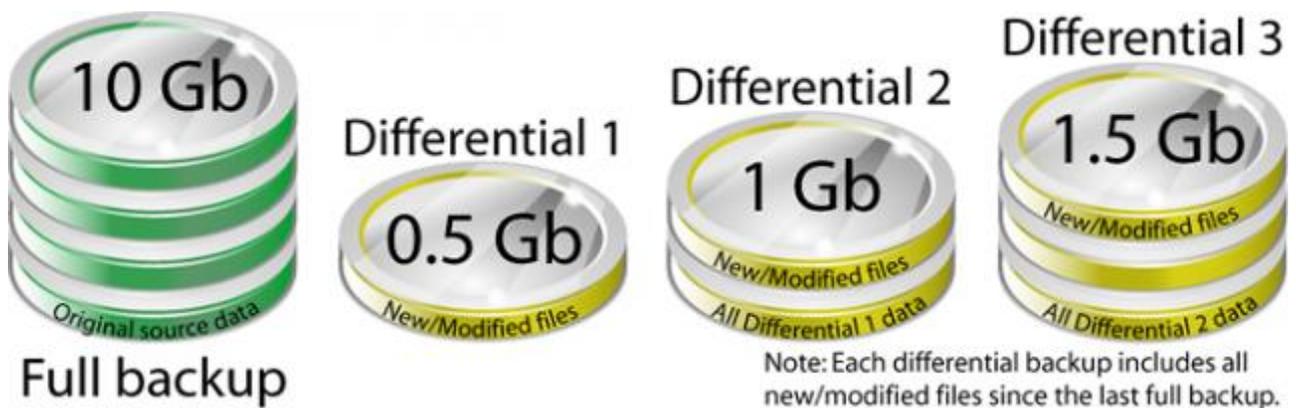
Advantages	Disadvantages
• Differential backups require even **less disk, tape, or network drive space than incremental backups**. • Backup time is faster than full or incremental backups.	• Restoring all your files may take considerably longer since you **may have to restore both the last differential and full backup**. • Restoring an individual file may take longer since you have to locate the file on either the differential or full backup.

Incremental Backup

An incremental backup provides a **backup of files that have changed or are new since the last incremental backup.** For the first incremental backup, all files in the file set are backed up (just as in a full backup). If you use the same file set to perform an incremental backup later, **only the files that have changed are backed up**. If you use the same file set for a third backup, only the files that have changed since the second backup are backed up, and so on.

The image below shows how a backup job running four times would look like when using incremental:

Advantages	Disadvantages
• Backup time is **faster than full backups**. • Incremental backups require less disk, tape, or network drive space. • You can **keep several versions of the same files** on different backup sets.	• In order to restore all the files, you **must have all of the incremental backups available**. • It may take longer to restore a specific file since you must **search more than one backup set to find the latest version of a file**.

Trends in Storage Systems

Storage systems are currently going through a considerable change with:

- **Cloud storage** becoming increasingly more popular
- **Price per gigabyte of backing storage decreasing**, making higher capacity storage more affordable.
- The **amount of data** we consume continues to increase and this is not going to stop. Consumers are demanding higher quality video, audio and graphics and all of this requires more storage.

SDD (Solid State Drives) Replacing HDD (Hard Disc Drives)

SSD are progressively replacing HDDs. It's already the case in all smartphones, e-books, tablets, ultra books, etc. A PC or Mac with an SSD boots faster, launches apps faster, and has higher overall performance. An SSD has no moving parts, so it is more likely to keep your data safe in the event that you drop your laptop bag or your system is shaken about by an earthquake while it's operating.

However, SDD are very expensive in terms of price per gigabyte. At the time of writing (2014) a 1TB SDD would cost around £400-£430 compared to a 1TB HDD costing around £50-£60.

The Cloud

Cloud storage is booming. With increasing Internet speeds the cloud is becoming a one of the most popular forms of storage. Consumers have enthusiastically adopted public cloud storage services such as Dropbox, Box, OneDrive and Google Drive for some time — primarily, of course, because of their convenience and low cost (all operate a 'freemium' model for consumers).

The cloud makes it easier for users to access their data from anywhere using any device. Cloud services enable users to keep their data kept in sync across multiple devices saves having multiple versions of the same file and wasting storage.

Networking

What is a Network?
A **collection of computers interconnected** by communication channels that allow sharing of resources and information.

Stand Alone or Networked
Most computer systems today are connected to a network most of the time or at least some times. If a computer is just stand-alone then it has **no access to share resources and communicate with other computers**.

Local Area Network (LAN)

A group of **linked computers** in **close proximity to each other**, such as in an office building, a school or at home.

LANs are useful for **sharing resources** such as files, printers or other applications.
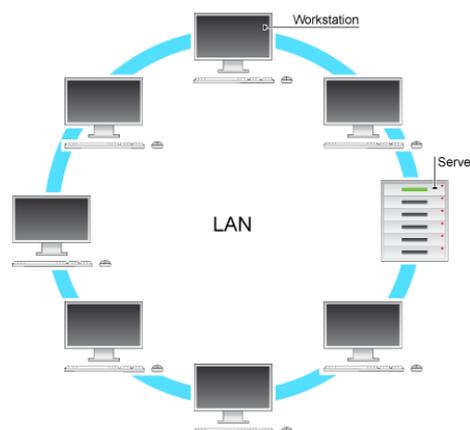
Wide Area Network (WAN)/Internet
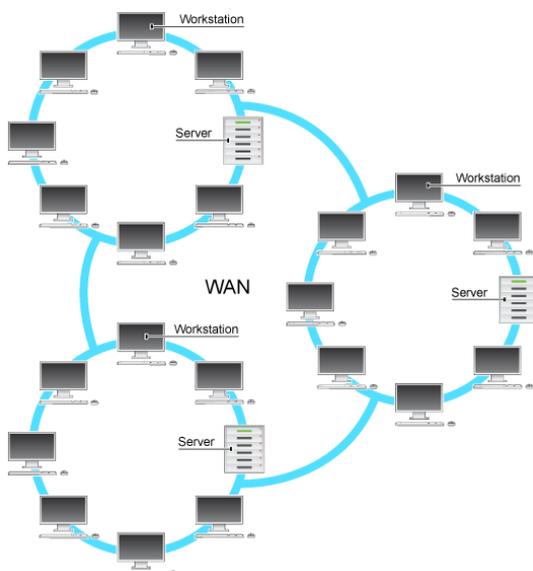
A **WAN** covers a **large geographical area**.

Most WANs are made from **several LANs connected together**.

The **Internet is a WAN**.

Cloud Storage

Cloud storage means to **store data online**. There are many services, both **free and paid**, that provide cloud storage services such as Google Drive, Dropbox and OneDrive. Some services are free but if you're trying to store large amounts of data, expect to make a payment.

Pros

- Some services offer a basic free version, such as Dropbox (2 GB) and OneDrive (25 GB)
- **Available anywhere** there's an internet connection without having to carry anything extra
- **Files accessible via the internet from any device**
- **Third parties handle taking care of the hardware** so no worries about storing external media in a safe place
- Allows **multiple users to share, edit and save files**.

Cons

- **Internet connection required**. In addition, a relatively fast connection is recommended for uploads and downloads to work well.
- Depending on a third party that **you have no control over**. They can technically do whatever they want with your files. Be sure to read their terms and privacy policies.
- The third party might **randomly shut down** due to financial hardships or other unforeseen circumstances.
- Just like your primary hard drive, the hardware third parties are using can fail at any time.
- Often can be **more expensive if you need to store large amounts of data**. Free services usually only offer a maximum of a few gigabytes.

Cloud Computing Models

Cloud computing comes in three forms: public clouds, private clouds, and hybrids clouds. Depending on the type of data you're working with, you'll want to compare public, private, and hybrid clouds in terms of the **different levels of security and management required**.

Public Clouds

A public cloud is basically the Internet. Service providers use the Internet to make resources, such as applications (also known as Software-as-a-service) and storage, **available to the general public**, or on a public cloud. Examples of public clouds include Amazon Elastic Compute Cloud (EC2), IBM's Blue Cloud, Sun Cloud, Google AppEngine and Windows Azure Services Platform.

For users, these types of clouds will provide the **best economies of scale, are inexpensive to set-up because the provider covers hardware, application and bandwidth costs.** It's a pay-per-usage model and the only costs incurred are based on the capacity that is used.

There are some limitations, however; the public cloud may not be the right fit for every organisation. The model **can limit configuration and security making it less-than-ideal for services using sensitive data**.

Pros	Cons
Cost Public clouds are generally **free or available as pay-as-you-go** services; you pay hourly for the resources you use. **Accessibility** Since the infrastructure of public clouds is shared, **information is easily accessible**. This is particularly advantageous to organisations that wish to get their information out to the public quickly and easily.	**Security** One of the main drawbacks of a public cloud is a **lack of security**. Because systems are shared, it is easy for people outside of your organisation to access your information. **Limited Customisation** Some companies have specific needs and wants; **public clouds are not customised** to your company's individual needs

Private Clouds

The goal of a private cloud is not sell "as-a-service" offerings to external customers but instead to **gain the benefits of cloud architecture without giving up the control of maintaining your own data centre**.

Private clouds **can be expensive** and therefore is usually not an option for the average Small-to-Medium sized business. Large companies that need to **keep their data secure** normally use private clouds. Keeping the organisations assets within a firewall does this.

Pros	Cons
Security There is an **increased level of security** since designated people can only access private clouds.	**Cost** Since private clouds are created and designed for a specific corporation, there is an **associated cost with designing and maintaining them**.
Control and Flexibility You have the ability to **control what your cloud looks like and how it is used**.	**Time** Private clouds take more **time to implement.**

Hybrid Clouds

A hybrid cloud is a **combination of a private cloud combined with the use of public cloud services.** With a Hybrid Cloud, an organisation has their own private (internal Cloud) with services running within their firewall. However, Hybrid Clouds allow users to access data that is stored off site via a Public Cloud.

This model is beneficial when an organisation wants to have **control over their data storage, but needs additional space for archiving data**. They have the security and supervision of the Private Cloud in their network, but can store excess data in a scalable on-demand Public Cloud.
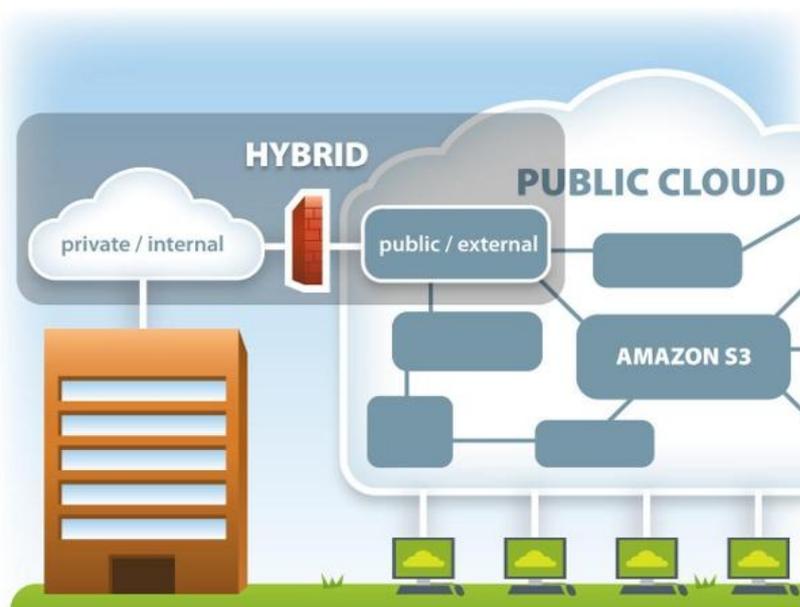
Cloud Based Services

Cloud Services refers to **applications, services or resources made available to users on demand via the Internet** from a cloud computing provider's servers. Below are some other examples of cloud-based services:

Google Drive

This is a pure cloud computing service, with **all the apps and storage found online.** Drive is also available on more than just desktop computers; you can use it on tablets like the iPad or on smartphones. In fact, **all of Google's services could be considered cloud computing**: Gmail, Google Calendar, Google Voice, and so on.

Apple iCloud

Apple's iCloud service is primarily used for online storage and synchronisation of your mail, contacts, calendar, and more. All the data you need is available to you on your iOS, Mac OS, or Windows device. iCloud also stores media files.

QuickBooks Online

The world's most popular small business accounting software is now available online. The online versions have the same features and capabilities as the installable desktop versions, including multiple users, payroll, invoicing and integrated online banking. Handling QuickBooks online might seem more expensive than buying your own software, but the online version includes automated backups for your data, automatic upgrades and updates, customer support, and **100% availability from any computer with Internet access.**
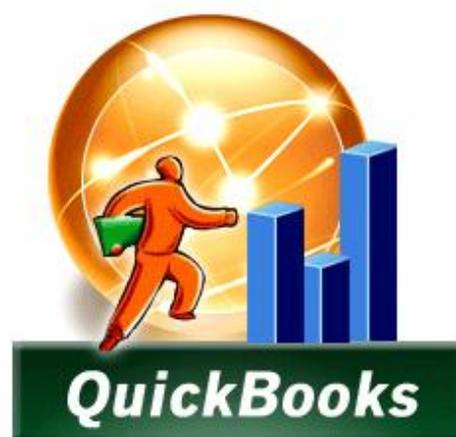
Facebook

Facebook is a cloud-based service. It runs on a server and you are **able to access it on demand on various devices**. You upload photos to Facebook and they look after them, you don't have to worry about having storage space on your computer to store them. You can share your photos with anyone and view them whenever you like.

YouTube

The worlds most popular video streaming website is a cloud based service. **YouTube runs in the cloud and is accessible from any device**. Think about when you upload a video, you don't have to worry about where it is stored or if you have enough storage capacity, that's YouTube's job. YouTube launched a **cloud-based video editor that lets you do basic video editing online. This works in your browser with no download needed**.

Microsoft Office 365

Microsoft Office 365 is an **online subscription service that gives you access to web based versions Microsoft Office** software such as Word, PowerPoint and Excel. One advantage of Office 365 is that it is regularly updated approximately every 90 days without companies having to pay any upgrade fees.

Web Hosting

A web host is in the business of **providing server space, Web services and file maintenance for Web sites** controlled by individuals or companies that do not have their own Web servers.

If you **create a website and want it to be publically accessible on the Internet** then your website must be hosted by a company. You may be familiar with some hosting companies. Below are some hosting plans to give you an idea of what some companies will offer you.

	Start Up from **£2.49** a month (ex VAT at 20%)	**Business** from **£4.16** a month (ex VAT at 20%)	**Professional** from **£7.49** a month (ex VAT at 20%)
NEW New Feature			
BOOSTED! Boosted Features			
Core Features			
Free domain name (.co.uk)	1	2	3
Web space	BOOSTED! 1 GB	50 GB	Unlimited
Bandwidth	Unlimited	Unlimited	Unlimited
Mailboxes	100	500	Unlimited
Mailbox size	1GB	1GB	1GB
Databases	No	5	Unlimited
Databases size	NA	150MB	BOOSTED! 500MB
Multi-site hosting ?	1	1	3
SSL Certificate	from £9.99	from £9.99	Free 123-SSL
Malware Monitoring	from £4.99	from £4.99	from £4.99
OS	Linux & Windows	Linux & Windows	Linux & Windows

Website files are hosted on servers. The servers "serve" those files to individual computer users, upon request. The Internet makes it all possible.
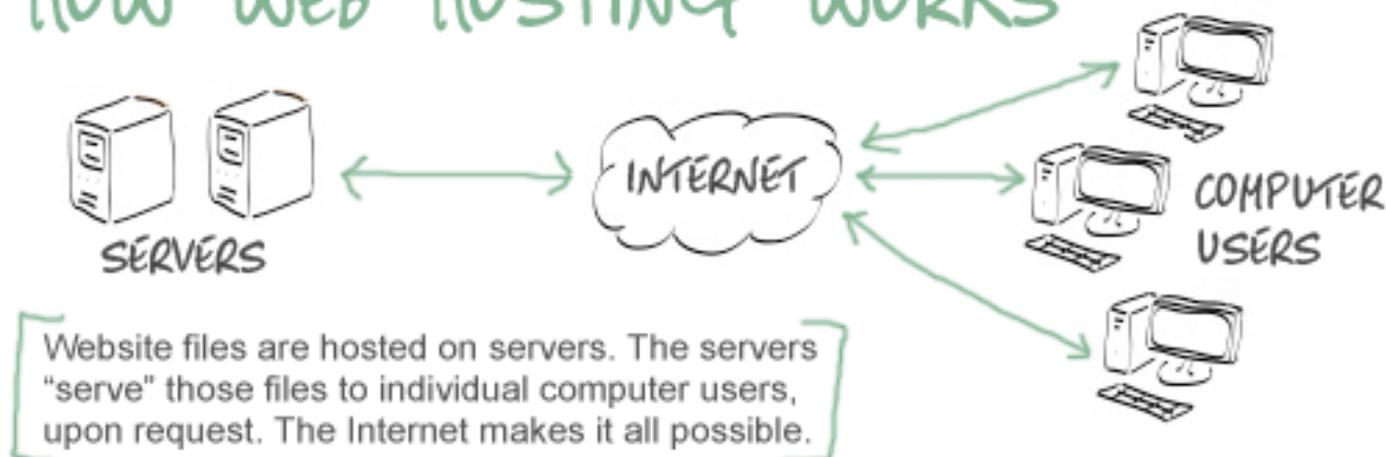
Trends in Networking & Connectivity

802.11ac WiFi

During 2013, the **next major evolution of wireless networking** was finally certified. The 802.11ac Wi-Fi standard was officially certified in June.

802.11ac is the successor to 802.11n which is now widely deployed in enterprise wireless access points and client devices. The promise of 802.11ac is bandwidth of 1 Gbps and perhaps even higher as the next wave of devices and enhancements are being developed.

In 2013, the first wave of enterprise access points began to debut with support for 802.11ac, but it will be in 2014 and into 2015 as technology refresh cycles kick in on the client side of devices, as well as enterprise access points, when adoption is likely to growth rapidly.

Broadband Speeds

Every day users are demanding **faster and faster Internet access**. HD video and high quality graphics require more bandwidth. **Fibre optic** broadband is being rolled out across the UK and gives households broadband speeds of up to 50Mbps. This is enough to be able to **download HD movies and albums in seconds**.

The Internet of Things (IoT)

The Internet of Things is a scenario in wh **objects, animals or people are provided with unique identifiers and the ability to automatically transfer data over a network without requiring human-to-human or human-to-computer interactio**

A *thing*, in the Internet of Things, can be person with a heart monitor implant, a far animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or **any other natural or man-made object that can be assigned an IP address and provided with the ability to transfer data over a network**. So far, the Internet of Things has been most closely associated with machine-to-machine (M2M) communication in manufacturing and power, oil and gas utilities. Products built with M2M communication capabilities are often referred to as being smart.

4G - Mobile Connectivity

4G is the fourth generation of mobile phone technology and follows on from 2G and 3G. 2G technology was suitable for making calls and sending text messages while 3G makes it possible to access the Internet more effectively through your mobile phone.

4G services should make it **much quicker to surf the web on your mobile, tablets and laptops** – speeds will be nearer to what you currently experience with home broadband. Because of this, **4G is ideally suited for services which demand more capacity like video streaming, mapping and social networking sites**.

For the typical user, download speeds of initial **4G networks could be around 5-7 times those for existing 3G networks**. This means a music album taking 20 minutes to download on a 3G phone and just over 3 minutes on 4G. This is based on existing 3G speeds being 1Mbit/s on average and 4G speed being 6Mbit/s (average of 5 and 7 times faster).

Security Risks

Spyware

Spyware is a software program that once installed on your computer, **can monitor and collect personal information** about your web surfing habits and the web pages that you visit.

You are usually **unaware that your machine has been infected** by spyware and it can sit in the background, collecting information about you and then transmitting it back to the author of the spyware - often advertisers who want to know what you are interested in and what adverts you click on.

Keyloggers

Keyloggers are another form of spyware. The purpose of a key logger is to **monitor and store a record of every keystroke** made on the computer. This data may then be sent to a remote server without your knowledge. It is specifically looking for user names and passwords used for things such as **bank accounts, credit card numbers** etc.

Phishing

Phishing is a form of **online fraud** where criminals aim to **steal valuable information** such as credit cards, social security numbers, user IDs and passwords for bank accounts.

They set up a **fake website which looks identical to a legitimate company** such as a bank or insurance company. They then try to trick people into logging into the site and giving their account details and security codes.

Identity Theft

Identity theft is where **criminals obtain personal information** such as your date of birth, bank account numbers, your mother's maiden name, your pet's name and so on.

Companies for you to prove who you are over the telephone often use personal details as questions.
So, if the thief can answer these questions there is a good chance they will succeed in impersonating you and could possibly purchase things in your name, take out loans, even take money from your accounts!

Online Fraud

Online Fraud is the use of Internet services to **defraud victims or to otherwise take advantage of them**. Most businesses and consumers rely on the Internet and other forms of electronic communication to conduct transactions; illegal activity using the very same media is on the rise.
Fraudulent schemes conducted via the Internet are generally difficult to trace and prosecute, and they cost individuals and businesses millions of dollars each year.

DOS (Denial of Service) Attacks

A DoS attack is an illegal act, with the **intent of disabling a server**.

A server responds to external requests from its network. For example a web server responds to a browser calling for a web page to be delivered from its hard drive. Each request takes a small amount of time and some CPU resources on the server.

With a 'Denial of Service' attack, the **server is overwhelmed by millions of rogue requests** being sent it, effectively **using up all its resources** and denying normal service for legitimate users.

Security Precautions

Encryption

Encryption means to **scramble a message** in such a way that **only the people who are meant to read it can** do so.

A message sent 'in the clear' looks like:
"This is a message anyone can read"

The encrypted message looks like gibberish:
sH""a12HYaaao%%111.9827££»,//[]223)(llkSSwqja67sg

Encryption works by both people **making use of a secret 'key'** that only they know (or at least their computers know). The original message is mixed in with the key to create a secret message. This is done by some very crafty mathematics so that it is very hard for someone to crack the code - very powerful computers working for a long time would be needed to crack a good code.

Biometrics

This describes various technologies used to measure some **feature of a person** in order to identify them.

For example
- **Fingerprint recognition**
- **Iris recognition**
- **Voice recognition**
- **Facial recognition**

These biometric systems are very secure as the **biometric information is unique to that one person**.

Biometrics is a controversial topic because many people are concerned with privacy issues when they are applied to things like passports and identity cards.
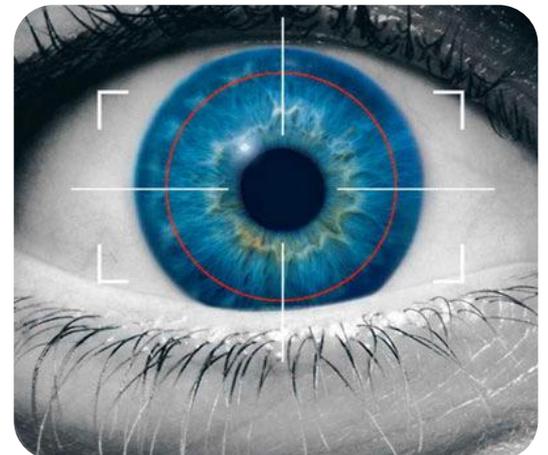
Biometrics in Industry

Biometrics is becoming increasingly popular in industry. One example of this is the **iPhone using a fingerprint scanner called Touch ID.** The fingerprint scanner will use your fingerprint to uniquely identify the owner of the phone and unlock it. It can also be used to purchase Apps, music and movies from the iTunes store.

This sort of technology is also **becoming increasingly popular in commerce. Paying for products with your smartphone** and using biometric data such as a **fingerprint to confirm it is you** are on track to become second nature in a few years.
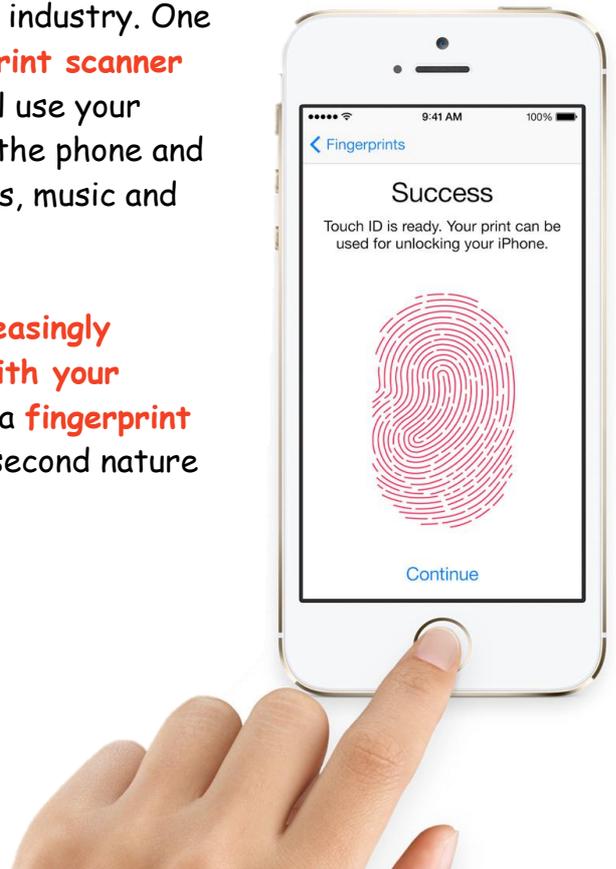
Digital Signature

A digital signature is basically a way to **ensure that an electronic document (e-mail, spread sheet, text file, etc.) is authentic.** Authentic means that you know **who created the document** and you know that it has **not been altered** in any way since that person created it.

Digital Certificates

Digital Certificates are the attachment to an electronic message used for security purposes. The common use of a digital certificate is to **verify that a user sending a message is who he or she claims to be**, and to provide the receiver with the means to encode a reply.

Digital Certificate provides a means of proving your identity in electronic transactions; just like a driver's license or a passport does. You can present a Digital Certificate electronically to prove your identity or your right to access information or services online.

A Digital Certificate is issued by a Certification Authority (CA) and signed with the CA's private key. It typically contains:

- Owner's public key
- Owner's name
- Expiration date of the public
- Name of the issuer (the CA that issued the Digital Certificate)
- Serial number of the Digital Certificate
- Digital signature of the issuer

You may be familiar with the **"lock" icon** in your browser when you are logged into a website or about to buy something. The **lock indicates that the website is backed by a digital certificate and is a genuine website** and is not a fake set up by criminals.

Here is what PayPal looks like in Internet Explorer. The lock icon and green background of the address bar let us know that this website is backed by a digital certificate. Clicking on the lock provides additional detail about the certificate.
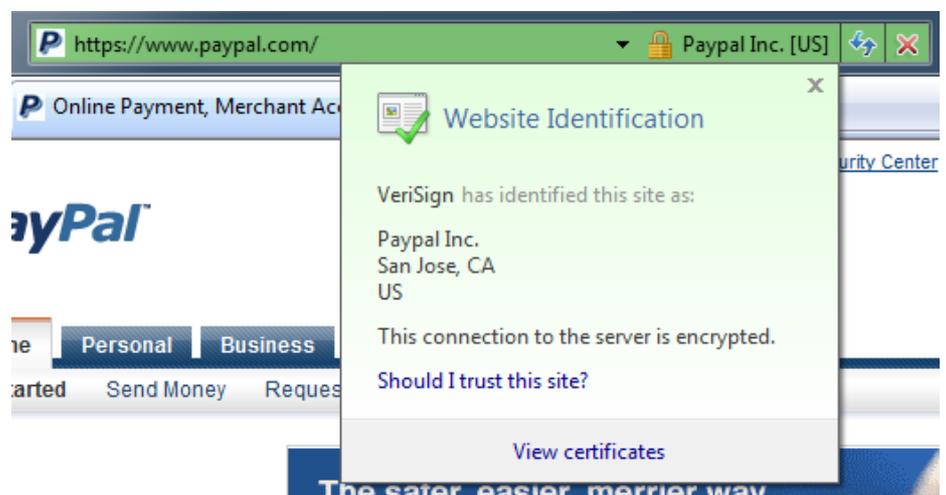
Server Side Validation

What is a form?

Forms **allow users to enter data** that gets sent to a server for processing or validation. Forms can contain:

Checkboxes

☐ I have a bike
☐ I have a car

Radio buttons

○ Male
○ Female

Password field

Password: [_____]

Security

Forms are often used for **security purposes**. For example when you sign into an account such as Facebook or Twitter your **username and password is checked on the server**. This is to make sure the website knows it is you and so you only get access to your data.

How does server side validation work?

The diagram below will help explain how server side validation works for security purposes. The example below explains how server side validation works with Facebook. The same process applies to online banking, Amazon, YouTube, Twitter and any other website that a username or password.

1. You go onto Facebook and **type in your username and password** into the form and click submit/login.
2. Your **login information is sent to Facebook's server** so they can check to make sure it is you.
3. **Facebook's server then accesses Facebook's database**. This is the place where Facebook stores all its user information such as logins info, contact details, passwords etc.
4. The database then will **search for that certain username and password to check if it is valid.**
5. **If the username and password are found** the server then sends you the HTML files to **access your account**. If the combination is incorrect you will be asked to re-enter your login details.

Facebook Server

Facebook Database

Username	Password
stephen@gmail.com	Password123
johnsmith@hotmail.com	loch@ber
markzuckerburg@gmail.com	i@mMinted
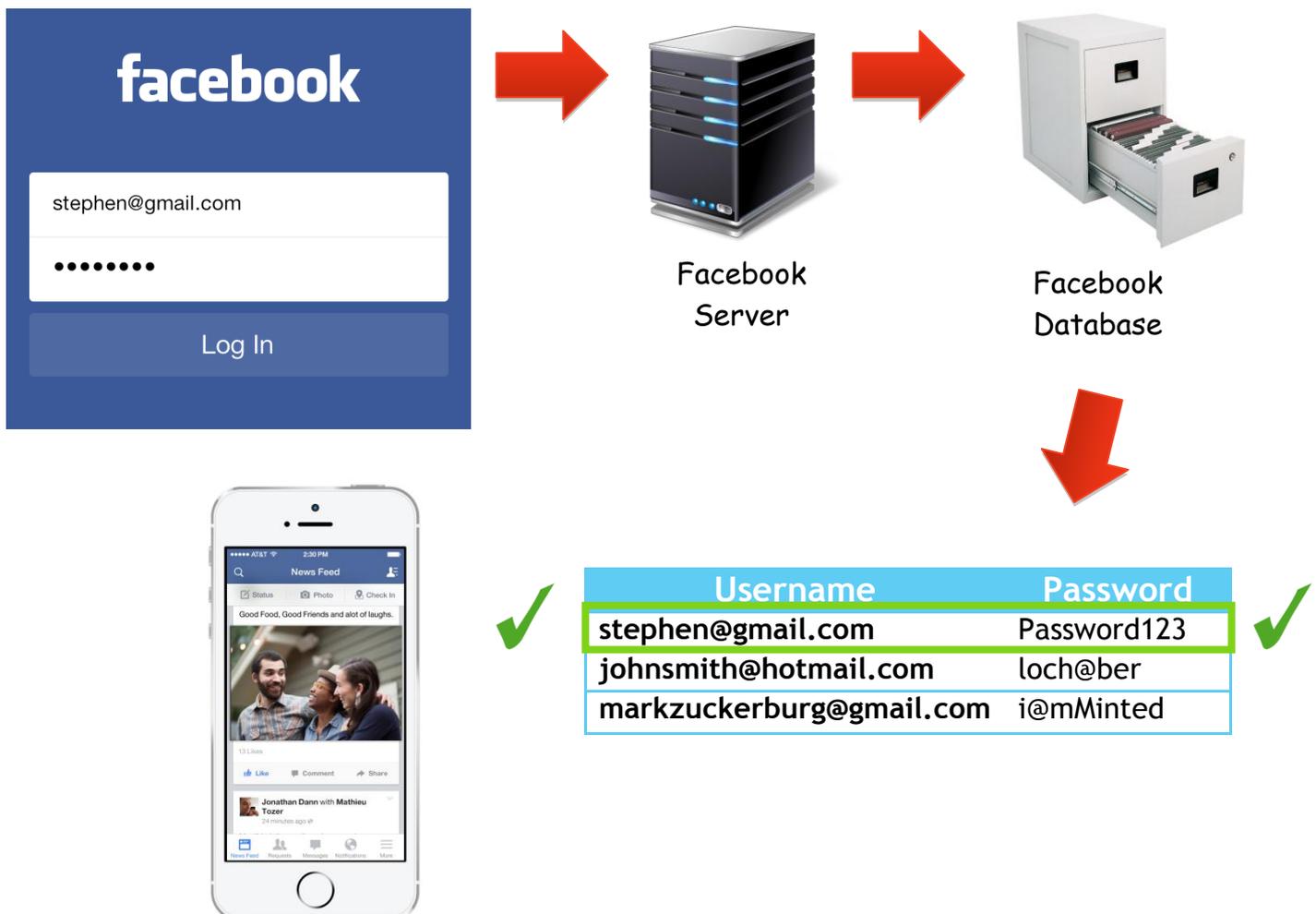
Server Side Validation (Updating Centrally Held Data)

Updating centrally held data is not possible with client side scripting. This is something you **can only do on the server**.

Suppose you have an online store selling iPads. A user enters the number of tablets he/she wants:

> **2**   iPad Tablets - £800

Maybe you've sold out of iPads. You want to tell the user:

> **2**   iPad Tablets
>
> **Sorry, out of stock**

The code for this will be something like:

if number_ordered > current_inventory then…

You get number_ordered from the form the user filled out. But where does current_inventory come from? The variable current_inventory comes from the database. The web server will **look up the inventory database to see if there is 2 iPads available and return its findings**.

Browser   Web Server   Database Server
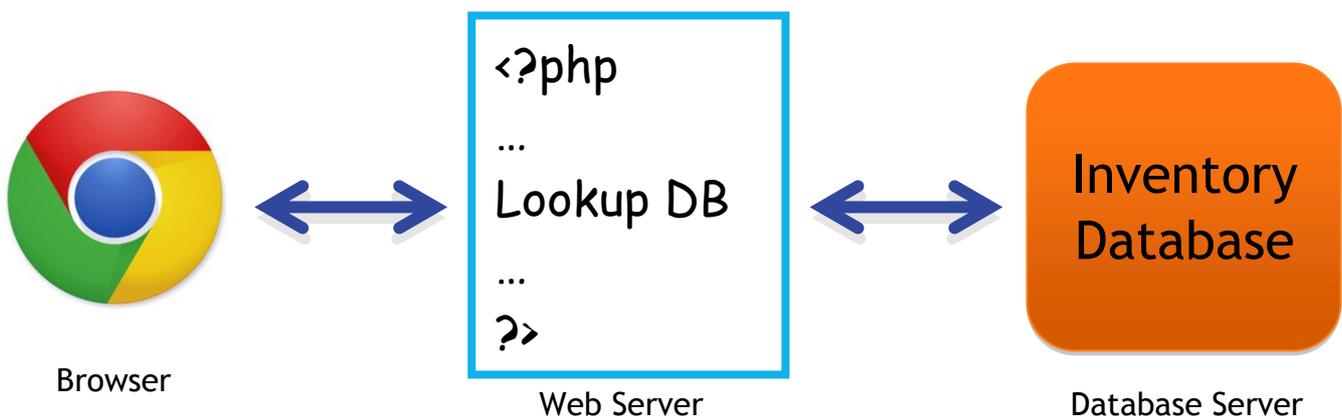
The if statement above is usually done by PHP code on the server, not the browser. The server has access to the database. The browser does not.

Computer Misuse Act

ANONYMOUS

The Computer Misuse Act enables people to be prosecuted if they commit one of the following offences:

- **Unauthorised access** to computer material
- Unauthorised access with intent to commit or facilitate a crime
- **Unauthorised modification** of computer material.

This mainly relates to **hacking and distributing viruses** although other computer related crimes could be tried under this Act.

Copyright, Designs and Patents Act

With the increasing use of computers, material can be copied very easily. Increasing use of the Internet for downloading music can lead to copyright infringement.

Downloading music of movies without paying for them would break this act.

Copying images from web pages and using the images on your own web page would break this act. (Permission would need to be sought)

Communications Act

It gave regulation body Ofcom its full powers

Ofcom has wide-ranging powers across the television, radio, telecoms and postal sectors. It has a statutory duty to **represent the interests of citizens and consumers by promoting competition and protecting the public from what might be considered harmful or offensive material**.

It also made it **illegal to use other people's Wi-Fi** broadband connections without their permission

Regulation of Investigatory Powers Act (RIPA)

Regulation of Investigatory Powers Act was introduced to allow law agencies to catch up technologically with the increasingly sophisticated tools used by terrorists, drug smugglers and organised criminal gangs.

This is a law that was created to define the legal power of certain organisations to **carry out surveillance and interception of communications**. The main use of this law is for **security and crime detection**.

For Internet Service Providers, such as BT, TalkTalk or Sky, there are **financial implications**. They must **implement technical systems for the storing and interception of information** that may be requested by government.

The Act includes detail about
- The interception of communications such as emails and telephone conversations.
- The carrying out of surveillance.
- Access to electronic data protected by encryption or passwords.
- The use of undercover agents.

RIPA Issues

RIPA is becoming increasingly **difficult to implement**. Encryption is becoming more sophisticated and therefore more **difficult to decrypt data and messages**. Also getting the **user to cooperate and provide the encryption keys** or passwords can be an issue.

Environmental Benefits

Running an environmentally friendly business helps you **reduce your impact on the environment and preserves natural resources**. Your business can help the environment in many ways. For example, you can:

- Use products that **reduce your reliance on natural resources** (e.g. rainwater tanks, solar hot water systems)
- Use **products that are made from recycled material** (e.g. office supplies made from recycled plastic, furniture made from recycled rubber)
- Look at all your business activities to see if you can do anything differently (e.g. **reducing air travel by holding video conference calls** instead of flying around the country to meetings).

Making your business environmentally friendly not only benefits the environment but can also **save you money**.

Reduce Costs

Avoiding, reducing, reusing and recycling can lower your costs. For example, a few simple changes to how you deal with paper can involve your staff in environmentally friendly processes while saving you money:

- Avoid using materials unnecessarily
- Reduce your paper needs by asking staff to **print double-sided**
- Reuse by encouraging staff to **use scrap paper for message-taking** instead of purchasing message pads
- **Recycle by shredding excess paper** - you could recycle this commercially or invite staff to take it home for their compost or mulch heaps.

Attract New Customers

Promoting your environmentally friendly methods can **set your business apart from your competitors and attract new customers** who want to buy products and services from an environmentally friendly business.

Improves Sustainability

Reducing the environmental impact of your business will improve the sustainability of your business. If you are **less dependent on natural resources** than your competitors and have ways to deal with rising costs due to climate change, your business will have a **greater chance of long-term success**.