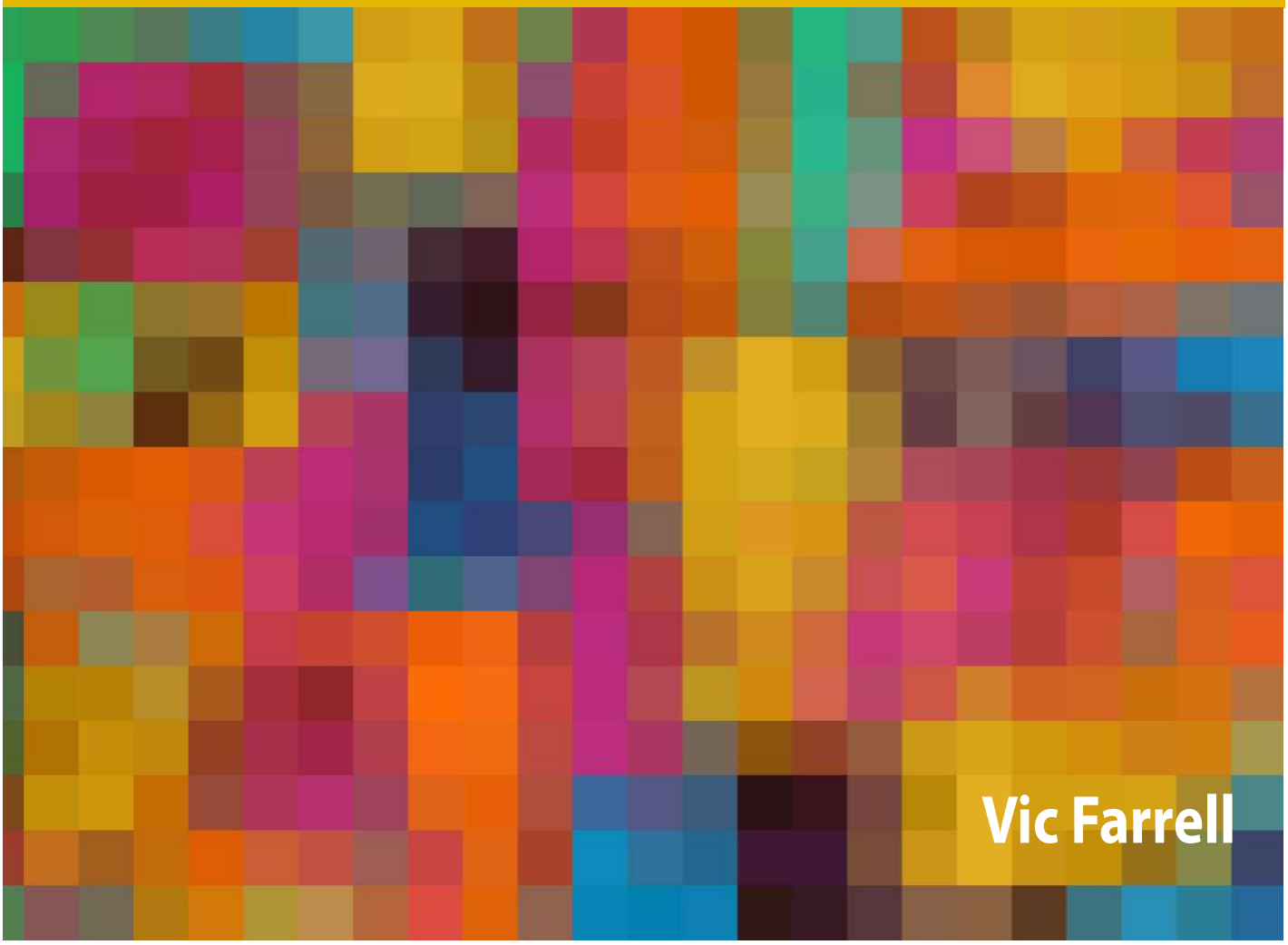
Supporting the ACARA Curriculum Version 9.0

Designed for Australian Secondary Schools Years 7 - 10

Digital Technology



Vic Farrell

To teachers everywhere who battled through 2020 & 2021 by supporting each other so they can provide the best education for their students.

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Many thanks to Randall Munroe for the use of his excellent comics www.xkcd.com

This publication is designed to meet the teaching and learning needs of teachers and students of

Digital Technologies Australian Curriculum, Assessment and Reporting Authority 2022.

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About this book

Many students arrive at secondary school with plenty of experience with mobile devices. They have become dependent on easy-to-use touch screen interfaces and some have rarely used a mouse. An ever-dwindling number of students bring basic desktop computer skills to Year 7. Few are able to demonstrate basic use of office software and the storage and retrieval of files.

This text book brings together ICT techniques and the Australian Digital Technologies curriculum to assist teachers and students to navigate secondary school computing.

Instead of identifying year levels, the chapters are identified as Foundation, Intermediate, Advanced and Specialised. Foundation and Intermediate are based on the ACARA Australian Curriculum for Years 7 and 8, but the activities are just as relevant for Years 9 and 10. If you have especially skilled or experienced middle school students who need to be challenged, move them up into the Advanced and Specialised activities and content.

Each chapter is made up of three sections

- ICT Skills
- Digital Technologies
- Assessment Tasks

ICT Skills provides step by step practical techniques to create solutions, analyse data and use various applications.

Digital Technologies covers the theory content that can be examined.

Assessment Tasks include a range of practical projects that can assess students' skills and knowledge of the digital technologies curriculum.

All programs presented in this book along with the assessment tasks and their rubrics have been implemented in years 7 - 10 over the period of 2010 - 2020.

A Teachers Companion Guide is also available with sample solutions and rubrics.

Australian Curriculum

FOUNDATION - INTERMEDIATE LEVEL
(Aimed at Years 7 - 8)

Digital Technology Knowledge and Understanding

ACTDIK023 Investigate how data is transmitted and secured in wired, wireless and mobile networks, and how the specifications affect performance

ACTDIK024 Investigate how digital systems represent text, image and audio data in binary

Digital Technologies Processes and Production Skills

ACTDIP025 Acquire data from a range of sources and evaluate authenticity, accuracy and timeliness

ACTDIP026 Analyse data and visualise using a range of software to create information, and use structured data to model objects or events

ACTDIP027 Define and decompose real world problems taking into account functional requirements and economic, environmental, social, technical and usability constraints

ACTDIP028 Design the user experience of a digital system, generating, evaluating and communicating alternative designs.

ACTDIP029 Design algorithms represented diagrammatically and in English, and trace algorithms to predict output for a given input and to identify errors.

ACTDIP030 Implement and modify programs with user interfaces involving branching, iteration and functions in a general purpose programming language.

ACTDIP031 Evaluate how student solutions and existing information systems meet needs, are innovative, and take account of future risks and sustainability.

ACTDIP032 Plan and manage projects that create and communicate ideas and information collaboratively online, taking safety and social contexts into account.

Australian Curriculum

ADVANCED - SPECIALIST LEVELS
(Aimed at Years 9 - 10)

Digital Technology Knowledge and Understanding

ACTDIK034 Investigate the role of hardware and software in managing, controlling and securing the movement of and access to data in networked digital systems.

ACTDIK035 Analyse simple compression of data and how content data are separated from presentation

Digital Technologies Processes and Production Skills

ACTDIP036 Develop techniques for acquiring, storing and validating quantitative and qualitative data from a range of sources, considering privacy and security requirements

ACTDIP037 Analyse and visualise data to create information and address complex problems, and model processes, entities and their relationships using structured data

ACTDIP038 Define and decompose real-world problems precisely, taking into account functional and nonfunctional requirements and including interviewing stakeholders to identify needs

ACTDIP039 Design the user experience of a digital system by evaluating alternative designs against criteria including functionality, accessibility, usability, and aesthetics

ACTDIP040 Design algorithms represented diagrammatically and in structured English and validate algorithms and programs through tracing and test cases

ACTDIP041 Implement modular programs, applying selected algorithms and data structures including using an object oriented programming language

ACTDIP042 Evaluate critically how student solutions and existing information systems and policies, take account of future risks and sustainability and provide opportunities for innovation and enterprise

ACTDIP043 Create interactive solutions for sharing ideas and information online, taking into account safety, social contexts and legal responsibilities

ACTDIP044 Plan and manage projects using an iterative and collaborative approach, identifying risks and considering safety and sustainability

Fundamentals

For decades it has been assumed that kids know more than adults about technology. This is becoming increasingly incorrect with the advent of touch screen mobile devices.

You cannot assume all students in your class know how to use email, store and retrieve files or even use a mouse. This section of the text covers fundamental ICT skills that will support all students navigate their way through high school using digital technology. It is broken into four sections:

- IT at School. How students keep records for access email, the school moodle or portal and printing.
- Google Apps for School. Focuses on storage and work processing so students can write school assignments without losing them.
- Social and Ethical use of IT . This supports students in acknowledging sources and understanding responsible technology use.
- Shortcuts using the keyboard.

This chapter focuses on skills using Google Apps because they are free and are easily accessible from Google Chrome browser. For students without home internet access, please skip to the Foundation Chapter for word processing.

Suitable for all year levels

This section could be used as a "licence" to use digital technology at your school.

Fundamentals I
ICT at School

SETTING UP YOUR LAPTOP

1. Create a password for your laptop and change it every school Term.

Write a HINT here to help remind you what your laptop password is for each term:

Term One: _____

Term Two: _____

Term Three: _____

Term Four: _____

Here are some ideas for memorable passwords that are hard to guess: a neighbour's car rego plate, a distant relative's name and their date of birth, highest game score inside the name of a band you hate, your parents anniversary date inside the name of the location of a favourite holiday.

2. Create FOLDERS or DIRECTORIES for each subject on your laptop. This is where you will save all the files and notes you wish to store on your computer. You might like to create a folder for friends or for your sports team. If you start the year organised and use your organisation always, you will never lose track of where you saved a photo or a document. Sometimes, it is a good idea to store everything for school in a folder named School2020 and then put your subject folders inside. This way you can tell the difference between English this year and English next year.

If you use a PC, you will use Windows Explorer. The Windows Explorer icon on the left can be found in the menu on the bottom of your screen. You can also just hold down the Window key and then click on the E key.

If you have a Mac, you will use Finder. The Finder icon on the left can be found in the menu on the bottom of your screen. You can also just hold down the Command key and then click on the F key.

3. You will need the Google Chrome browser installed on your computer to make it easier to use free Google Apps. You can do this by using a browser you already have installed.

Use this website: **https://www.google.com/chrome/**

If you have a PC you will have Microsoft Internet Explorer or Edge.

If you have a Mac you can use Safari.

4. Remove all distractions from your school laptop. Do not use your school laptop for:

- Games
- Social Media
- Chat

A good rule of thumb is to have a work machine (your school laptop) and a personal machine (your Games console, mobile phone or tablet). Keep them separated so you can reward yourself with fun activities without being tempted while working on school tasks.

YOUR SCHOOL PORTAL, EMAIL & PRINTING

1. Your school will have some portal, website or moodle for you to log into each day to access lesson resources, your timetable, school news information or other instructions.

Write the web link here:_____

2. Your school will have provided you with an email address.

Write your email address here: _____

3. You will need a separate password for your school logins. You will need to change these passwords each term. DO NOT make them the same as your laptop password.

Write a HINT ONLY here to help you remember the passwords each term

Term One: _____

Term Two: _____

Term Three: _____

Term Four: _____

4. Your school will have provided you with a storage location for your school work. Below, write the instructions on how to store you work while at school.

_____

_____

_____

_____

Each school will have their own instructions for accessing the school portal or website. It is important that all students have a guide to using the school portal and instructions on how to access the school email. The next two page have been left blank for these instructions to written or affixed.

IT CLASSROOM RULES

There are special rules for school IT labs and computer classes. Please fill in the space below by writing the rules provided by your teacher.

Fundamentals II
Google Apps for School

The number one software application used all over the world and on nearly every computer in all organisations is a word processor. You will need to learn how to use a word processor efficiently so you can write and submit your school assignments. We will be using the free online app, Google Docs.

You have been instructed in the first section of this chapter to install Google Chrome. This will ensure all your Google apps work well.

Word Processing using Google Docs

Open Google Chrome. It should open directly to Google as the homepage. At the top right of the page is an icon called a "waffle" made of nine dots. This opens a menu to all the Google Apps.

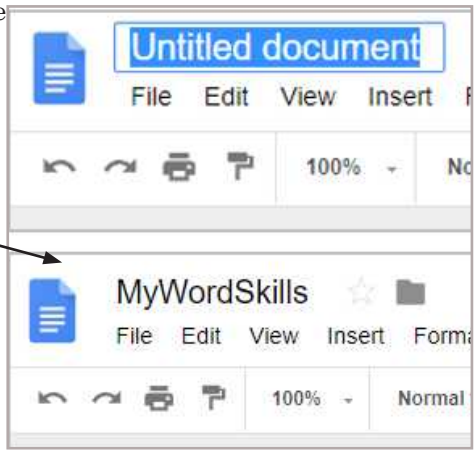
Google Docs Icon is a blue page icon.

1. Creating a File:

When you open Google docs, you should always rename your file first.

Select FILE and RENAME.

Rename your file – "MyWordSkills"



2. Creating a Table:

A table is a great way to organise your information.

Choose the INSERT menu then TABLE.

3. Editing Text:

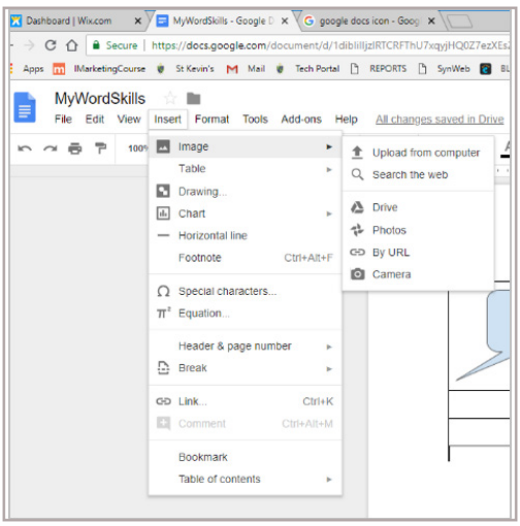
Changing font, font colour and size can be done in this menu below.

4. Adding Drawn Shapes & Pictures:

Insert a shape. Choose INSERT, then DRAWING.

Create an object with text in it.

Insert a picture. Choose the INSERT Menu.



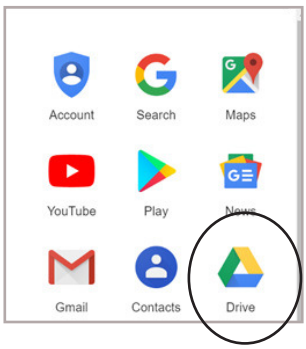
File Storage using Google Drive

In Fundamentals I we created folders on your computer to store your files. This is a great way of organising your notes, assignments and homework. If we save files into these folders we can access them if we have access to our laptop computer.

What if something were to happen to your computer? It might break-down, run out of battery or get left behind at home. You would not be able to access the files that are stored on it.

Google Drive allows you to save files "in the cloud". This means if you can access the internet and your Google Drive account, then you can access your files that you have saved there, from any computer.

Just like Google Docs, you access it from the waffle icon on the Google home page. You can see the icon circled on the right.



Once you open your Google Drive you will see your "MyWordSkills" document stored under Quick Access.

Google Drive is very easy to use.

1. Click on the + New or "My Drive" buttons on the top left. They reveal a menu that allows you to create a new Google Docs file or a folder.

2. Create a new folder called "Homework". You will see the folder appear below.

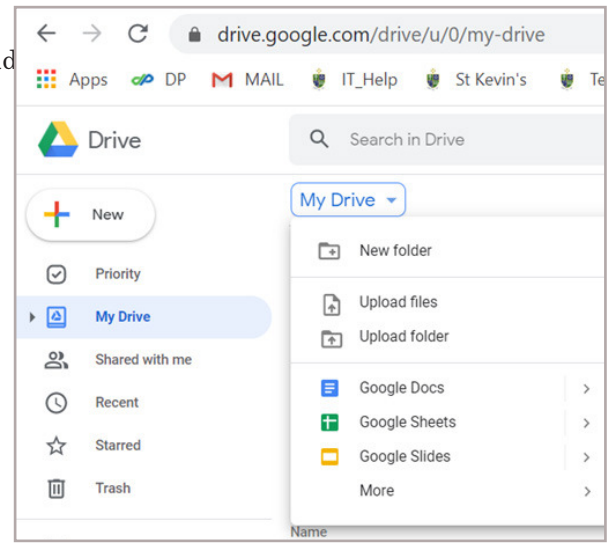
3. Find an image on your laptop.

4. Click on + New or "My Drive" and select "File Upload

5. Browse for the location on your file on your laptop.

6. Select your file and click Open or Upload.

7. Your file will upload and will appear in your drive.



Cloud Computing is useful for sharing files too. Sometimes you might need to work on the same document with a fellow student in a team. Google Drive allows for two or more people to edit the same file.

If your school uses Gmail this means all the email addresses at your school are managed by Google. This makes sharing files with teachers a lot easier. This could be a great way to submit your work or ask for some feedback on a draft assignment.

Effective Online Searching

What is Google?

Google is search engine. It is not a website and it is not a source of information. Google takes your keywords and searches for them on other websites. Google then displays links to those websites with some descriptive text about the pages. If you use an image search, it will display images from those websites. Google does not own or store that data. It merely displays the data. You need to click on the links to go to the author's web pages to view the source of the text, images or video. If you go to the source of data you will understand the context of the data better.

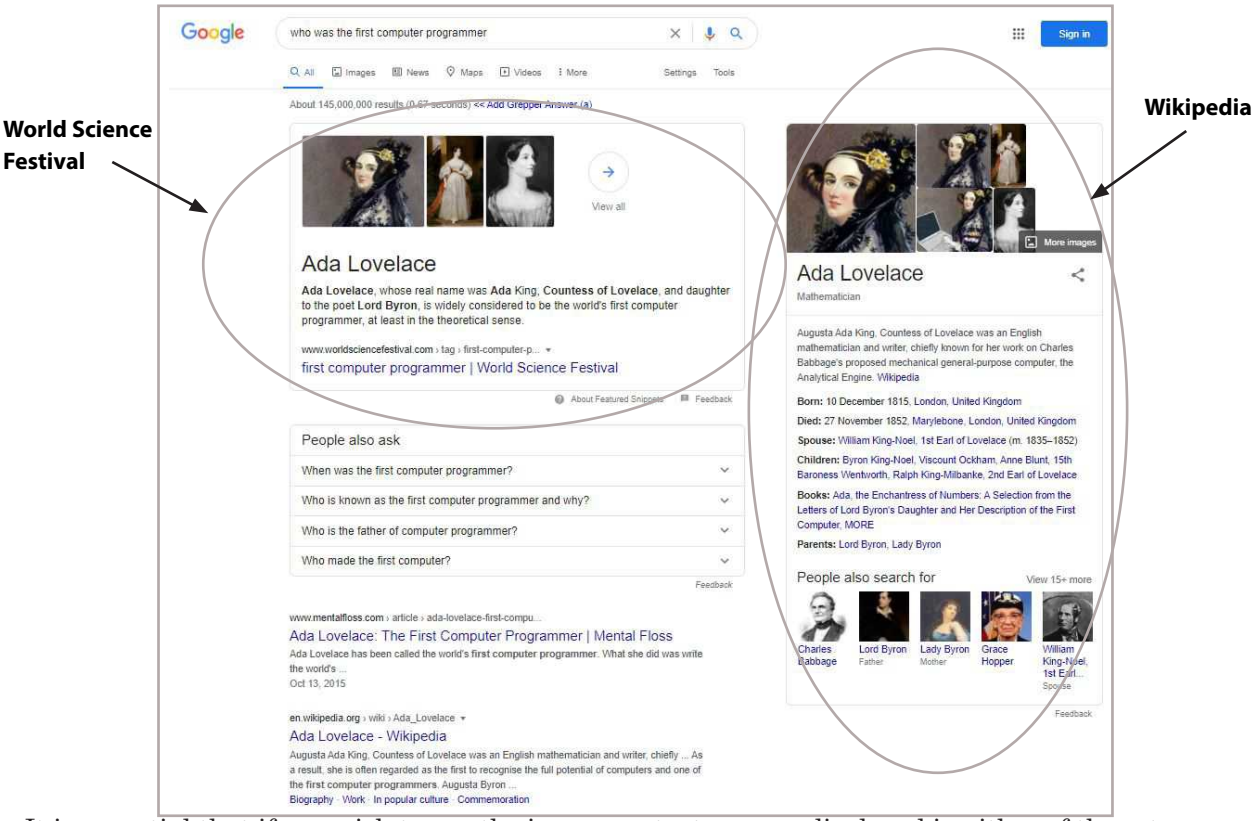
Google Search Example:

You are asked to do a research project on the history of computing where you must report on an important innovator. You decide to research who the first computer programmer was and discover more about them.

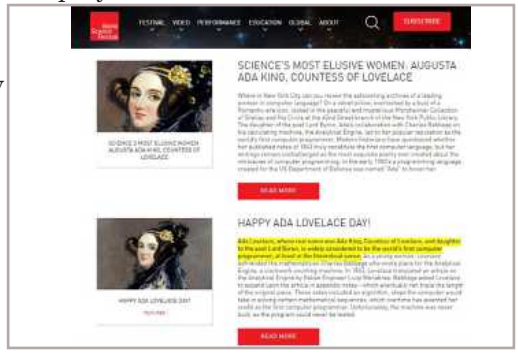
You enter the following key words into Google:

"Who was the first computer programmer?"

The search returns the results below. The two main sections circled are summaries from two separate web sites. The summary on the right hand side is from a Wikipedia page and the smaller at the top of the left hand side of the page is a highly ranked web site called "World Science Festival".



It is essential that if you wish to use the images or text you see displayed in either of these two summaries, to go to the original source pages to read the context and get further information. On the right you can see that the link to the World Science Festival page automatically highlights the summary text in yellow. Always check if the website is an authoritative source that you can rely on for correct information.



Keywords & Google

Sometimes you might search Google for an answer to a question and not find what you are looking for. There are some techniques you can use to find what you are looking for. Here is an example:

You are reading a science article with the word “cholate” in it. You want to know more about this word so you type it into Google and you get in return: “Did you mean chocolate?”

There are a couple of things you can do:

1. Add the context of the word to your search. It was a science article, so you can add the word “science” to the search.

2. You know you don’t want information about chocolate, so you can remove it from your search by typing a minus sign in front of it.

3. Now once you have a look through these search results, you will see more information more closely related to the term you are searching for. Some terms that are coming up are “Sodium” and “Salt”. We can add these to our search now and get more information. If we write “What is sodium cholate salt?”, we get a more detailed answer:

“It is an organic sodium salt. A trihydroxy bile salt that is used as a digestive aid in dietary supplements.”

As you can see, you do not always get what you are looking for in the first attempt to search, you need to experiment with adding and removing different keywords and looking beyond the first page of search returns. Click on the links rather than just reading the Google return page.

Let’s see if you can successfully answer the following questions using these techniques.

1. What does the term “Hoi Polloi” mean and where does it come from?
2. What is the name of Ashley McBryde’s song that is about a bar in a place with a name starting with “D”?
3. What is the oldest living thing in the world and where is it?
4. How long have humans been living in Australia. (The latest finding).
5. What is a logic gate? Describe it in words you understand.
6. Find other words for: “Enthusiastic”
7. “Get The Party Started” by P!nk was written by a member of which famous band?
8. Which species of crane is the tallest?

Writing a Report

When writing a submission for any subject it is important that you include some information and formatting to assist your teacher in being able to mark the submission and return it to you.

Below is a list of things you MUST include with every electronic document you create!

1. Name the file. Include YOUR name and the name of the task.

   For example: "Brian Evans_Science Report".

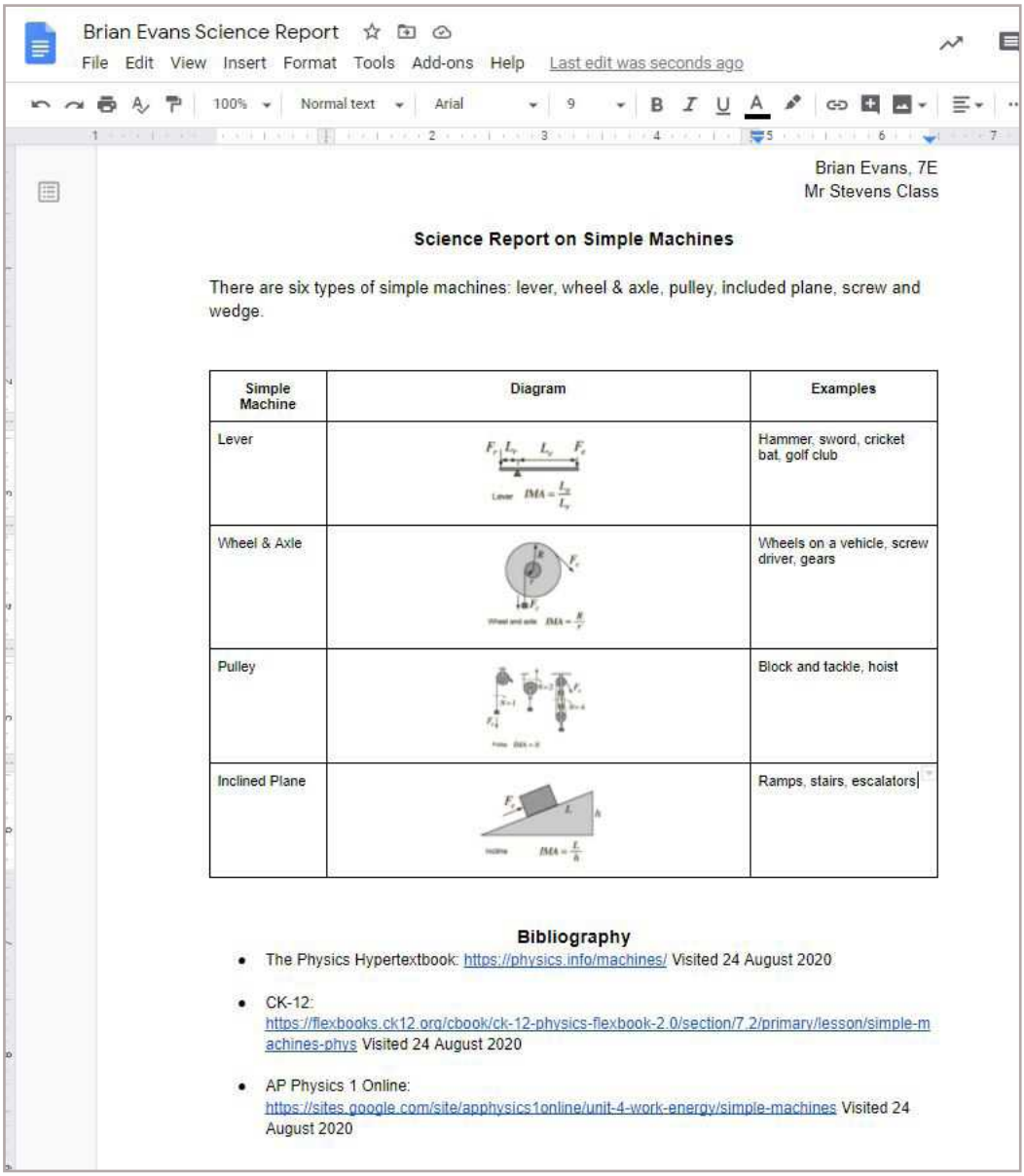
2. Put your name in the document. The best location is the top right. *(See example below)*

3. Put the name of your teacher in the document. *(See example below)*

4. Include a TITLE that identifies the assessment task.

   For example: "Book Report: The Outsiders by S. E. Hinton"

5. If you have used an online source in developing your submission, you must include the link in your bibliography. You must also identify the date you visited the website. *(See example below)*



Brian Evans Science Report

File Edit View Insert Format Tools Add-ons Help Last edit was seconds ago

Brian Evans, 7E
Mr Stevens Class

Science Report on Simple Machines

There are six types of simple machines: lever, wheel & axle, pulley, included plane, screw and wedge.

Simple Machine	Diagram	Examples
Lever		Hammer, sword, cricket bat, golf club
Wheel & Axle		Wheels on a vehicle, screw driver, gears
Pulley		Block and tackle, hoist
Inclined Plane		Ramps, stairs, escalators

Bibliography

- The Physics Hypertextbook: https://physics.info/machines/ Visited 24 August 2020
- CK-12: https://flexbooks.ck12.org/cbook/ck-12-physics-flexbook-2.0/section/7.2/primary/lesson/simple-machines-phys Visited 24 August 2020
- AP Physics 1 Online: https://sites.google.com/site/apphysics1online/unit-4-work-energy/simple-machines Visited 24 August 2020

Fundamentals III
Social & Ethical Use

RESPONSIBLE USE OF TECHNOLOGY

Digital technology and networks are powerful tools, When used responsibly, access to information on the world wide web, connections across networked computers can enhance your learning and your life. With great power, comes responsibility! You have the power to send a tweet that could make someone smile, or cause a defamation legal battle. You could keep in contact with friends from far away, or allow a criminal into your life. It is your behaviour with these powerful tools that will determine your safety and the safety of others. In this section we will examine the following key areas of responsible use of technology:

- Protect your Technology
- Staying Safe Online
- Authentic Sources
- Copyright and acknowledgement
- Netiquette

Protect your Technology

There is a wide range of intelligent software out on line that is ready to do damage to your computer. This is called 'malware'. Malware is any software build to be deliberately destructive. There are a wide range of malware types.

- Viruses are the oldest form of malware, and most people have heard of them. These are applications that are hidden from view, that install themselves to do harm to your computers. Sometimes they slow down your computer, sometimes they destroy your data or crash your computer device. Some capture your personal information to be sent to criminals to sell on the dark web.
- Worms are self replicating code that fills a network slowing down the transfer of data. The worm code fill the network band width so that user on the network can not access their data stores or the internet.
- Trojans are malware that appear to be games or some type of app that is desirable. When it is downloaded and installed, it unleashes it's destructive powers on your computer.

Some malware has been responsible for shutting down entire organisations, destroying years of hard work and wasting a lot of time and money.

Here are some things you can do to keep your devices free of malware:

- Keep your operating systems up to date. Every time new malware become prevalent, operating system developers make 'patches' to keep the bad guys out.
- Install anti-malware software and keep it updated. Following instructions your anti-malware provides you to eliminate any threats.
- Keep your firewall security set to 'High' and do not visit websites that result in a warning from your firewall or other anti-malware software.
- Do not give any of your usernames or passwords to anyone.
- Do not leave your device unprotected by a password.
- Do not open emails from people you do not recognise.
- Create regular back-ups of all your work on a USB memory stick, in the cloud or on an external disk.

Staying Safe Online

Venturing onto the world wide web can be like walking out into an unknown city. This can include playing MMO games where there are no controls over who has access to the games. You can never be sure who you are playing with unless you have arranged to be play with known friends and family.

Here are some rules that you should always keep in mind, while online.

1. If you are entering your email address into a website, expect to receive emails from that site. Create an email address that you use when signing up for 'free' online services. You can use that email address to collect the advertising messages, so you don't have to deal with them in your day-to-day email at school.

2. Never provide anyone with your photo, address or phone number online. If you use social media, ensure you have set our privacy settings to limit who can access your posts and photos. While you are under 18 years of age, you should limit your social media interactions to friends and family who you know in real life.

3. Passwords are for you and you only. No one will ever ask you for your password. If your family members share your device you should share your device password with your parents or guardians in case you need assistance. Keep you passwords changing each month.

4. If you find yourself disagreeing with someone online - always remain respectful in they way you communicate. There is no need to be rude online. Think carefully before posting something that could be hurtful online.

5. If you see, hear or read something that makes you feel uncomfortable, tell an adult about it immediately.

Authentic Sources

When we go online we can end up on any web pages hosted by anyone. The world wide web, is not written entirely by reputable content developers. We have to know where we can find reliable information.

Wikipedia is a massive information website that is developed and edited by keen volunteers. It is mostly reliable, and provides a detailed source list on the bottom of each page. A Google search will often return a Wikipedia page very high on the list. Although, Wikipedia is not 100% reliable, it is a great place to begin your research. Wikipedia will give you an overview of what you need to know. It may even be a bit out of date in some instances. Use the source listings at the bottom of the page to verify the information is correct.

Scholarly reviewed books and articles produced by researchers and professionals in their field for use in research, are the best sources. Unfortunately, unless you are member of a university that covers the cost to accessing these articles, you will find it very difficult to get access. You might even have difficulty in understanding sources at that level.

The next best thing are sources that have been developed by educational institutions and government organisations. Website that use the following n their URL web addresses:

- .edu/ sites come from U.S. academic institutions, and may be indicators of academic quality or thoughtfulness.
- .gov/ sites come from U.S. state, local, federal or foreign governments; these may be indicators of reliability, accuracy.
- .org/ sites can be non-profit organizations (museums, institutes, charities); these may indicate advocacy, thoughtfulness, reliability.
- .int/ sites come from international organizations, United Nations and sites involving treaties and international agreements.

Anyone who tries to register a domain name like 'jeffsmith.edu.au' would have to prove that they are a registered educational organisation and provide documentation to the domain server hosting the site.

Always look for a date on the page. Is it the most recent information? If you can not find a date, the information may not be reliable.

If you are unsure about a source, you can perform a Google search on the source (ie. jeffsmith) and find out what other website have to say about his authenticity.

Copyright & Acknowledgement

All students must get into the habit of identifying where they are getting their information, images and other data from, so that they can acknowledge their sources. It is not just an annoying thing teachers make you do, it is a habit you will need to develop throughout your academic life.

Copyright refers to the ownership of literary works, artistic works, musical works, computer programs, sound recordings, films and broadcasts. Basically, copyright is the exclusive right to copy. If you write an essay, take a photo, create a painting or write a song, you have exclusive right to copy, perform or publish that work. If anyone else wishes to perform, publish or copy your work, they must ask you permission. In most cases, you would could charge them a fee and outline the rules for its use.

Copyright is important so that composers, writers, artists and other content creators have a legal right to their own work and how it is used by others. It allows content developers to earn a living from their work.

Now if you use text, an image or ideas taken from a book or a website without acknowledgement you are essentially 'stealing' that information and telling your teacher that you created all the elements yourself.

In high school and in undergraduate study it is perfectly acceptable to find relevant sources for your academic work, and to write about what you find. However, it is crucial that you keep records of the original authors of the work and acknowledge them in a bibliography.

The APA (American Psychological Association) style of referencing is used in computer science and social sciences. If you have copied text from a document you have found online or ina book, you can use it as long as it is presented as a quote. For example:

> "All students must get into the habit of identifying where they are getting their information, images and other data from, so that they can acknowledge their sources. It is not just an annoying thing teachers make you do, it is a habit you will need to develop throughout your academic life." (Farrell, 2021)

The text has been taken from this page of the textbook and it is presented in quotations and followed by the name of the author and the year it was published. This means the reader can then go to the reference section of your report, or your bibilography and find the full reference.

Farrell, V.(2021) Digital Technology 2021-2022, A textbook for Australian Secondary Schools Year 7 - 10. Melbourne, Australia.

A reference is constructed like this:

Author's surname, Initial, (Date Published) Title of Book, Location of publisher.

or

Author's surname, Initial (Date Published) Title of Article, Location of publisher, Retrieved from (URL).

Netiquette

Most people experience abuse or other negativity online, through email, social media and other platforms. Do not be one of the people responsible for that negativity. Try the Grandma Rule - "If you wouldn't want your grandma to know about it - don't do it!"

Don't take on trolls who want to start arguments. Ignore them!

If you or a friend are being bullied by abusing or threatening messages, tell and adult. That behaviour is against the law. It is always a good idea to create a folder to store records of the abuse so you will have legal evidence later.

If a website has been banned by you school or parents, it is because there is a safety reason.

Never attempt to access someone's else's' email or computer without their permission. This is also against the law.

Foundation Level

ACARA CURRICULUM

Digital Technology Knowledge and Understanding

ACTDIK023 Investigate how data is transmitted and secured in wired, wireless and mobile networks, and how the specifications affect performance.

ACTDIK024 Investigate how digital systems represent text, image and audio data in binary.

Digital Technologies Processes and Production Skills

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ACTDIP026 Analyse data and visualise using a range of software to create information, and use structured data to model objects or events.

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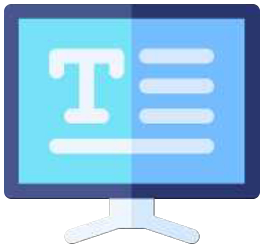
ACTDIP030 Implement and modify programs with user interfaces involving branching, iteration and functions in a general purpose programming language.

ACTDIP031 Evaluate how student solutions and existing information systems meet needs, are innovative, and take account of future risks and sustainability.

Suitable for all year levels

1a. Foundation ICT SKILLS

Word Processing

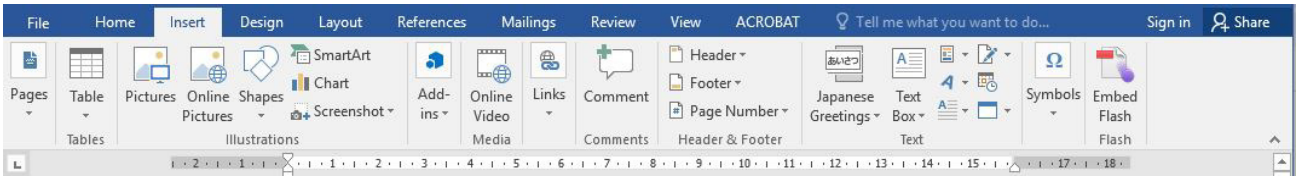


Mastering word processing is essential at all levels of education. Many students rely on Google Docs because it is freely accessible but the most commonly used application is Microsoft Word. In this chapter we will look at some features of Microsoft Word that will assist all students in presenting their school assignments effectively.

Microsoft Word is organised with "Ribbons" that appear under each of the menus. We are going to use the following ribbons: Home, Insert, Design, Format, Layout and View.

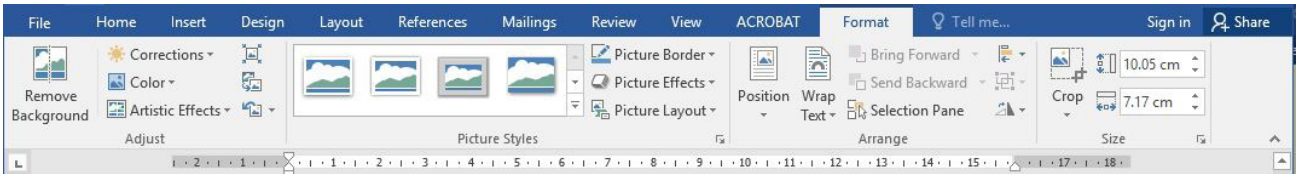
Home Menu

Insert Menu

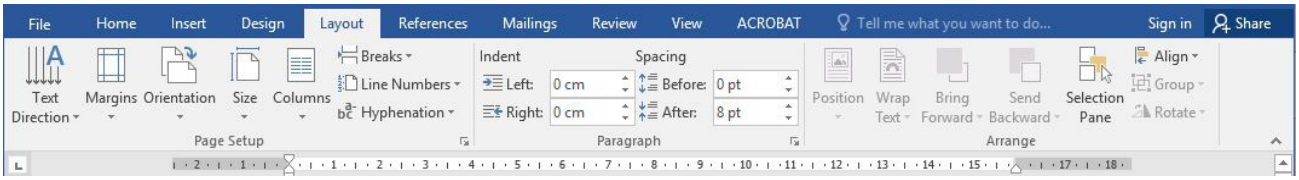


Design Menu

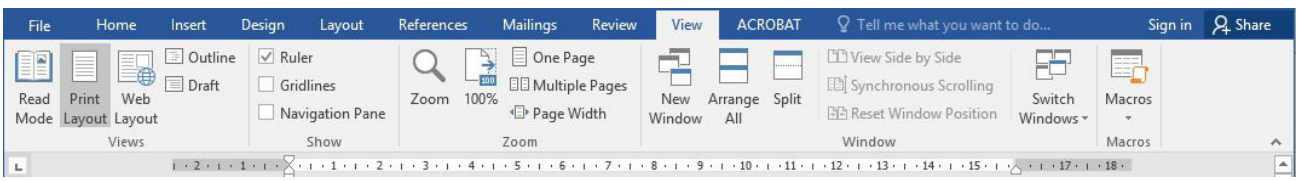
Format Menu



Layout Menu



View Menu



We are going to create an assignment with the following features:

- Header with student name
- Footer with page numbers
- Inserted image
- A table that has been edited with the ruler
- Use of shapes
- Numbered lists and dot points
- Edited fonts

We are going to make the following document in Figure 1.1 below.

Fig 1.1

Brian Evans, 7E

Ms. Farrell

CORE IT SKILLS

Introductory Skills Report

1. Important Web Links:

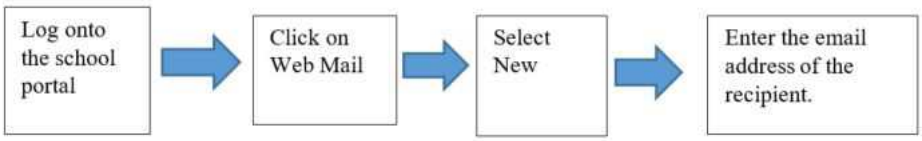
School Portal Login	https://www.myschool.edu.au/
Library	https://www.myschool.edu.au/Library
Google Drive	https://drive.google.com
Email	https://mail.google.com

2. Saving your Work:

When saving a document for the first time, use SAVE AS so you can identify where you are saving the file and how you are going to name it.

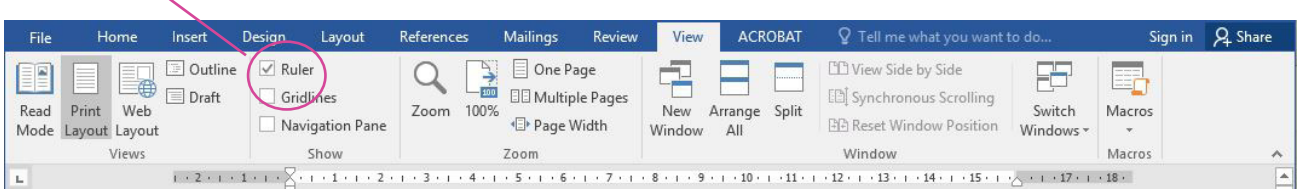
While editing the document once it has been named, repeatedly use SAVE to ensure your changes are not lost.

3. Using Email:

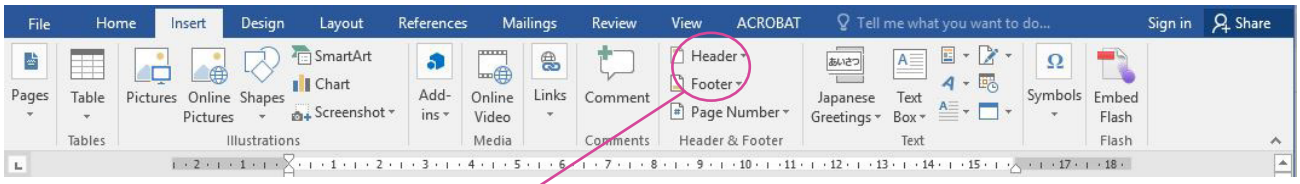


Page 1

First we need to set up the screen with the ruler visible. Go to the "View" menu and make sure the ruler box is checked.



This will show the ruler across the top of your word document. The ruler allows you to control the margins of the pages and the size of the rows and columns in a table.



We are now going to edit the header and footer of our document on the "Insert" menu. This will open two new sections on your document. All your assignments that you submit at school should have your full name and class included in your Header. No matter how many pages you create, each page will have your name and class on it.

Now scroll down to the bottom of your page and write "page". We are going to add a page number using an automated feature in Word. Select "Page Number" and "Current Position" and it will automatically update the page number as you add pages to your document.

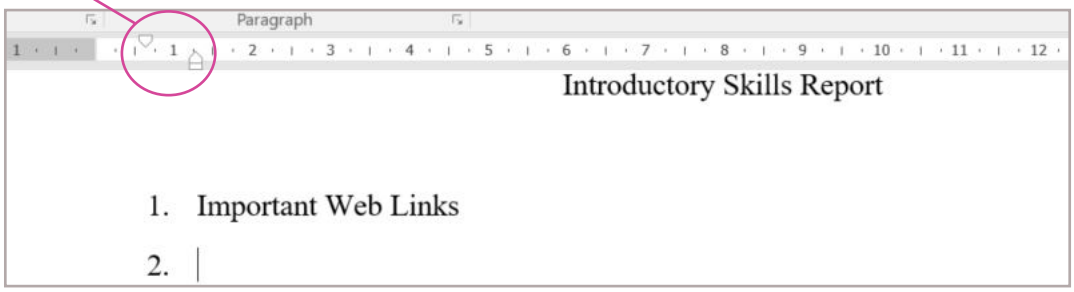
We are going to assume you know how to add text and edit bold, alignment and other font elements.

Let's type:

CORE IT SKILLS and Introductory Skills Report.

When we type "1. Important Web Links" Word may automatically indent from the left. When you hit enter it may automatically create a new line beginning with " 2. ". We can use the ruler to control our tab indents.

There are two white controls on the ruler that show the depth of the indent and the location of the number.

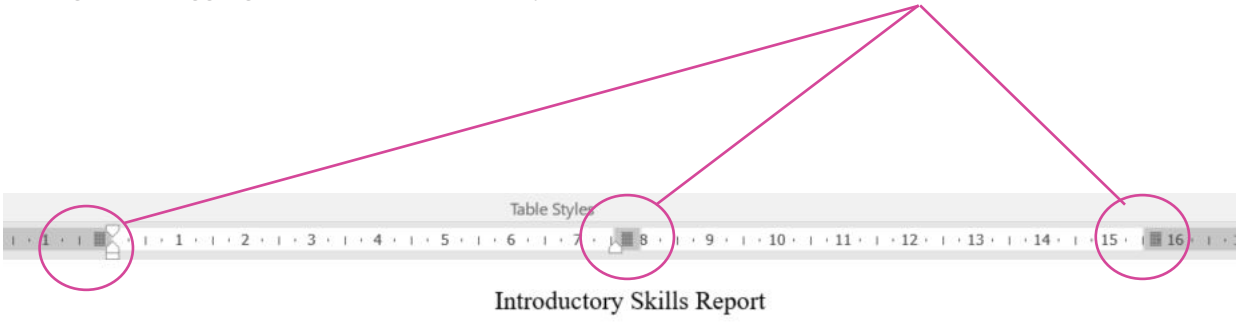


Click and drag these controls back and forth to see how they work.

We don't want the "2" just yet, so hit the enter button a couple of times to provide some room for your table.

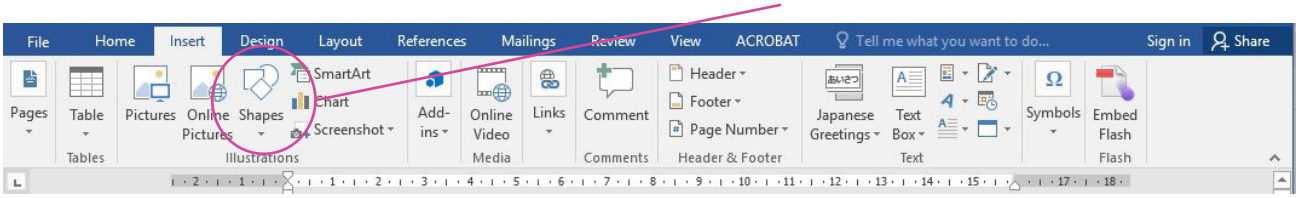
We want to add a table under our first point. Let's open the "Insert" Menu again and select "Table" to see the pull down menu. Select "Insert Table" and a new window will open. Add 2 columns and 4 rows and hit "OK".

Now you should have something like the table below. You can see three grey tabs on the ruler. Try clicking and dragging them and see how they affect the table column widths.



Complete the table with the important school web links that your teacher will provide. Complete the second and third points.

Below the third point we are going to create a diagram using Shapes in Word. We need the "Insert" menu.



Under Shapes we can choose Text Boxes and other shapes. Experiment with some of the options. Create a diagram that illustrates how you access your school email.

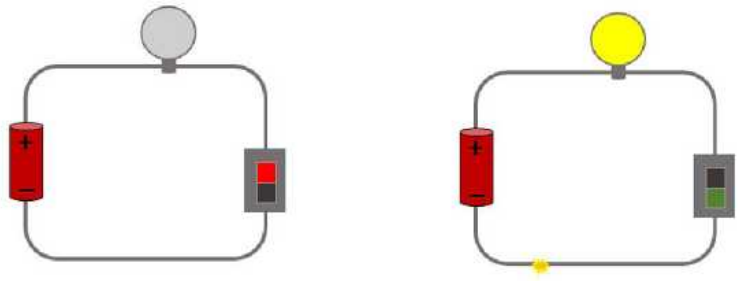
PowerPoint Animation

There is an old saying: "Death by PowerPoint". It refers to the boredom experienced by audiences and students everywhere having to sit through a long boring PowerPoint Presentation.

This section will teach you how to make real animations in PowerPoint so you can demonstrate exactly what your presentation is about.

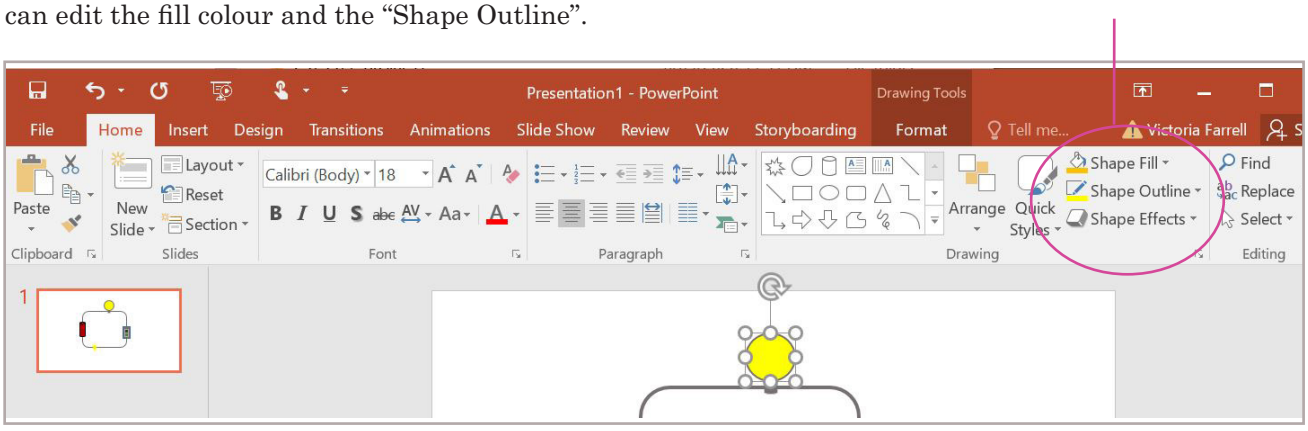
We are going to animate this illustration below. It depicts a circuit turning on and off. When the circuit is on (and the light globe is lit) it creates ones. When the circuit is off it creates zeros. Ones and zeros are the basis of the binary system. This is the way computers store data.

Fig 1.2



OFF = 0 **ON = 1**

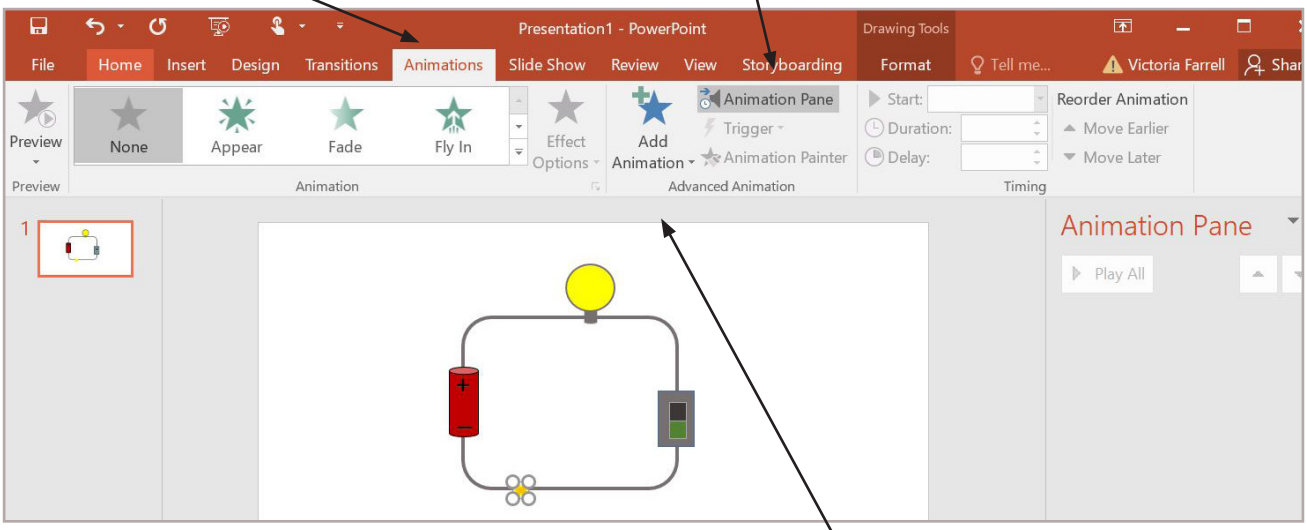
We are going to draw this circuit using the same Shape tools in PowerPoint that we used in Word. They can be found in the "Insert" and the "Home" menu. You will need to edit your shapes using Format. You can edit the fill colour and the "Shape Outline".



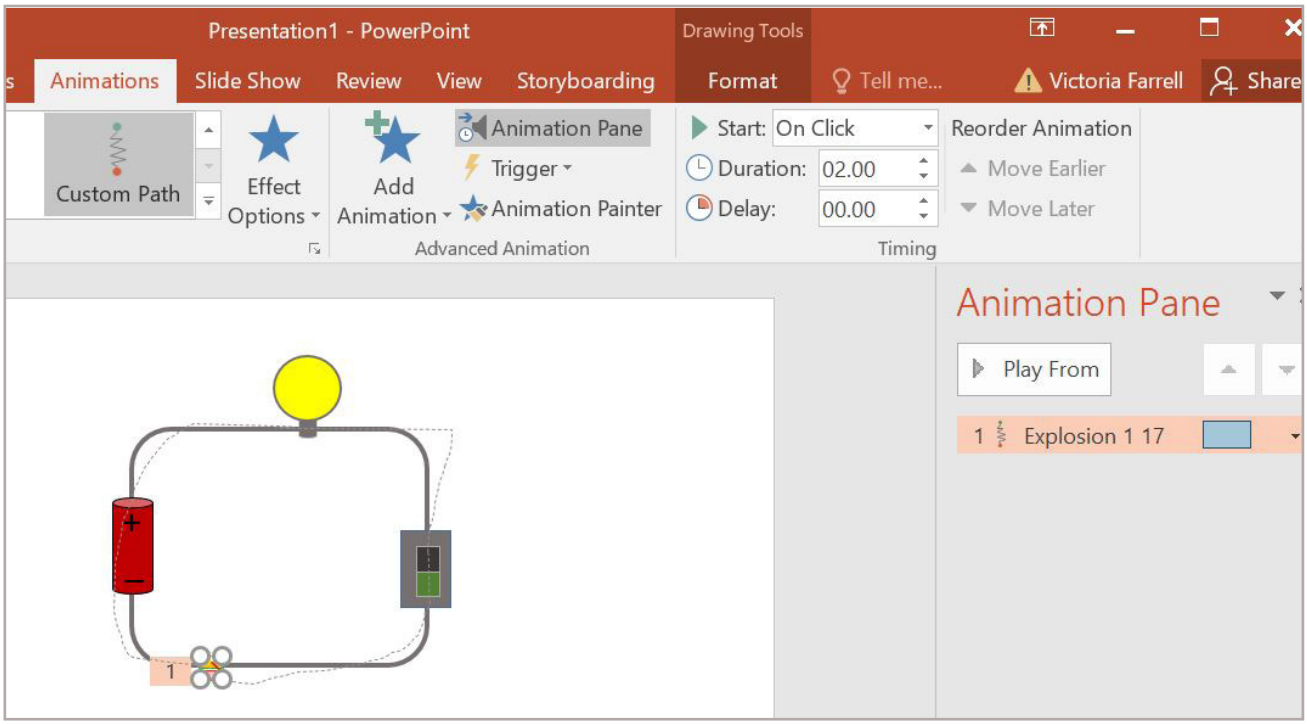
You can see that the yellow circle is selected and the Format Drawing Tools is visible. Once the object is selected , you can edit the colour and the width of the outline.

Before we start animating our drawing we need to open the Animation Pane. It must be open all the time so we can edit the order of the animations and durations.

Select the "Animation" menu and then the "Animation Pane"



When we animate an object we must click on the "Add Animation" button and then we can select the type. Select the object that we have put on the circuit to signify the electrical pulse. The first animation we are going to do, is a "Custom Path". You need to scroll down to the bottom of the Animation Types pull down menu to find it. We can now draw our animation around the circuit.



You should be able to watch the animation once you complete your path with a double click. The animation will now appear in the Animation Pane. It will be numbered and the dotted line on the diagram will also be numbered to show which animation it is.

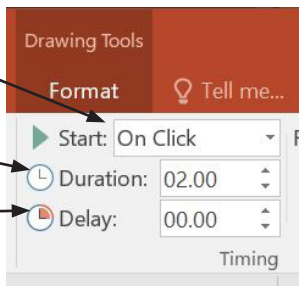
Now we need to make sure the animation doesn't wait for a mouse click, in fact we want our whole animation to just play like a video.

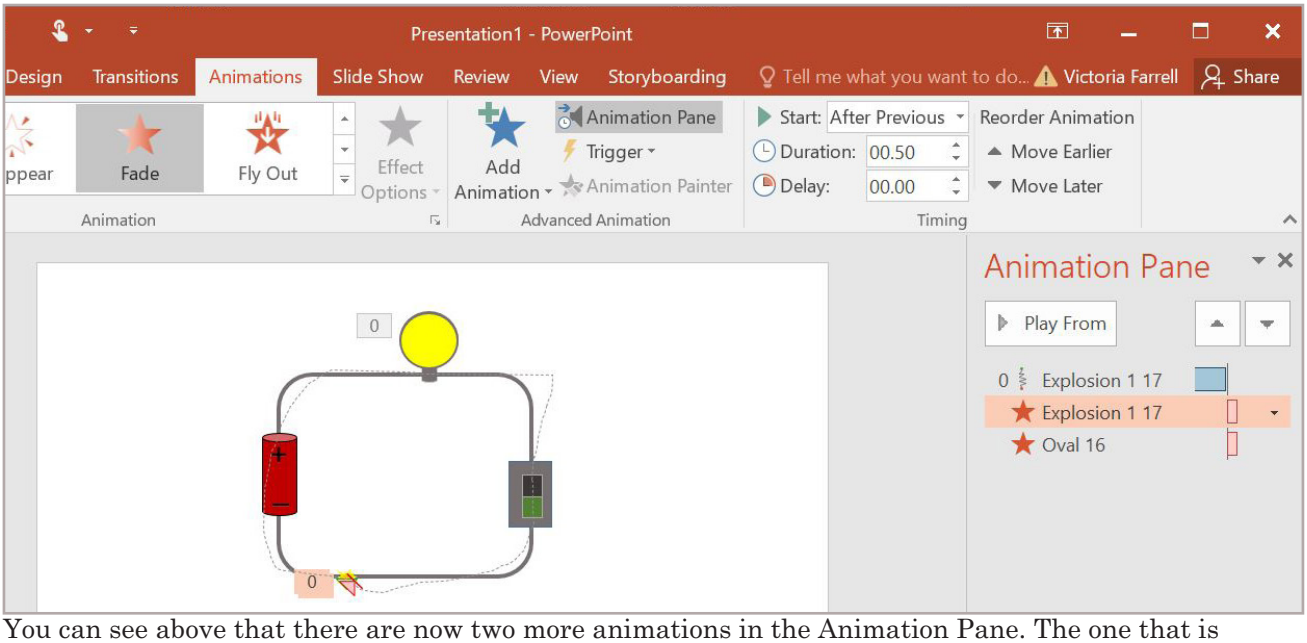
We can change the "Start" setting from "On Click" to "After Previous".

We can even make two animations happen at the same time by setting "With Previous".

If we want to change the speed of the animation we can change the Duration.

Finally, we can delay the beginning of the animation by adding values here.





You can see above that there are now two more animations in the Animation Pane. The one that is selected is a Fade Out. It is set to "After Previous". The animation below it is the oval that represents the light globe in the diagram. It is set to "With Previous" so it will Fade Out at the same time as the electrical spark.

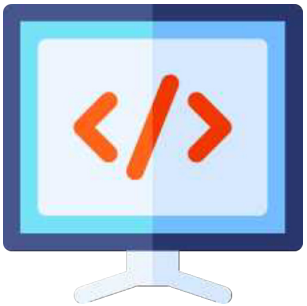
You can also click and drag the order of the animations in the Animation Pane. Ideally the next option is to turn off the switch from On to Off, by fading the green square out and fading the red one in.

Can you animate the circuit to show the switch ON and the electricity moving around the circuit with the light globe glowing?

Can you animate the switch so it is turned off and the electricity disappears and turns off the light?

How will you show that the ON light = 1 and the OFF light = 0?

Web Development I



There are plenty of ways to make a web site, but it is important to learn how web pages are made. All web pages are made of HTML (HyperText Markup Language). It is very easy to learn and we are going to make a very basic website. We only need a text editor and a browser. We also need to be very good at knowing exactly where we are saving our files and what we are saving them as.

We need a text editor. PC computers come with Notepad which is fine. Mac computers may need to download a text editor like Atom from https://www.atom.io.

We need a browser. Chrome is very forgiving with wonky HTML so I recommend using it in preference to Safari or Internet Explorer.

The first step is to create a directory (or folder) to store all the files you will use in your website. Let's call this main directory "Website". Inside it, we will need another directory for our images. If you look at the Figure 1.3, you can see how we need to organise our files. You can not use any short-cuts. You must ensure you know exactly where the files are stored.

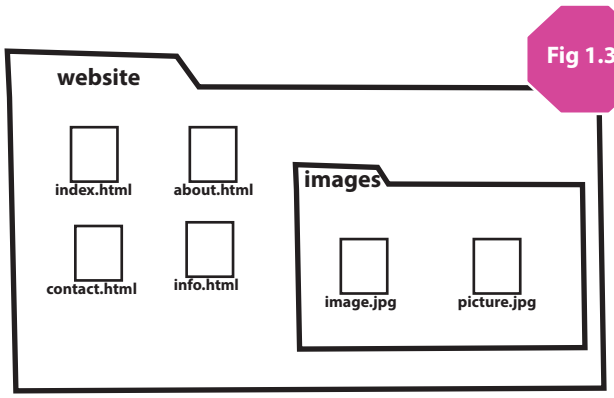


Fig 1.3

If you use Windows, avoid using "Recent Files". You can get into some sticky situations where you have two identical files in different locations.

If you use Mac, get to know your Finder menu. Save your directory in your "Documents" directory. Keep your folder open and visible on your screen at all times!

HTML is a scripting language. This means it needs a program to interpret it. HTML creates instructions for an internet browser to organise text, images and other media on the screen. At the foundation level, we are going to make some very basic HTML pages with a menu so that all pages are linked together. This section is not comprehensive. For more information about HTML visit: https://www.w3schools.com.

HTML controls content with tags. For example:

```
<b>This is bold text</b>
<center>This text is centred</center>
```

You can see in the example above that there is an OPEN bold tag and a CLOSE bold tag . Everything between these two tags ill be formatted bold. The open and close tags affect the text between them the same way. You might notice that 'center' is spelt in the American way because HTML was developed in America.

```
<!DOCTYPE html>                          ← Open HTML tag. Declares the whole document as HTML
<head> My First Website </head>          ← Places text in the header of the window
<body>                                   ← Open Body tag. Everything between the body tags is
                                           visible on the web page.
<center>                                 ← Open Center tag to centre the Heading.
<h1>Heading</h1>                         ← H1 is the largest heading size.
</center>                                ← Closes the Centre tag.
This is some content written on the page. ← Content text
<p>                                      ← P tag creates a paragraph break
<img src="images/picture.jpg">           ← Image tag finds the image file in the Images folder
</body>                                  ← Close Body tag.
</html>                                  ← Close HTML tag.
```

When writing HTML you will need the text editor and the browser visible on the screen as well as the file finder or windows explorer so you can see the location of your files. When all three windows are visible on your screen you can make changes easily and see those updates immediately. In Figure 1.4 you can see the file "index.html" in the Website directory (Folder) so it can be clicked and dragged into either the browser or the text editor.

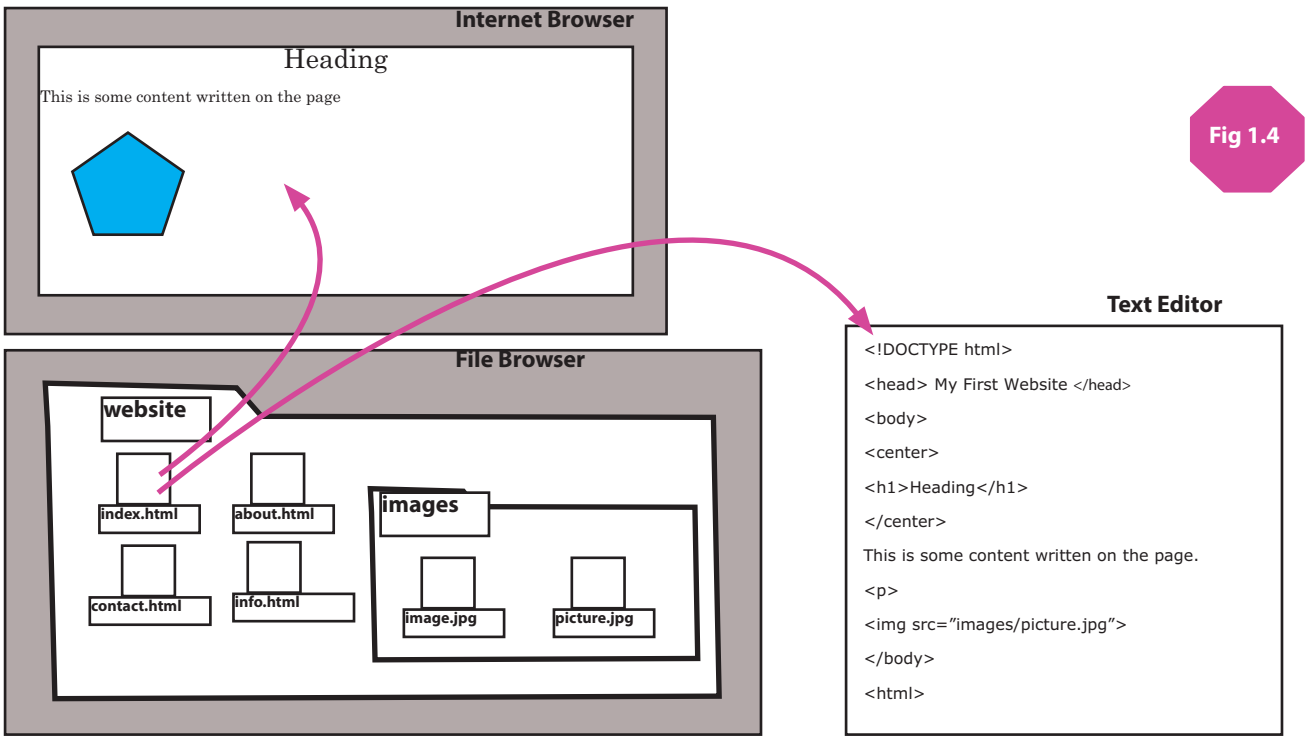


Fig 1.4

We are going to design our index.html home page and then create copies of it to make the other pages. We need to include tables to organise the content and we need links to connect the pages together.

A table organises the layout of the content. If we want two columns and three rows, we use <tr> for row and <td> for each data cell.

```
<table>
<tr>  <td></td>  <td></td>  </tr>
<tr>  <td></td>  <td></td>  </tr>
<tr>  <td></td>  <td></td>  </tr>
</table>
```


```
<table>
<tr>  <td>One</td>  <td>Two</td>  </tr>
<tr>  <td>Three</td>  <td>Four</td>  </tr>
<tr>  <td>Five</td>  <td>Six</td>  </tr>
</table>
```

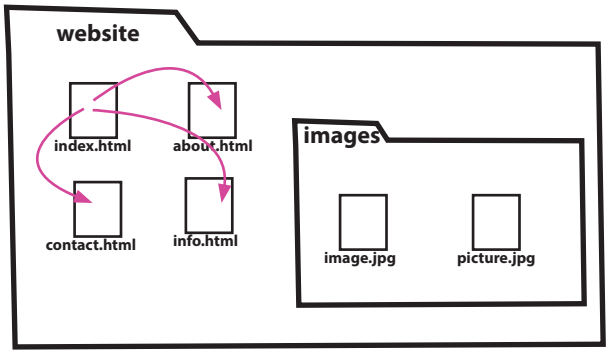
One	Two
Three	Four
Five	Six

The other thing we need to do is create a menu of links to all the other web pages in the site. We also need to create a link to our images in our image folder.

Our four pages are called:

- index.html
- about.html
- contact.html
- info.html

We only need to complete ONE page (index.html). Once we have finished the page and we are happy with the design, we can make copies of it for the remaining three pages, so we don't have to repeat the coding. We only have to change the content.



We need to design the links. We know what the pages are called so our links will be:

```
<a href="index.html">HOME</a>
<a href="info.html">INFO</a>
<a href="about.html">ABOUT</a>
<a href="contact.html">CONTACT</a>
```

Open Link tag is .

Close Link tag is .

The text between the tags is the visible link.

Let's put it all together:

```
<!DOCTYPE html>
<head> My First Website </head>
<body>

<center>
<h1>Heading</h1>
<table>
        <tr>
                <td> <a href="index.html">HOME</a> </td>
                <td> <a href="info.html">INFO</a> </td>
                <td> <a href="about.html">ABOUT</a> </td>
                <td> <a href="contact.html">CONTACT</a> </td>
        </tr>

</table>
</center>
This is some content written on the page.
<p>
<img src="images/picture.jpg">
</body>
<html>
```

This is our original website from the previous page with the menu in a single row table.

You can see that the table has only one row and four data cells.

In each data cell is a link.

You should look closely to see where the close tag is located. What will be centered?

The diagram on the right illustrates how the HTML code above will look in Chrome.

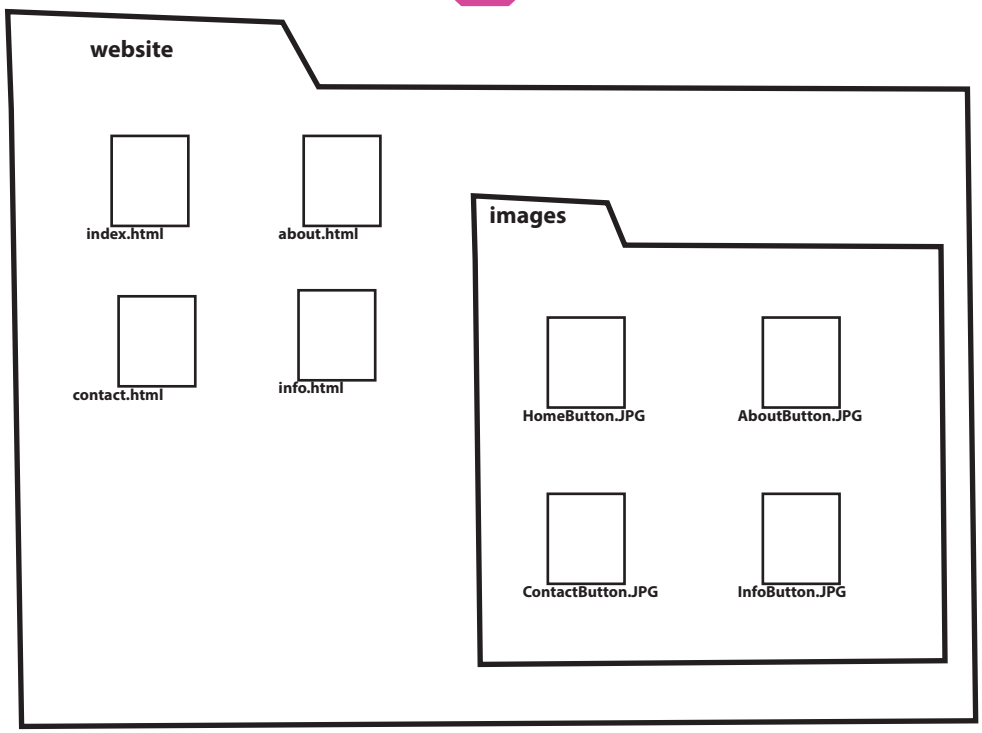
This design is ok, but it's not very attractive with text links. We can use what we know about image links to create buttons in our menu instead.

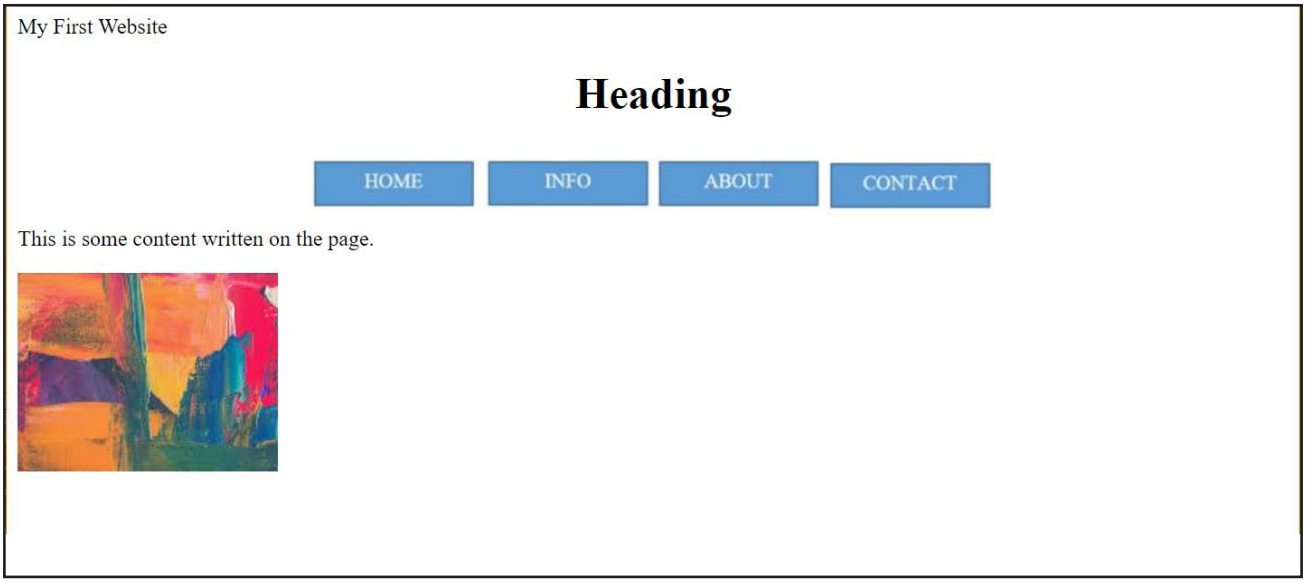
Why not make four buttons and save them as jpeg files in the "images" folder?! You can use Word and Snipping Tool to create your buttons if you have Windows. If you have a Mac, use Word and then Shift ⌘ + 4 to capture your images and save them.

In Figure 1.5 on the next page, you can see how the four buttons need to be saved into the "images" folder and how the code must be put together to make the menu.

```
<!DOCTYPE html>
<head> My First Website </head>
<body>

<center>
<h1>Heading</h1>
<table>
        <tr>
          <td> <a href="index.html"><img src="images/HomeButton.jpg"></a> </td>
          <td> <a href="info.html"><img src="images/InfoButton.jpg"></a> </td>
          <td> <a href="about.html"><img src="images/AboutButton.jpg"></a> </td>
          <td> <a href="contact.html"><img src="images/ContactButton.jpg"></a> </td>
        </tr>

</table>
</center>
This is some content written on the page.
<p>
<img src="images/picture.jpg">
</body>
</html>
```

Fig 1.5





Once you are happy with your design (see the example above) you can complete your website. It is really very easy. Just SAVE AS "info.html"! Then edit the heading to "Information". Then SAVE AS "about.html" and edit the heading and do the same for "contact.html".

All your documents are complete and the links should all work. If they don't, check your spelling of the files and the location of the files.

Now you can put information into each of the pages! Happy Web Making!

Turtle Programming

We are going to start to learn programming with real code. The code is called Python and there are a lot of free resources online to learn this language. Just look for the Python logo when googling for free lessons.

When you start to learn programming it can be tricky to get your head around it. We start by giving a little turtle instructions. In the Python language we can create all kinds of cool designs using instructions that boss a turtle around the screen leaving behind a trail or line.

Imagine our turtle is facing right and we give it an instruction to go FORWARD 100 steps.

Then we can tell the turtle to turn RIGHT by 90 degrees! and then FORWARD 20 steps.

We could get our turtle to create a square:

FORWARD 20 steps, RIGHT 90 degrees, then FORWARD 20 steps, RIGHT 90 degrees, and FORWARD 20 steps, RIGHT 90 degrees, and then FORWARD 20 steps, RIGHT 90 degrees.

Looks like we have some repetition going on there!

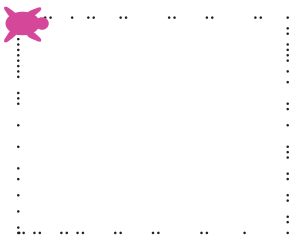
What computers are really good at is automated repetition so we, the humans, don't have to!

We know the square needs to include FORWARD 20 steps then RIGHT 90 degrees four times. Let's tell the computer to repeat the instructions four times rather than writing the instructions out line by line. (We don't want to get RSI from typing!)

We can use a FOR Loop: "for Counter in range 4:"

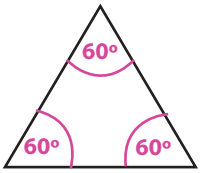
This will repeat any following instructions four times. Here is what the actual Python code will look like:

```
from turtle import *

for COUNTER in range(4):
        forward(20)
        right(90)
```



The first line is importing the turtle module so we can use it to program our designs. It uses an asterisk (*) which indicates ALL the sub routines are needed to make the turtle programming work in Python. The next line uses a counter will change in value from 1 to 4 because the range is set to four. Finally, the instructions for the turtle require the words "forward" and "right" to be all lowercase and the sets and degrees must be in brackets. These rules are called Syntax. Syntax is the grammar of the programming language - just like English has rules, we must follow rules in Python too. You will also notice the instructions under the "for" loop are indented. This is not just to make it easier to read, but is an essential part of the syntax rules of Python.

OK! Now we can give directions to our turtle to draw anything we like. Let's draw an equilateral triangle. All the sides must be the same and all the angles the same. Your Maths teacher will have told you that the internal angles of a triangle should add up to 180 degrees.



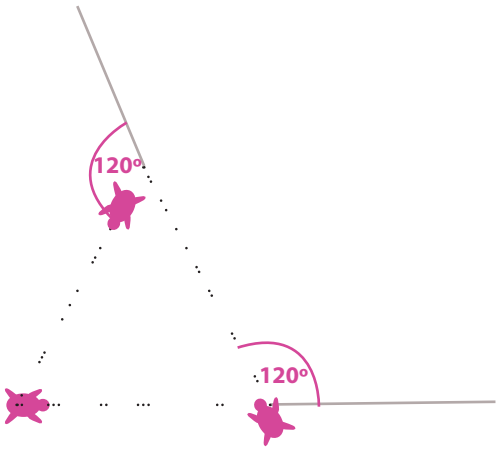
Each of the three internal angles will equal 60° as you can see in the triangle on the left.

But let's look at the journey of our turtle on the right.

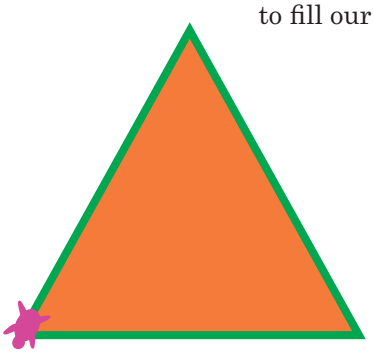
First turtle is facing right so it needs to turn left a full 120°. Turtle can travel forward and again needs to turn left 120°.

So you do need to know a bit of geometry to get this right.

Why is the angle 120°? Do you know?



Once we know what we want to draw, we can add colour to our lines and colour to fill our shapes.



```
from turtle import *
pencolor('green')
pensize(5)
fillcolor('orange')
begin_fill()
for COUNTER in range(3):
    forward(100)
    right(120)
end_fill()
```

It is difficult to draw what you want when you can't lift your pen off the page and move it somewhere else. So python lets you you do that with the instructions: penup() and pendown().

Read the code below and draw the shape it makes in the space below. If you are not sure, run the code in Python and see what it does!

```
from turtle import *
pencolor('black')
pensize(5)
fillcolor('red')
begin_fill()
for COUNTER in range(3):
    forward(100)
    left(120)
end_fill()
penup()
right(90)
forward(10)
pendown()
pencolor('black')
pensize(5)
fillcolor('blue')
begin_fill()
for COUNTER in range(4):
    forward(100)
    left(90)
end_fill()
```

Draw the result of the code in the box below.

Where you can find resources for PythonTurtle for free:

Grok Learning: https://www.groklearning.com

Online Python: https://repl.it/languages/python_turtle

PythonTurtle: http://pythonturtle.org/

Trinket: https://trinket.io/python

RealPython: https://realpython.com/beginners-guide-python-turtle/

Turtle Online: https://www.turtle.ox.ac.uk/online/

Python is a great language to learn. It's easy, commonly used and... it's the language that Google is built with!!

If you are keen to learn more, the Python IDLE (Integrated Development and Learning Environment) can be downloaded for free from: https://www.python.org/

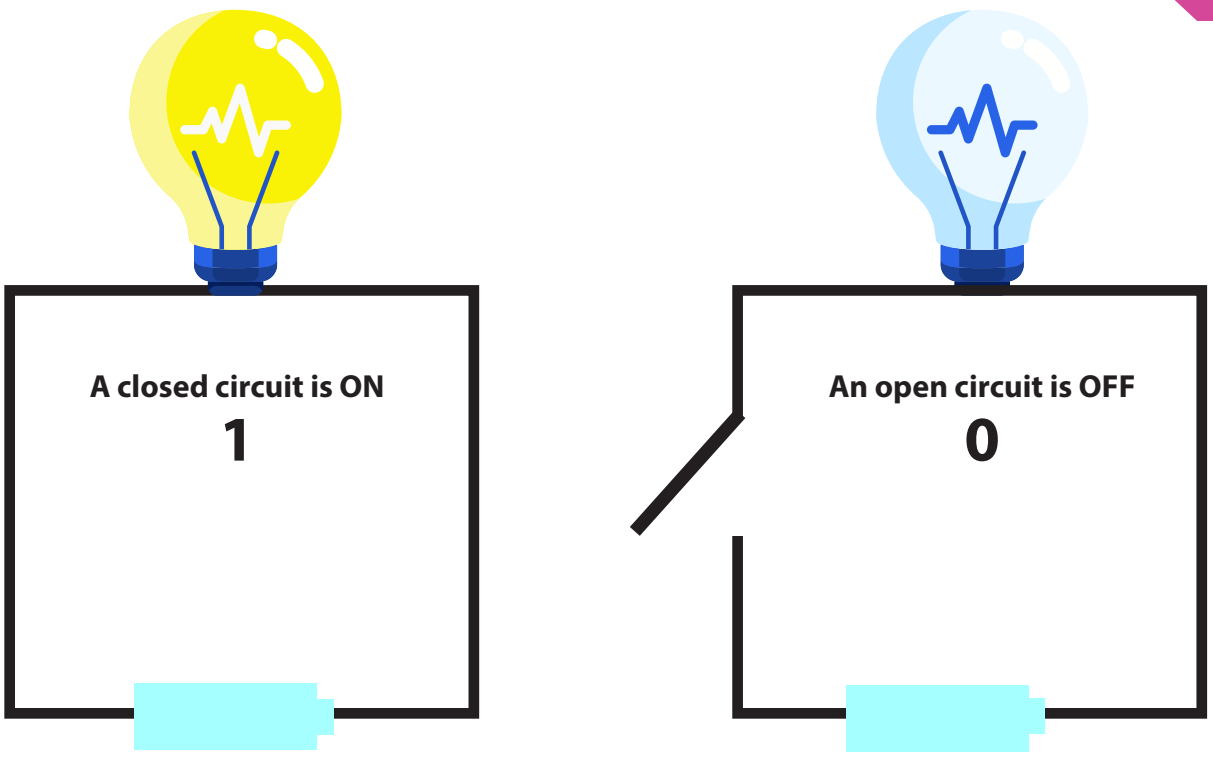
You can install the IDLE on your own computer and be a real computer programmer.

1b. Foundation Digital Technology

Binary

Computers are just things made of glass, metal and plastic. They do not understand anything. They do not think. The only thing computers really understand about the world around them is where electricity is moving through their circuits. A circuit allows electricity to flow in order to do work, like turn on a light or turn a wheel. When electricity flows through a computer circuit it is registered as a ONE. When the electricity stops it is registered as a ZERO.

Fig 1.6



In Figure 1.6 above you can see the two states a circuit can be ON and OFF. Humans have a hard time understanding data as circuits flashing on and off, so if we call the two states, one and zero, we can make a system that humans can understand. With these two values we can make a number system called Binary.

We are familiar with the Roman number system that used Is and Vs and Xs.

For example:

I, II, III, IV, V, VI, VII, VIII, IX, X, XI etc...

We don't use this number system anymore because it was too hard to do mathematics. How would you calculate CXXVI ÷ VI without the use of the decimal system? Roman Numerals look great carved on buildings and on the credits of movies, but they're too hard to use in simple arithmetic.

Let's go back to something we are more familiar with: Decimal! Decimal is a number system based on the number 10 and it uses 10 symbols (0,1,2,3,4,5,6,7,8 and 9) to make all the numbers. In the Table below you can see how decimal numbers are made up of powers of 10. The three is in the thousands place, the 2 is in the hundreds place, 4 is in the tens place and 8 is in the unit's place = 3248.

10^3	10^2	10^1	10^0
1000	100	10	1
3	2	4	8
3 x 1000	2 x 100	4 x 10	8 x 1

In the decimal system we have 10 symbols to play with to make our numbers, but in binary we only have two symbols: 0 and 1. In the table below you can see that each column is set up the same way as the table above. Instead of powers of 10 we are using powers of 2. Instead of the 1's place, the 10's place the 100's place and the 1000's place, we have the 1's place, the 2's place, the 4's place the 8's place, etc. You may be familiar with these numbers. When you buy a computer device such as a mobile phone or a USB memory stick, the memory is always one of these numbers 4, 8, 16, 32, 64, 128 and so on. Binary code is the reason.

In the table below you can see the numbers 0 to 7 completed as binary. Since you only have 0 and 1 to put in each location, you need to add up the values at the top of the columns.

For example 5 is (1 x 4) + (0 x 2) + (1 x 1). You will see a 1 in the 4 space, a 0 in the 2 space and a 1 in the 1's space. This means 4 + 1 = 5.

Let's look at 7 and 8.

7 = (1 x 4) + (1 x 2) + (1 x 1)

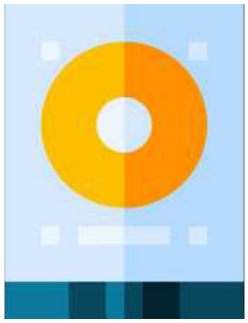
8 = (1 x 8) + (0 x 4) + (0 x 2)+ (0 x 1)

Now it's your turn. Fill in the rest of the table Fig 1.7

Fig 1.7

2^5	2^4	2^3	2^2	2^1	2^0	
32	16	8	4	2	1	DECIMAL
					0	0
					1	1
				1	0	2
				1	1	3
			1	0	0	4
			1	0	1	5
			1	1	0	6
			1	1	1	7
						8
						9
						10
						11
						12
						13
						14
						15
						16
						17
						18
						19
						20

Data Storage & Memory



When we enter data into a computer it needs to be held there using memory, even if it is just temporarily. Memory is storage space for data on a computer device.

RAM (Random Access Memory) holds data temporarily until the it is stored permanently.

A hard drive (HD) in a computer can store data permanently so you can access it again later. This is where you save your files to when you use Save As.

What is a bit?

The ones and zeros created by our computer circuits are called bits (1 or 0).

What is a byte?

One byte is made up of 8 bits. Each character that you type in from the keyboard is represented as a single byte.

We rarely measure computer memory in bytes because they are too small. The next unit above byte is kilobyte. A kilobyte is 1024 bytes because it is calculated by 2 to the power of 10 (2^{10}). All units increase by 1024. The table in Fig 1.8 below illustrates the memory sizes.

Fig 1.8

Unit	Description
Bit	A bit is a one or a zero.
Byte	1 Byte = 8 bits
Kilobyte	1 KB = 1024 Bytes
Megabyte	1MB = 1024 KB
Gigabyte	1 GB = 1024 MB
Terrabyte	1 TB = 1024 GB

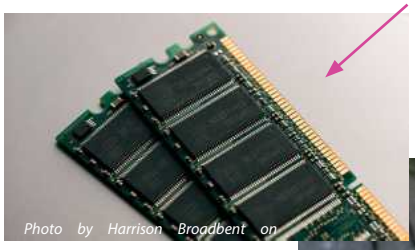


Photo by Harrison Broadbent on

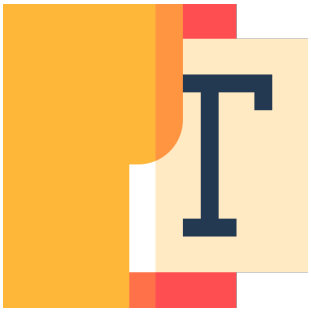
RAM stores data temporarily while you work on your computer, until you store it permanently on your hard drive. RAM is usually 4GB, 8GB or 16GB. If you have a particularly powerful computer, you might have 32Gb of RAM.

Photo by Alex Knight on Unsplash

Photo by Vincent Botta on Unsplash

A hard drive is the permanent storage place for your computer. Hard drives come in a wide range of memory capacities, or sizes. More recently drives range from 1GB to 5 TB. You can also buy external hard drives that you can plug into your computer to use as extra storage space, or as a back-up drive.

Data Types & File Types

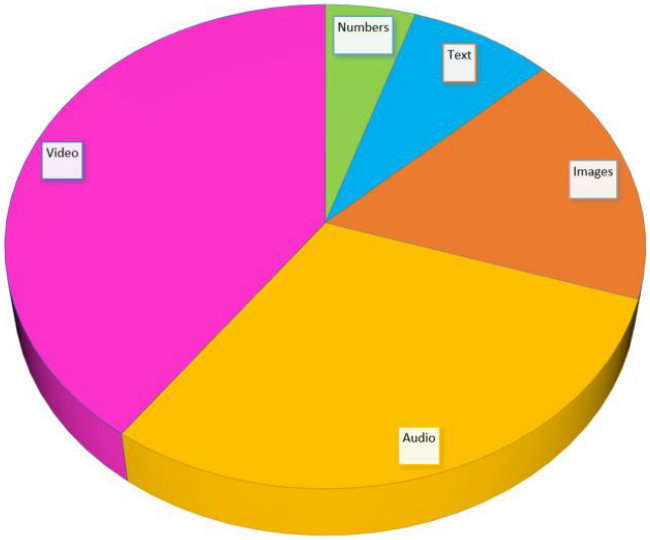


It is important that all computer users are aware of data types and how they can be saved into different file types. When you are writing an essay for English you are entering text data. You will probably save your essay data in a Word file called .docx.

Data Types

There are five types of data that can be entered, stored and retrieved on a computer device:

1. Numbers
2. Text
3. Images
4. Audio
5. Video



Numbers are used in applications such as calculators, spreadsheets and ordering apps. Numbers can be stored in text too, but the values are only displayed if they are not used in a calculation. When numbers are used in calculations they do not use very much storage space. File sizes for spreadsheets made in Microsoft Excel or Google Sheets, are very small. They only take up a single byte per value. (10 - 50 KB)

Text is a combination of letters, numbers and symbols. Text is the most commonly used data type to enter into software. We enter text when we enter our names into a website, our address into a form, or just write a school assignment. Sometimes numbers are stored as text, such as phone numbers. These are not used in calculations so are stored as text which makes it easier to store a value beginning with zero. Text files are often larger in size than files that store only numbers, due to the sheer volume of characters entered. If every letter, space, item of punctuation and symbol is stored in a byte, these files are usually quite a bit larger. (50Kb - 50 MB) A basic text file (.txt) will only store the characters typed into the file, while a Microsoft Word document (.docx)stores all the formatting information such as text font, colour, shapes etcetera. This makes Word documents much larger that plain text files.

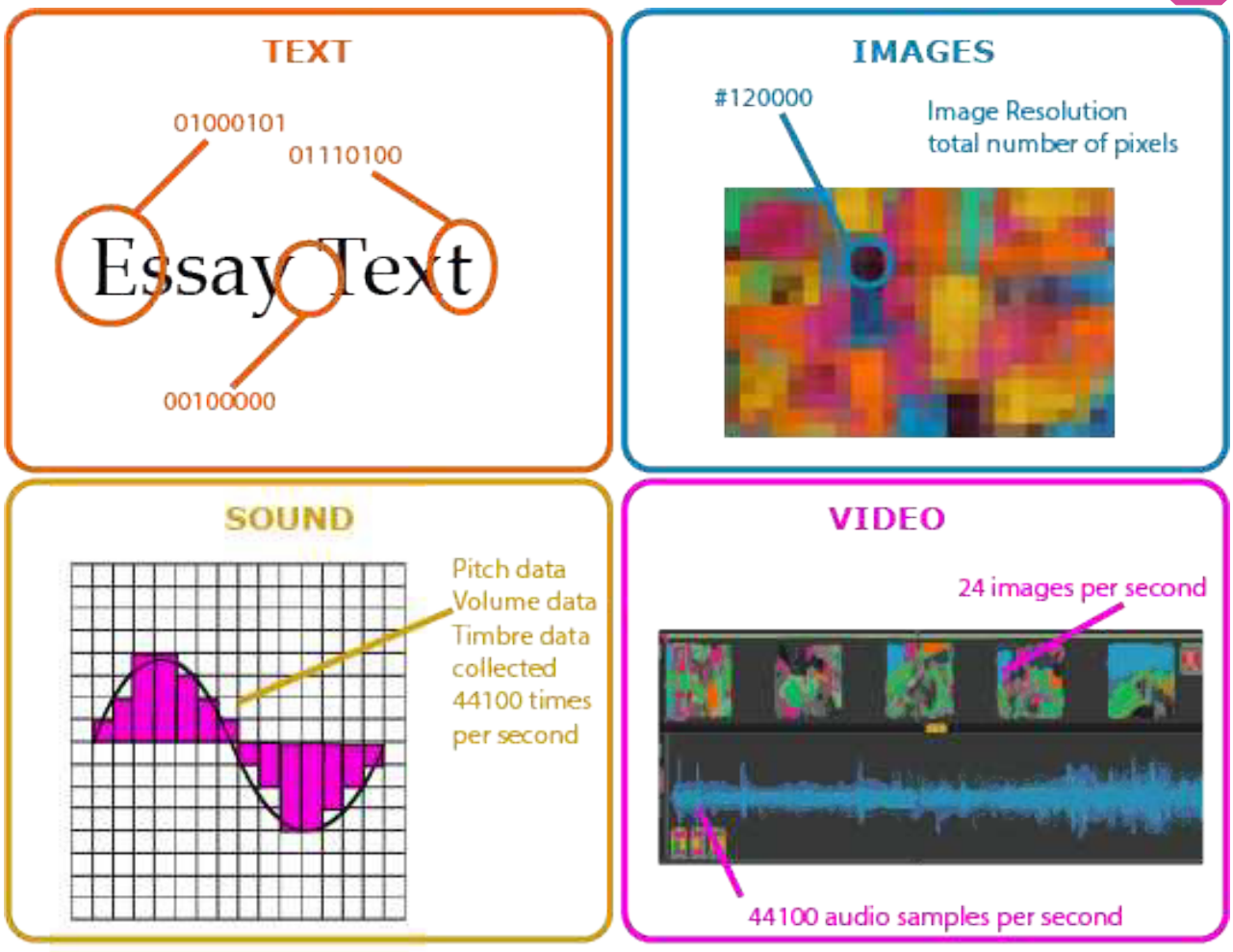
Image data is constructed differently to numbers and text. Image data s made up of colour data and data that controls where the colour is displayed on the screen. This can mean thousands of colour data bytes and thousands of location bytes. 1000 * 1000 = 1000,000 bytes. That's a lot of data! Images can be small (around 1 MB to many GB) depending on how the image information is stored. Common file types include: JPEG (Joint Photographic Experts Group) Sometimes called JPG, these file types are used only for photographic images with millions of colours. PNG (Portable Network Graphics) These file types were developed to compress images for display on the internet.

Audio uses a lot more data. When sound is converted into digital data, each sample is described in bytes related to volume (loud or soft), timbre (type of sound) and pitch (high or low). Each of these three samples are collected 44,100 times per second. This is called the sample rate and it is expressed as 44.1 kHz. Kilohertz means thousands of times per second. Audio requires a lot of samples to allow our ears to hear a smooth continuous sound. Sizes range from 1 MB to many GB depending on the length of the sound. A three minute song compressed into an MP3 is usually around 3 MB.

Video is a combination of images and sound that is linked together using specialised code. Sound always requires a minimum of 44.1 kHz. The data size of the images relies on the resolution, or how many pixels (squares of colour) are on the screen. The higher the quality, the more pixels are required. The more pixels, the more data. Video requires 25 images per second which are called frames. You may have heard the term "frames per second" in relation to video. A high quality video will have large frame sizes at 25 per second along with at least 44,100 audio samples per second. This results in files sizes being 100s of MB to many GB. A high quality movie is usually around 4 GB.

In the diagram below, Fig 1.9, you can see how digital data types increase in size from Text to Images then to Audio and finally Video. In a text file, each character or symbol is a byte. Images are made up of millions of colours each represented by data called hexadecimal code. Sound is made up of three types of sample code, 44,100 times per second. Video stores 25 images per second connected to sound data.

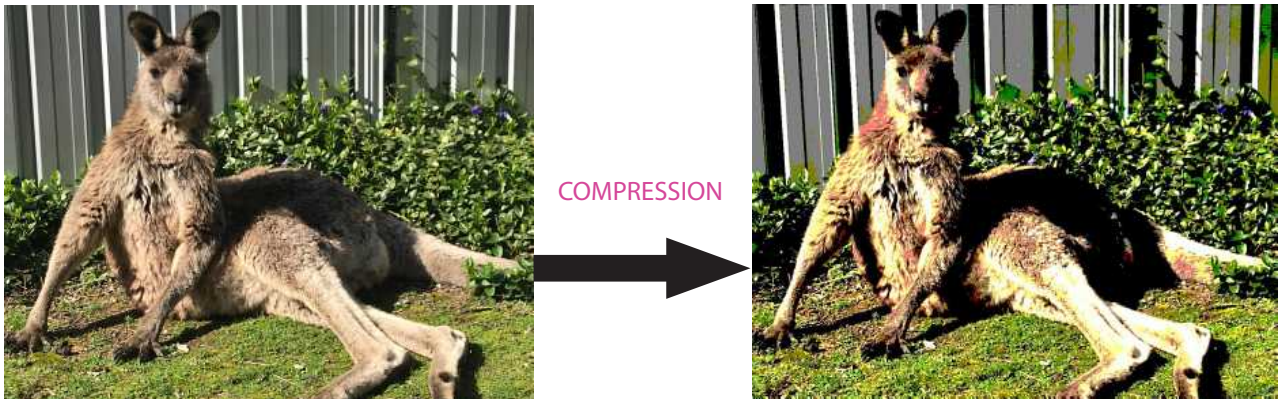
Fig 1.9



File Types

For each data type, there are many different file types. We use different files types because they store the data in different ways.

When we take a photo with a digital camera, the file that is saved is in a raw state. It has not been compressed. Compression is where we try to make the file smaller in size without reducing the quality of the data. When we take the JPEG image from the camera it is still in a large size format so that all the detail in the photo is maintained. If we wanted to upload the photo to email or the internet, there are often restrictions on the size of the file that can be used.



Original JPEG taken from camera is in its raw form and takes up 2MB of memory for storage.

After compression, the image remains of similar quality but the file size is reduced to 500KB.

Number File Types

There are not many file types that are purely designed for number data types. Usually they contain some text data as well. Most commonly we reserve our number data type for spreadsheet file types.

The most commonly used file types for numbers are Excel Spreadsheets. Excel is a Microsoft product and the file name extension is .xls. For example Budget. xls.

Google Sheets is an online application that saves the files in the cloud. Many people use Google Sheets to share their number data with colleagues. Being saved in the cloud makes it much easier to share data. Google Sheets files can be downloaded as any type of file, but they start off as a GSheet file.

Your budget data may be saved as Budget.GSHEET online. It can then be saved as a .xls file so it can be opened in Microsoft Excel.

People who use Apple computers often use the software that comes with the device. This is called Apple Numbers. The files have the extension .numbers. For example Budget.numbers. These file types can not be opened in Microsoft Excel or used with Google Sheets without first being converted to another file type.

In Fig1.10, you can see our Budget File. It does contain some text, but the numbers are actively being used in calculations.

The Total Income in cell B14 is the sum of the values in the B column. The Total Costs in cell C14 is the sum of the values in the C column.

You can see that the cell D14 is currently selected and the calculation is visible in the bar at the top:

= B14 - C14

This calculation is in the D14 cell and it displays the result of the difference between B14 and C14.

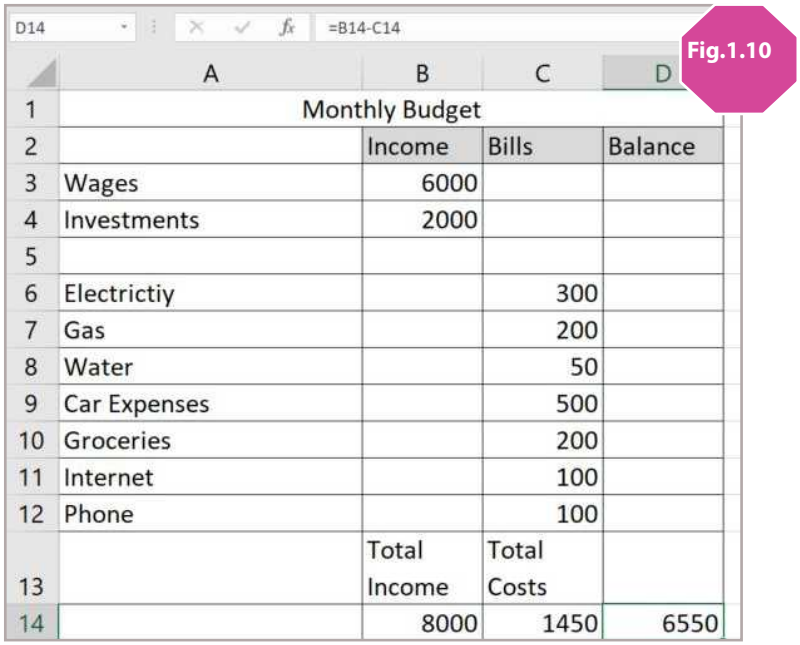


Fig.1.10

	A	B	C	D
1	Monthly Budget			
2		Income	Bills	Balance
3	Wages	6000		
4	Investments	2000		
5				
6	Electrictiy		300	
7	Gas		200	
8	Water		50	
9	Car Expenses		500	
10	Groceries		200	
11	Internet		100	
12	Phone		100	
13		Total Income	Total Costs	
14		8000	1450	6550

Text File Types

There are many types of text files. Some are basic text, while others have sophisticated formatting information. This textbook was put together in a program called InDesign which is a desktop publishing application that allows for a wide range of formatting of text, and more flexibility that simple word processing.

The most basic text document is a .txt file. These only hold the data related to the characters and the spaces in the file. They do not store font type or font size and they cannot hold image data. These types of files are used in programming and web development. Spreadsheet files can be converted to basic text so they can be read by other software applications such as Apple Numbers or Google Sheets. Simple text files are rarely used for typing documents to be read by people.

The number one text file application is Microsoft Word. It not only stores text information, but it stores formatting, images and layout features such as headers and footers. Word also provides spell check and grammar check features. Word documents use the file extension .docx and can only be opened in Microsoft Word. Word files are always a lot larger than basic text files because they store so much more formatting information.

When people need to share text data, Google Docs provides basic word processing functions. Google Docs uses the file extension .GDOC and is stored in the cloud to allow for sharing. These file types can be converted easily to .docx files for download. Google Docs don't have all the features that Word files have. This makes them smaller and easier to transport by email or over the internet.

The application Pages is installed on Apple devices using the file extension '.pages'. Pages create basic text files. It can only be used on Apple devices and needs to be converted to PDF if a file is to be shared with PC computers. Pages is similar to Google Docs in sophistication and file size, but is less flexible when sharing data.

Once a text file has been created and we want all the formatting to stay the same when we share it, we can convert it to a PDF file type. PDF stands for Portable Document Format and it allows Apple devices, Android devices and Windows devices to all see the same version of a text document. PDF stores all the text formatting, images and layout in a file with the extension .pdf. These are compressed for easy sharing and so often have smaller files sizes than the original text file. Most text applications allow for the user to Save As PDF because it is such a commonly used file format.

Image File Types

There are dozens of digital image file types. We will only look at four main file types that you may encounter online.

The most commonly found image type online is JPG or JPEG (Joint Photographic Expert Group). It is designed to compress photographic images for sharing online. These files can store millions of colours required for a photograph. They are built around a compression algorithm (a special program to summarise the data) to make the file size small without impacting on the quality of the image. JPG files carry their own palette of colours to reduce the files' size. You can choose the level of compression (number of colours) to manage the size of the file. Both images below are JPG files with different levels of compression

Low compression
High Quality
Millions of Colours

High Compression
Low Quality
Low number of Colours

PNG stands for Portable Network Graphic and it stores photographic quality images with a transparency feature. They are designed for display on the internet.

PNG files require more sophisticated techniques to edit than JPEG files. They use layers to remove pixels of colour from areas of the image.

You can see the area behind the cat in the photo on the left is filled with a grey check pattern. This indicates where all the pixels have been removed so that a website background colour can show through.

Graphic Interchange Format (.gif) has been around since the early years of the world wide web. This format was initially designed for non-photographic images such as diagrams and illustrations. It also supports multiple images that can be displayed in order to appear like a video. GIF animation files are a series of still images displayed in order. They do not hold many colours, so any photographic images appear pixelated.

In 1996 a web developer called John Woodell created an animated GIF using a computer generated image (CGI) of a dancing baby. It was a huge hit and even appeared on TV shows at the time. It was one of the first viral images online.

EPS files are common online for editable logo files. EPS stands for Encapsulated PostScript and they are designed for drawings, illustrations and simple logo images. These images can not be edited in Photoshop, they can only be edited in a drawing application such as Corel Draw or Illustrator. EPS files use objects or shapes that can be edited by changing the fill colour and the outline colour.

You can see in the image on the right that the blue curves in the logo are being edited with tools that change the shape of the objects.

Sound File Types

There are many audio file types, but the most common are .wav, .mp3 and .wma.

When you are recording sound, your device initially stores the data as a WAV file (.wav). WAV is short for Wave and it is a raw, uncompressed file type. The quality of WAV files is very high and contain CD quality. These files are very large in size and take a lot of processing power and memory to edit on a computer.

MP3 files are very commonly used for music files to be stored on mobile devices or online. MP3 stands for Moving Picture Experts Group (MPEG) Layer 3 Audio. It is a compressed file, making it easier to store and edit. Audio compression is the removal of sound data that is outside of the range of human hearing.

WMA (Windows Media Audio) is a commonly used audio file type developed by Microsoft as a competitor to MP3. It contains features that are not retained in MP3 such as different channels for editing.

Video File Types

The three main video file types are: MP4, WMV and MOV.

There are many file types that store video data, but Moving Picture Experts Group (MPEG level 4 Video) is one of the most frequently used. It is compressed so that it can be streamed on the internet. YouTube accepts MP4 file types for upload.

WMV (Windows Media Video) is a commonly used audio file type developed by Microsoft as a competitor to MP4. It is often the default file type for video editing software on PC computers.

Quicktime is a popular file format for videos edited on Apple devices. The file extension is .mov.

It is not always easy to convert video file types. It requires sophisticated understanding of the compression types and video editing software.

Data Types	File Types
Numbers	.xls, .GSHEET
Text	.txt, .docx, .pdf, GDOC, .pages,
Images	.jpg, .png, .gif, .eps
Audio	.wav, .mp3, .wma
Video	.mp4, .wmv, .mov

In the table above is a summary of common file types grouped by data type. These are just a small sample of the file types available. Can you find more examples?

To check what file type you have stored on your computer you need to look at the file via Windows Explorer on a PC, or Finder on a Mac. Below is an example of different file types and their file sizes. In Windows Explorer you can display all this information. It can be very useful, especially if the file icons are the same. You can see the icons for “Logo.png” and “Photograph.jpg” are the same, but the file types are different.

You can also see the difference in size between BasicTextFile.txt, WordDoc.docx and WordDoc.pdf. The three files contain the same text, but the file format creates different file sizes.

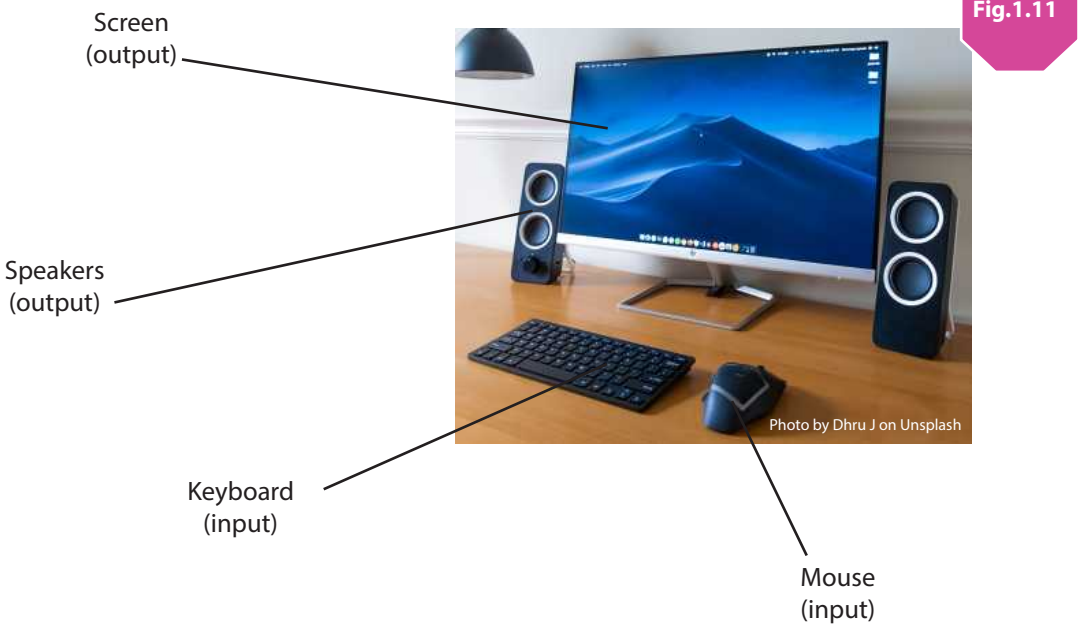
Name	Date modified	Type	Size
BasicTextFile	26/04/2020 3:03 PM	Text Document	4 KB
ExcelFile	26/04/2020 3:05 PM	Microsoft Excel Work...	9 KB
Logo	26/04/2020 10:48 AM	PNG File	12 KB
Photograph	31/01/2020 12:38 PM	JPG File	35 KB
WordDoc	26/04/2020 3:03 PM	Microsoft Word Doc...	78 KB
WordDoc	26/04/2020 3:04 PM	Adobe Acrobat Docu...	74 KB

Hardware & Software

Hardware

Hardware is the part of the computer that is physical. As users of computers, we only really interact with the input and output hardware components. In Fig 1.11 below, you can see a typical set up of a desktop computer. We type data into the keyboard and use the mouse to input instructions. We hear the information out of the speakers and see it displayed on the screen.

Fig.1.11



What you don't see is how the input becomes output. Inside the computer are processors that do lots of calculations per second. When you buy a computer with 2.7 GHz processor, for example, is 2.7 billion instructions per second. It hard to imaging this little black square(Fig.1.12), known as a CPU (Central Processing Unit). When we store data to retrieve it later, we use storage hardware such as the hard disc in Fig.1.13. Storage devices store the data in memory.

Fig.1.12

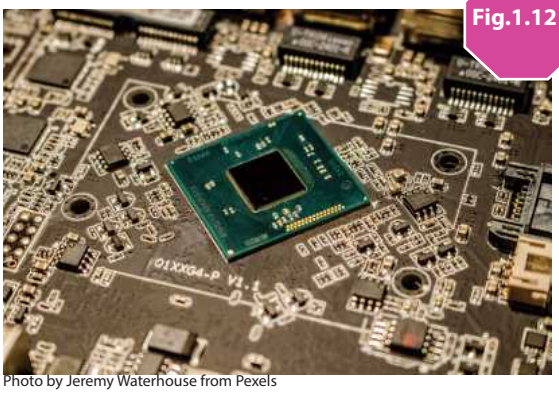


Photo by Jeremy Waterhouse from Pexels

Fig.1.13

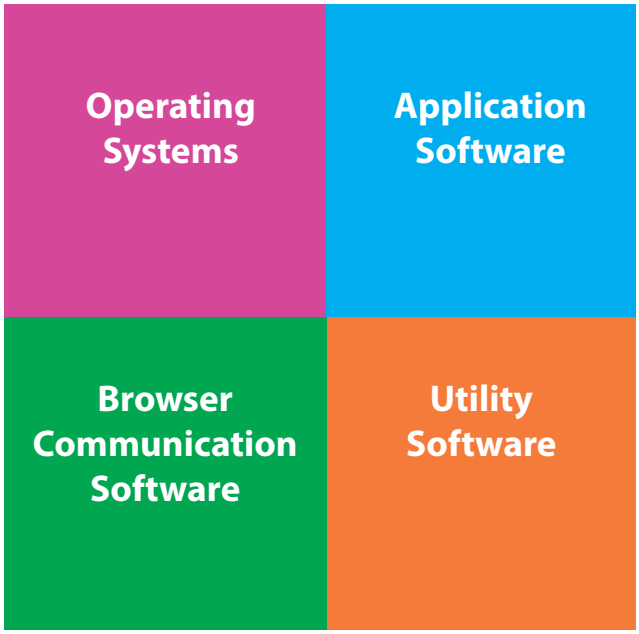
Photo by Picsaf Com from Pexels

So there are four main components of a computer system:

1. Input (keyboard, mouse, microphone)
2. Processing (CPU)
3. Storage (hard disc, USB memory stick)
4. Output (screen, speakers, printer)

Software

Unlike hardware, software is not a physical object. Software is a set of instructions for the hardware to follow. Without software, the hardware can not be useful. There are four types of software.



1. Operating Systems

An operating system is software that makes your computer easy to use and controls how the computer works. In the early days of computing the screen displayed only a flashing green square and waited for the user to enter the correct instructions using code. Now we have computers that are easy to use with buttons, icons and menus. This is because of advancements in operating system technology. If you have a PC computer you will probably be running the Windows Operating System. If you have an Apple Computer you will be running Mac OS. There are other operating systems such as Linux which was designed as an open source system for software developers.

2. Applications

Applications allow users to create and edit files. When you want to write an essay, you use Microsoft Word. Word is the application that you use to edit and create a Word file. There are hundreds of applications that allow you to edit spreadsheets, images, videos and sound files.

3. Browsers and Communication Software

A browser allows you to view and interact with data on the world wide web. There are many browsers available and they are all free to download and use. The most commonly used browsers are: Chrome, Safari and Firefox. A browser is also a type of communication software because it can allow for email and chat between users. Some communication software is not a browser, such as Skype, Zoom and Messenger. These types of software are designed specifically for communication.

4. Utilities

Utilities are software packages that provide protection for your computer. They can check for viruses, test to see if there are problems in the system, and protect from hackers. Commonly used utilities are Norton's Anti-virus and Kaspersky's Total Security. There are also free utilities available. They must be regularly updated to keep your computer safe.

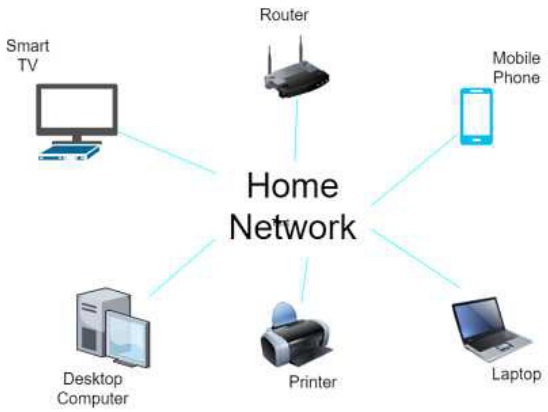
Fig.1.14

Software is created with code. The code the programmer creates is human-friendly, but not easy for computers to understand. So it is "compiled" into machine code. Machine code is ones and zeros. This is the computer-friendly language that humans have trouble understanding. Fig 1.14 shows some computer code a programmer is writing to make some software.

Networks

A network is created when two or more devices are connected. It is likely you have a network at home. The router that connects to the internet allows other devices to connect to each other such as mobile phones, a smart TV, desktop and laptop computers and printers. Some of these devices might need to use cables, while others can access the network via Wi-Fi.

So far we have investigated input, output, processing and storage hardware. To allow for people to use the internet, print documents, send and receive email, we also have another type of hardware: Communication.



Communication Hardware

Communication hardware enables devices to share data. If you have a home network, somewhere in your home will be an internet router. This device allows for internet access and for all your devices to talk to one another.

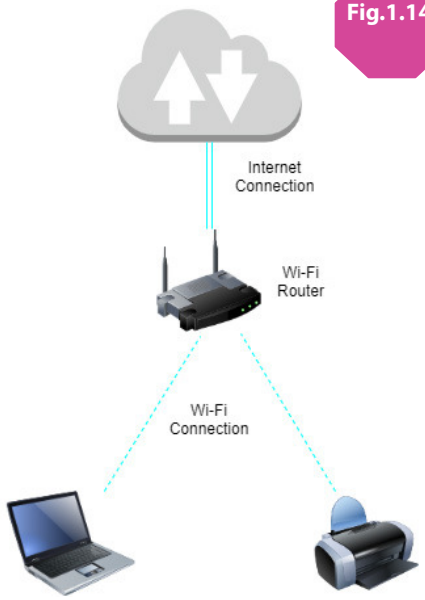
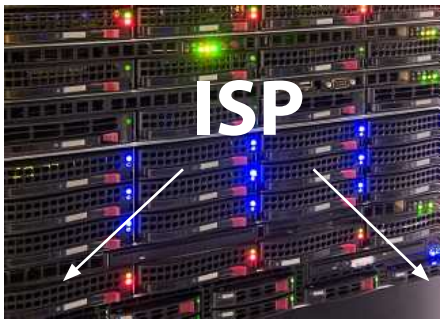


Fig.1.14 A Wi-Fi router allows your laptop and mobile phone to access the internet via your home Wi-Fi. The Wi-Fi is managed my your router.In Fig 1.14, you can see the role the Wi-Fi router has in connecting a computer to both the internet and a local printer. Data is sent and received through the router.

Other technology is required to allow you to access data on the World Wide Web. Every internet connection requires a gateway. We know them as Internet Service Providers (ISP). In Australia, there are many internet providers such as Telstra, Optus, Vodafone and TPG. These organisations have stations that direct all the data to its destination. An ISP is a large connector for billions and billions of data requests from end users. The data is sent via satellite or submarine cables, (glass cables under the sea) to locations across the world.



Submarine Cables

The Castle Group repairs damaged submarine cable.

https://live.infrapedia.com/

Satellites

Photo by NASA on Unsplash

Photo by Stellan Johansson on Unsplash

Communication Media

To move data from one device to another, we use communication media. There aphysical media such as cables and there are wireless media such as Wi-Fi. There are three main types of physical communication media:

1. Ethernet Cable is the blue cable you might see in your computer lab at school or connecting your smart TV to the router in your home. It is often blue and has a clear plastic clip on the connector. It is a fast connection, much faster than Wi-Fi. The wires inside are made of copper and the digital data signals are sent as electrical pulses.

2. Optical Fibre Cable is the fastest communication media. The wires are made of glass and the digital data is sent as pulses of light. These cables are very expensive and are used for networks in a big organisation. The Australian NBN relies on optical fibre to make the internet faster for users.

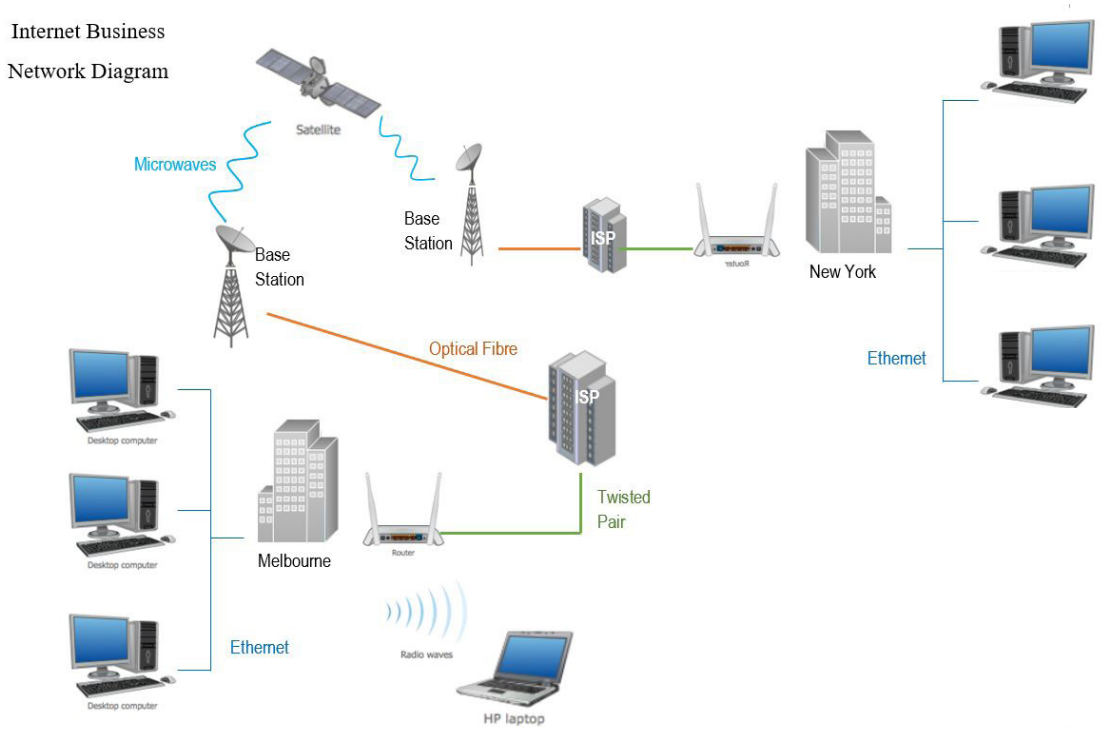
3. Twisted Pair Cable is telephone communication cable. It is made of pairs of copper wire twisted together. It is very cheap to produce, but is very slow. It relies on electronic pulses that move analog data over long distances.

Wireless Communication media uses different electromagnetic waves.

Wi-Fi uses various frequencies of radio waves. Radio waves emitted by your router can move through some materials but are unable to reach beyond about 100m due to the limited power of your router's transmitter. Big TV and radio stations use large transmitters with lots of power to be able to broadcast over a city or region. Radio waves are slower than cables and struggle to provide a lot of data at once.

Sending data across space to a satellite uses microwaves. These waves use very large amounts of power and can send large amounts of data long distances. The ground station can send huge amounts of data in a direct line up the geostationary satellite for it to be transmitted to another ground station or another satellite.

Bluetooth is specialised radio waves that connect devices. Bluetooth radio waves are produced by mobile phones and laptops that do not produce a lot of power. The range is only a few metres and can only cope with small amounts of data to be transferred.



Cybersecurity

Cybersecurity is the protection of internet-connected systems such as hardware, software and data, from cyber attacks. Malicious people attack networks to access or destroy data. They do this, often because there is financial profit involved.

Cyber Attacks

There are many ways you and your data can fall prey to cyber attacks. Here are a few examples:

1. Phishing is a technique where attackers use email to lure in victims. The email is designed to look like a trusted source such as your bank or a colleague. Once the victim opens the email, they are asked to disclose important information such as usernames and passwords. Once the attacker has access to the victim's accounts they may destroy the data or use it to take financial advantage.
2. Viruses are malicious programs that can be spread through email or downloads. They replicate themselves and use programming to find data the designer is looking for. Viruses can move through a system through the movement of data by unknowing victims. Viruses have been known to shut down whole computer networks for a company. They can lock down computers and demand payment for accessing the computer with an unlock code. Some viruses are attached to data the victim downloads, such as a game. The virus in hidden inside the game and is released when the game is played. Some viruses sit hidden in a computer system undetected while they spy on your computer use.
3. Hacking or Man-in-the-Middle attack is a technique used by a malicious programmer who actively accesses a computer system or network to steal data or destroy data. A common problem is when a victim accesses their bank account online using an unsecured Wi-Fi network. The attacker intervenes in the connection and is able to collect the username and password. The victim is unaware that the attacker has accessed their bank account.

Cyber Security

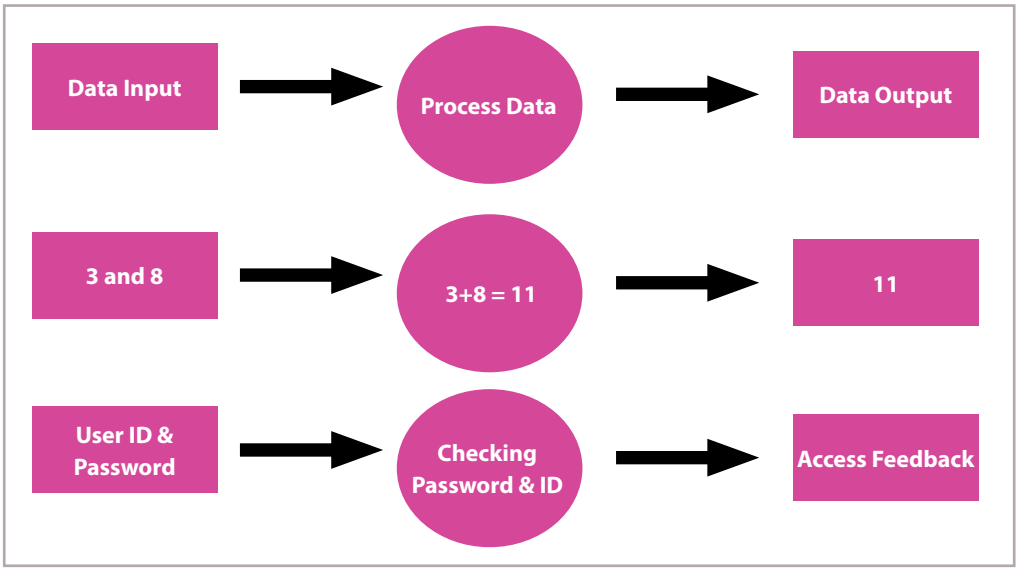
There are plenty of techniques you can use to protect yourself from attacks.

1. Ensure everyone using the network is aware of safe internet practices such as:
    * Using two-factor authentication when dealing with access to online accounts such as banking.
    * Never giving your password to any account to anyone.
    * Don't open emails from addresses you do not recognise.
    * Checking the URL address of the website you are on to see if it is the legitimate site before entering credit card details.
    * Using strong passwords and changing them regularly.
2. Keep all your software updated. Update your Operating Systems and all application software.
3. Ensure you are using up-to-date protection software on your devices such as Anti-Virus, VPN, Scanning Security software.
4. Always use secure internet access when making transactions such as banking or purchasing. Free Wi-Fi is not secure. In fact all Wi-Fi is less secure than cabled networks.
5. Make back-ups of all your data on a regular basis.

Programming I

A computer does not know how to do anything until it is programmed to do something. It is time to start creating our own programs using computer code. So far we have been using application software that other people and organisations have created for you to use.

The basic structure of all software is: 1. Data goes in, 2. It is processed and stored, then 3. It is output as a display or stored as information. You can see in the diagram below that software reads in data such as numbers 3 and 8. The Process is adding the numbers to get an answer (11). Then the Output is the answer. Every time you type in your user ID and password it is being processed by software to check if it is correct. Then it returns feedback when your input is correct, so you can access the profile you logging into.



Algorithms

An algorithm is a plan for a program that you are going to write. It solves the problem that your program will solve. We use a combination of natural language and special words to create a coded language called pseudocode. Pseudocode looks a bit like a programming language, but it is easier for humans to read when planning a program. Computer code is often tricky to learn and apply all the rules, for example Python needs to have indents (spaces before the line of code) and semi-colons after some lines of code. Programming languages have very strict rules because the computer needs to understand them. Pseudocode has fewer rules and can be adapted for different programming languages.

Below is an example of Pseudocode for a basic adding machine program.

```
START

  Read in Number 1
  Read in Number 2

  Answer = Number 1 + Number 2

  Display Answer

END
```

Data Input

Process Data

Data Output

The pseudocode is easy to read, it clearly reads in two numbers and adds them together to display the answer.

This algorithm does not specify what numbers are read in. It allows the user to type in any value for the two numbers. This is because the code uses a special thing called a variable.

There are three variables in this algorithm:

- Number 1
- Number 2
- Answer

Variables

A variable holds data. In our algorithm from the last page, the variables "Number 1" and "Number 2" can hold any value. The first time the program is run, the user can enter 3 and 8. The other variable "Answer" will then hold 11. The next time it is run, the user can enter different numbers such as 45 and 23 so that Answer will be calculated as 68.

Making Decisions

Computers are good at following very strict instructions. We can give a computer an instruction to test a variable to help it make a decision. For example: If the variable "Answer" from our algorithm was tested we could get the computer to give us more information. See the algorithm below with a decision

```
START

  Read in Number 1
  Read in Number 2

  Answer = Number 1 + Number 2

  IF Answer >50 THEN
        Display Answer " Is over 50"
  ELSE
        Display Answer " Is less than 50"
  END IF

END
```

In this algorithm you can see the two numbers are entered into the program and added together to store the answer into the variable "Answer".

This time, we are going to test the data in "Answer". If (Answer >50) is true, then it will:

Display Answer "Is over 50".

If (Answer >50) is false, then it will:

Display Answer "Is less than 50".

If the data entered into Number 1 and Number 2 were 45 and 34, the output would be:

79 Is over 50

If the data entered into Number 1 and Number 2 were 15 and 17, the output would be:

32 Is less than 50

Repetition

Computers are really good a repeating boring tasks very quickly and accurately. We can write programs that repeat lines of code a certain amount of times which can be very useful. Let's say we don't know how many numbers the user wants to add together. We can ask the user how many numbers and use a loop to ask the user the right number of times to enter a number. The algorithm below does this.

This algorithm asks the user to enter the amount of numbers to be added up. It sets the variable "Total" to zero because it will be used in a calculation. You can see that there are two lines between the Repeat loop. The Repeat loop will read in a Number and add it to Total over and over. If the user has 4 numbers to be added up, the loop will run 4 times.

The user is asked how many numbers they have to add up:

User enters 3.

Total = 0

The loop will repeat 3 times:

User enters number 5

Total = 0 + 5

User enters number 4

Total = 5 + 4

User enters number 2

Total = 9 + 2

Displays Total 11

```
START
  Amount = "How many numbers do you need to add up?"
  Total = 0
  Repeat (Amount)
     Number = "Enter a number"
     Total = Total + Number
  End Repeat
  Display Total
END
```

1c. Foundation Assessment Tasks

Students are asked to respond to the Digital Technology knowledge by using the Information Technology Skills they have developed.

In Foundation Level students learned skills in:

- Word Processing
- PowerPoint Animation
- Web Development
- Turtle Programming

Students developed knowledge and understanding of:

- Binary Code
- Data Storage and Memory
- Data Types and File Types
- Hardware and Software
- Networks
- Cybersecurity

Project One Poster Design

Students will use their Word Processing skills to develop a poster to inform and educate an audience of Middle School students. Students have a choice of topics:

a) How does a computer use binary code to store data?

b) How are different data types stored on a computer?

c) How much space does each Data Type take up in memory?

d) What are the major File Types most commonly used?

Students must use the following features in Word:

A border and background colour.

Their name and class in the header or footer.

Lines, shapes and text boxes.

Different font types and sizes.

Dot Points.

Orientation should be landscape.

The content must be correct and complete.

The layout must be easy to read.

All images must be sourced from copyright free locations such as:

https://www.flaticon.com/ https://pixabay.com/

https://unsplash.com/images/stock/non-copyrighted https://www.pexels.com/

Poster Design Marking Criteria

Web Development Skills

- Set Page Layout to Landscape
- Page Colour and Border has been edited.
- Student name and class is in the header or footer.
- Edit Font Type , Size and Colour.
- Edit alignment of text and use dot points for lists.
- Text Wrapping has been used with text box and or shapes.
- Use of Text Boxes and Shapes and formatted appropriately.
- Relevant shapes have been included and edited with fill, outline and effects.
- Saving and submitted files with required file name.
- Images not created in Word are from copyright free sources.

Content Knowledge

- Poster outlines the topic clearly.
- All information included is relevant to the topic.
- All information is correct.
- The poster is comprehensive in covering the topic.
- The text is easy to read.

Project Two Network Animation

Students will use their PowerPoint Animation skills to develop a video animation to inform and educate an audience of Middle School students. Students must demonstrate how email data is transported from one country to another.

The animation must show all the communication devices that handle the email, as well as all the communication media that transports the data. All devices and media must be labelled.

Network Animation Marking Criteria

PowerPoint Animation Skills

- All illustrations are artfully created from grouped objects to maximum effect.
- A range of animation types have been used to maximum effect.
- There is clearly a thorough use of layering to maximum effect in the animation.
- All timing setting make the animation engaging to watch – no slow boring sections nothing too fast to see or read.
- Animations have been put in correct order to maximum effect.

Network Content Knowledge

- All Sending and Receiving Devices Illustrated and located in the animation
- All devices correctly labelled.
- All transmission media included and animated.
- All transmission media correctly labelled.
- All devices are illustrated using shapes or sourced from https//:draw.io or https://app.diagrams.net/

Project Three Logo Design

Students will use their Python Turtle programming skills to develop a logo for their personal website. The Website will be a folio of their completed work in Digital Technologies. Students might like to incorporate their initials or silhouette of their favourite animal.

The logo must include:

- two or more colours
- a loop (*for counter in range(4):*)
- two or more shapes

Logo Design Marking Criteria

Programming Skills

- Use of a counter.
- Appropriate use of a loop.
- Total design is complete.
- The shapes work well together.
- Colours for fill and line has been effectively used.

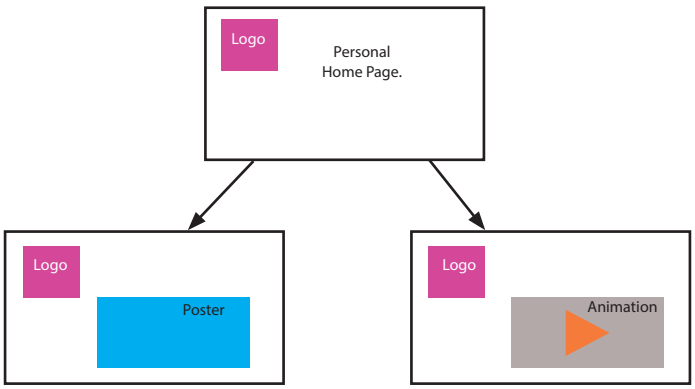
Project Four Web Design

Students will use their Web Development skills to develop website to display the folio of work completed in Digital Technologies. Students will create three web pages using HTML. Each web page will have the logo created in Python Turtle. One page will display the Poster Created in Word. The poster can be collected using a screen grab and saved as an image. One page will display the video created and exported from PowerPoint. The structure can be seen in the diagram below.

Web Design Marking Criteria

HTML Coding

- Correct file naming.
- Correct use of folders.
- Links to images and the video function.
- Links between pages work.
- The logo is on each page.
- The menu is the same on each page.
- The design allows the content to be easy to read.
- All open tags have been closed correctly.



Intermediate Level

ACARA CURRICULUM

Digital Technology Knowledge and Understanding

ACTDIK023 Investigate how data is transmitted and secured in wired, wireless and mobile networks, and how the specifications affect performance.

ACTDIK024 Investigate how digital systems represent text, image and audio data in binary.

Digital Technologies Processes and Production Skills

ACTDIP025 Acquire data from a range of sources and evaluate authenticity, accuracy and timeliness

ACTDIP026 Analyse data and visualise using a range of software to create information, and use structured data to model objects or events

ACTDIP027 Define and decompose real world problems taking into account functional requirements and economic, environmental, social, technical and usability constraints

ACTDIP028 Design the user experience of a digital system, generating, evaluating and communicating alternative designs.

ACTDIP029 Design algorithms represented diagrammatically and in English, and trace algorithms to predict output for a given input and to identify errors.

ACTDIP030 Implement and modify programs with user interfaces involving branching, iteration and functions in a general purpose programming language.

ACTDIP031 Evaluate how student solutions and existing information systems meet needs, are innovative, and take account of future risks and sustainability.

ACTDIP032 Plan and manage projects that create and communicate ideas and information collaboratively online, taking safety and social contexts into account.

Suitable for all year levels

2a. Intermediate ICT SKILLS

Spreadsheets

Spreadsheets are documents that allow the user to design tables of numerical data and calculations. These files are enormously useful for calculating financial information, scoring values and analysing large amounts of data.

In Fig 2.1 below, you can see two examples of spreadsheets. The one on the left simply displays a list of data with labels and then displays that data in graphs. Spreadsheets make it easy to create graphs from data. The table on the right contains some calculations. The columns C, E and G all calculate the percentages of the marks out of the total. In rows 11, 12 and 13 the Average, maximum and Minimum are displayed using formulas.

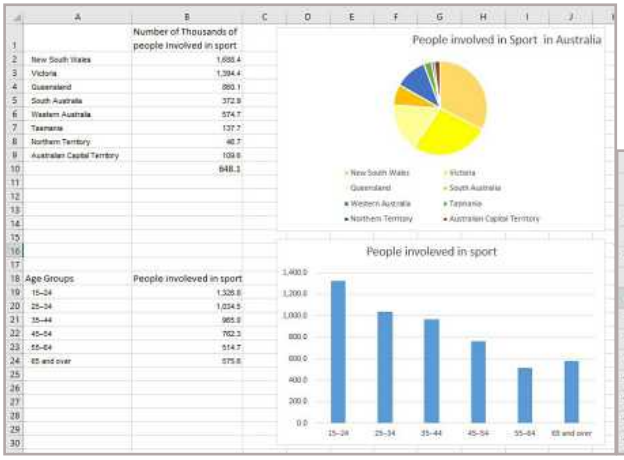


Fig. 2.1

	A	B	C	D	E	F	G
1	Student Grades for Software Development						
2	Name	ssignment (35 Marks	%	Report (25 Marks)	%	Exam (40 Marks)	%
3	Brian	30	86%	25	100%	39	98%
4	Bob	34	97%	24	96%	33	83%
5	Bradley	24	69%	20	80%	31	78%
6	Ben	20	57%	12	48%	25	63%
7	Bonny	32	91%	14	56%	20	50%
8	Brendan	29	83%	23	92%	29	73%
9	Bobby	27	77%	18	72%	33	83%
10							
11	AVERAGE		80%		78%		75%
12	MAX		97%		100%		98%
13	MIN		57%		48%		50%

Microsoft Excel and Google Sheets both operate on a grid that identifies cells by letters (columns) and numbers (rows). In Fig. 2.2 below you can see some of the important aspects of a basic spreadsheet. The cell G11 is active (it is selected). We know this because it is displayed in the Name Box. The value 75% is displayed in the cell, but the cell actually contains the formula = AVERAGE(G3:G9). This can be seen in the Formula Bar. It is possible to have more than one sheet in a file. At the bottom, you can see Name of Spreadsheet. You can create and name many sheets in a single file.

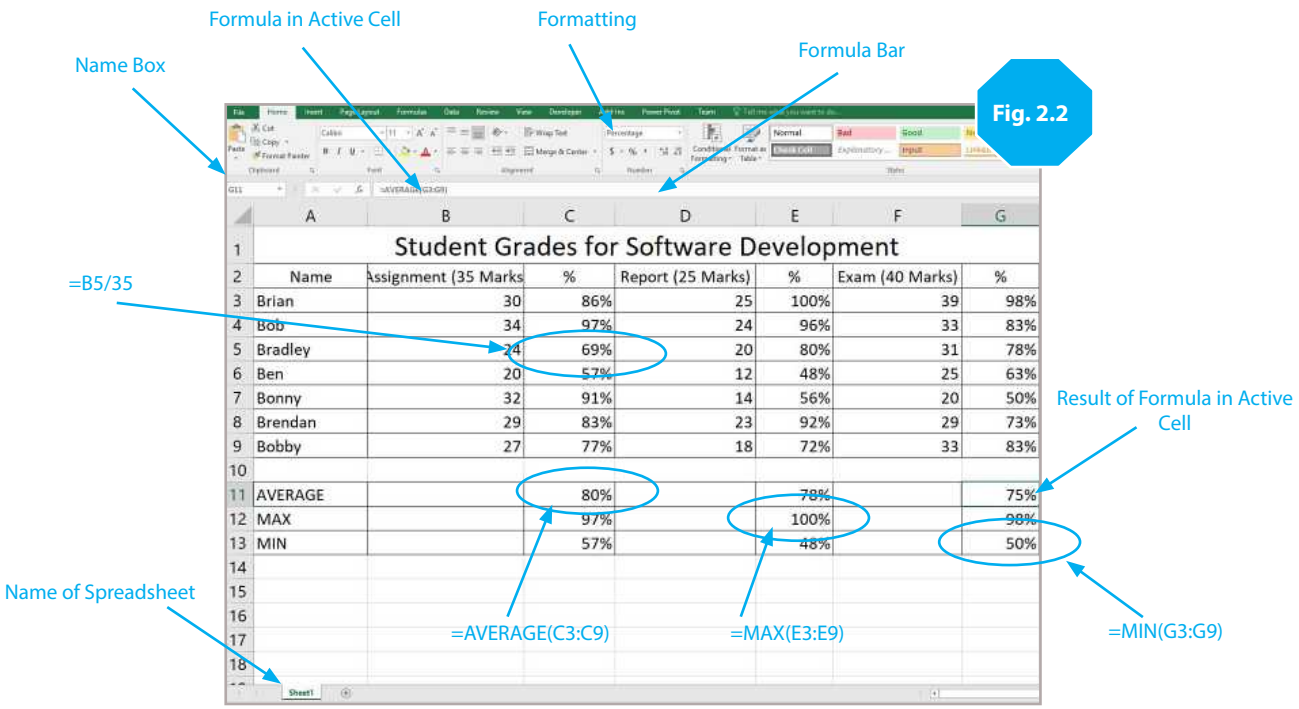


Fig. 2.2

	A	B	C	D	E	F	G
1	Student Grades for Software Development						
2	Name	Assignment (35 Marks	%	Report (25 Marks)	%	Exam (40 Marks)	%
3	Brian	30	86%	25	100%	39	98%
4	Bob	34	97%	24	96%	33	83%
5	Bradley	24	69%	20	80%	31	78%
6	Ben	20	57%	12	48%	25	63%
7	Bonny	32	91%	14	56%	20	50%
8	Brendan	29	83%	23	92%	29	73%
9	Bobby	27	77%	18	72%	33	83%
10							
11	AVERAGE		80%		78%		75%
12	MAX		97%		100%		98%
13	MIN		57%		48%		50%
14							
15							
16							
17							
18							

Spreadsheets use cell references (or cell names) such as G11 in Fig 2.2. We use the cell references when we want to add a formula. In Fig. 2.3 you can see the cell C3 contains the formula =A3+B3 and displays the answer in the cell. You can see the formula in the formula bar.

Now we could type in each formula down the C column, or we could use the very nifty feature called "fill-down". When we add a formula to a cell, we can 'click & drag' on the black dot that appears in the bottom right of the cell (circled in Fig. 2.3). Once it has been filled down, each cell will contain a formula with related cells. In Fig. 2.4 you can see that cell C7 contains the formula =A7+B7. When we fill-down using these cell references, they change the cell references in the formula to reflect the cell names in the corresponding rows. Cell names like A3 are called Relative cell references because they change when fill-down is used. We can change the references to Absolute references.

We can refer to the cell A3 as $A$3 instead. When we fill-down the C7 formula using the absolute reference $A$3 like this: = $A$3 + B3. When we fill-down this formula, each of the cells below will add the corresponding B column value to the value in A3 only.

If we fill-down = $A$3 + B3 the cell C7 would have = $A$3 + B7 resulting in the value 106. See Fig.2.5.

Fig. 2.3

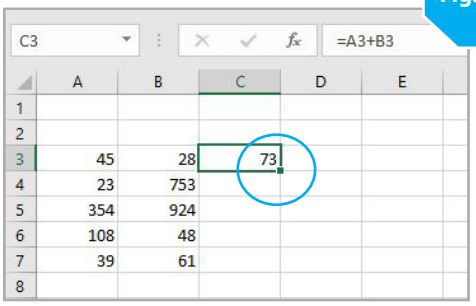
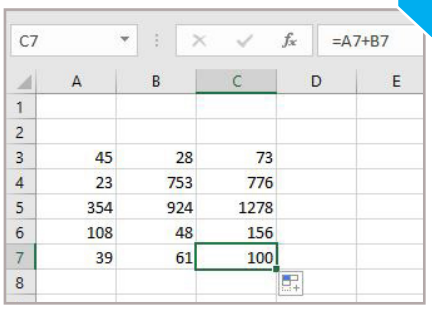


Fig. 2.4



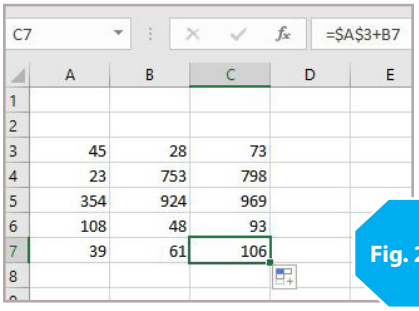
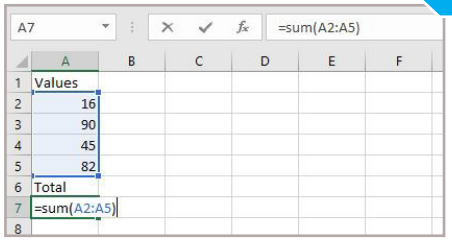


Fig. 2.5

In the spreadsheets above, we have added up values in different columns. This time we want to add up a series of values. In Fig. 2.6 you can see four values in a single column. In the cell A7, you can see the formula is =sum(A2:A5). To avoid having to write =A2 + A3 + A4 + A5 we can use the Sum function. If we have hundreds of values to add up we want to be able to do it quickly by writing the range of cells. We call up all the cells between A2 and A5 by using the colon. If we wanted to add up all the values between B2 and B102 we can do that easily with this formula =sum(B2:B102). This will add up each of the values in the B column.

Fig. 2.6



Summary

Relative cell reference: B5

Absolute cell reference: $B$5

Formulas

addition	= A3 + B3
subtraction	= A3 - B3
division	= A3/B3
multiplication	= A3*B3

Range (C3:C23)

Functions

=sum(C3:C23) =average(C3:C23)

=max(C3:C23) =min(C3:C23)

Spreadsheets are excellent for creating graphs. Ensure all your data is correctly labelled. Click and drag to select the whole of the table you wish to include in your graph. Select the Insert Menu and choose from the graph types available. As you can see below in Fig. 2.6, the graph is fully labelled and fully customisable.

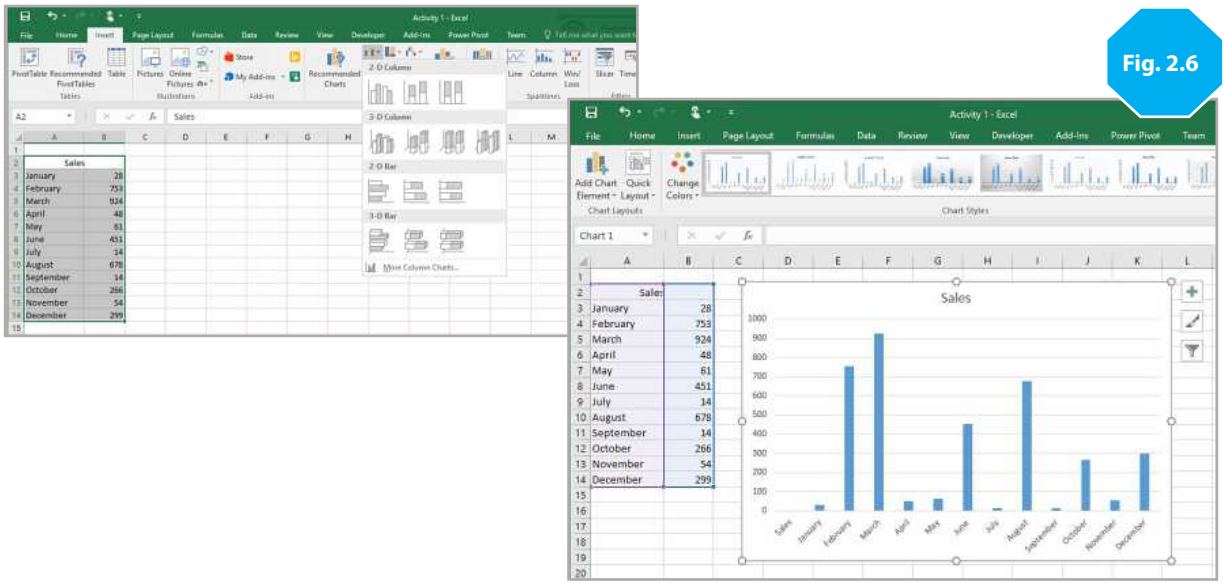


Fig. 2.6

Data Mining

The internet is a vast store of data and information. Many organisations publish the data they collect for research. Anyone can access the data online to download and analyse it. The United Nations publish data on every country in the world on a website called UNdata: data.un.org.

UNdata collects data on population, crime, employment, education, industry and health from every country in the world. It is a fascinating website to visit.

Below in Fig. 2.7 you can see Health statistics have been chosen and the number of Malaria cases reported is selected. You can see that in Afghanistan alone there is data collected from years 2000 to 2012. There is data for every country. You can search by country or by year, or by both!

There is a download button (circled) if you want to download all the data so you can import it into Excel for analysis.

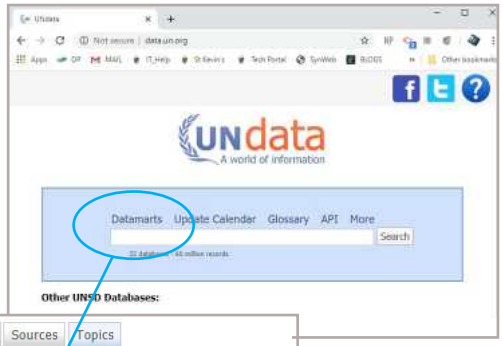
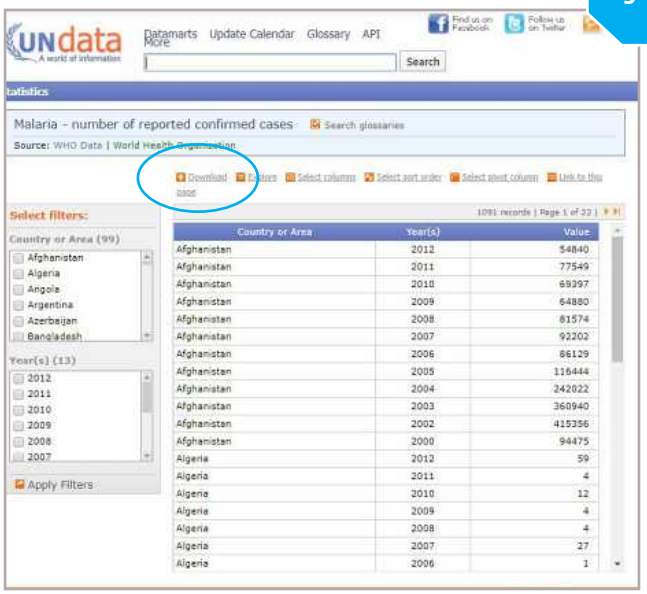
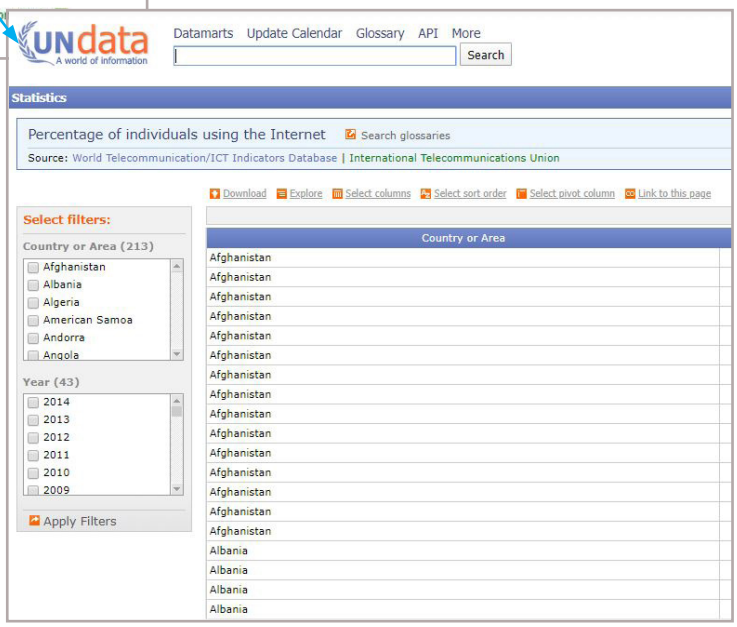


Fig. 2.7

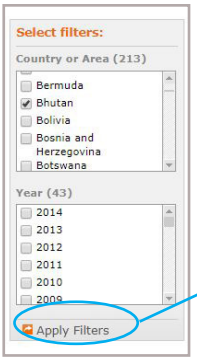


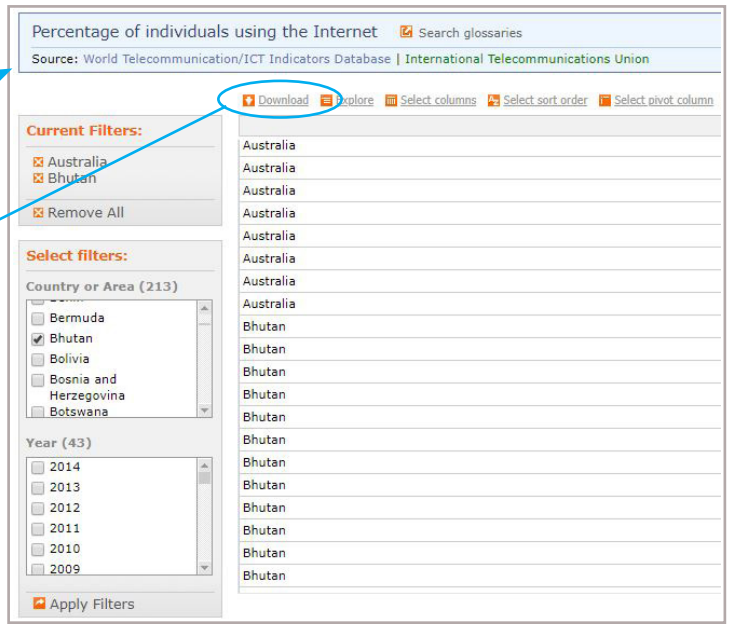
From the topic selection, you can click on "View Data". This allows you to choose the countries and dates.

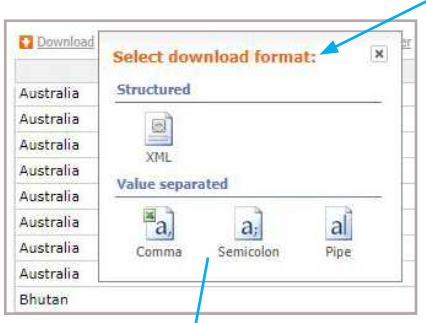


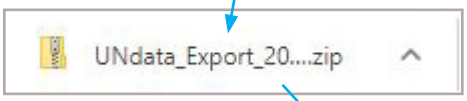
Below you can see the "Select filters" window where you can make any number of these selections. Click "Apply Filters and you get the option to "Download". You can choose any download format - Excel opens all of them.

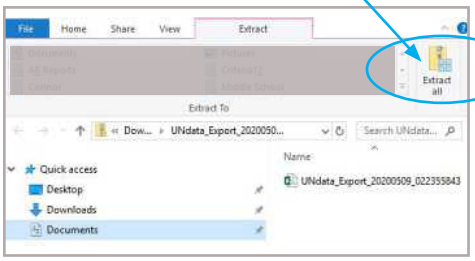
It will download a zip file that you can Extract and open in Excel for analysis.

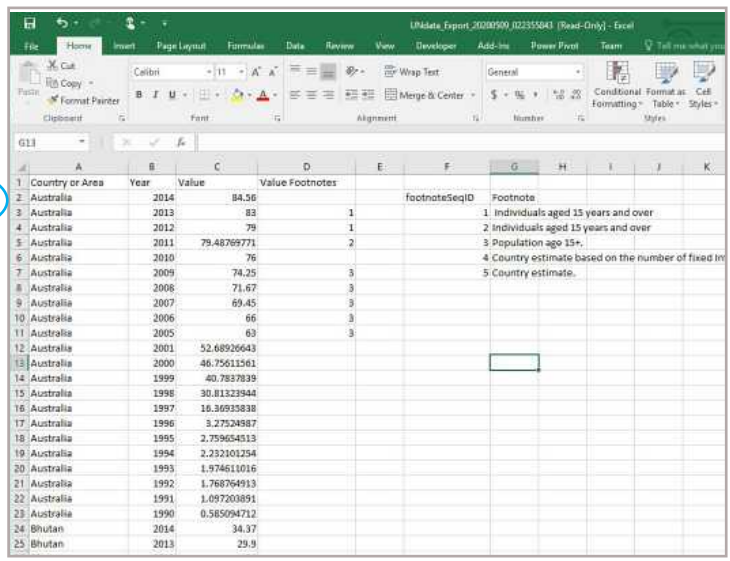












Once you open the Excel file, you can use formulas and charts to analyse the data.

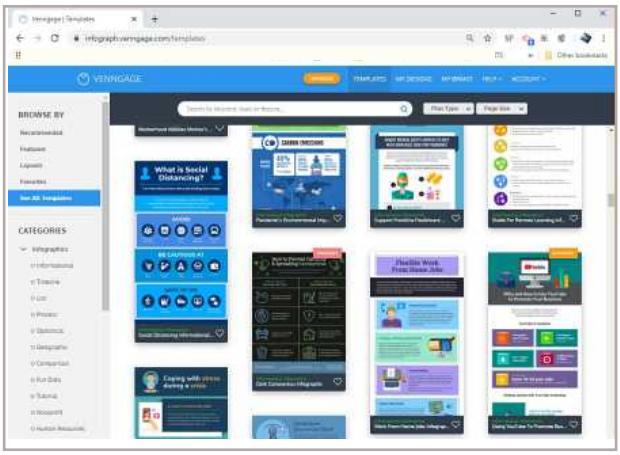
Online Visualisation Tools

Students can use any tool, such as MS Word or PowerPoint to create visualisations. However, there are plenty of online tools that allow users to enter data directly to create designer quality graphs along with other graphic features developed by expert graphic designers. These tools allow you to make decisions about how you want the data to be displayed, without having to create the graphic elements yourself. Not everyone has the creative and artistic skills to pull it all off themselves.

Here are a few online tools you can use:

- www.canva.com/
- infogram.com/
- venngage.com/
- visual.ly/
- piktochart.com/
- mindthegraph.com/

Most of these tools require students to sign up for free access. For this example, I will use Venngage.



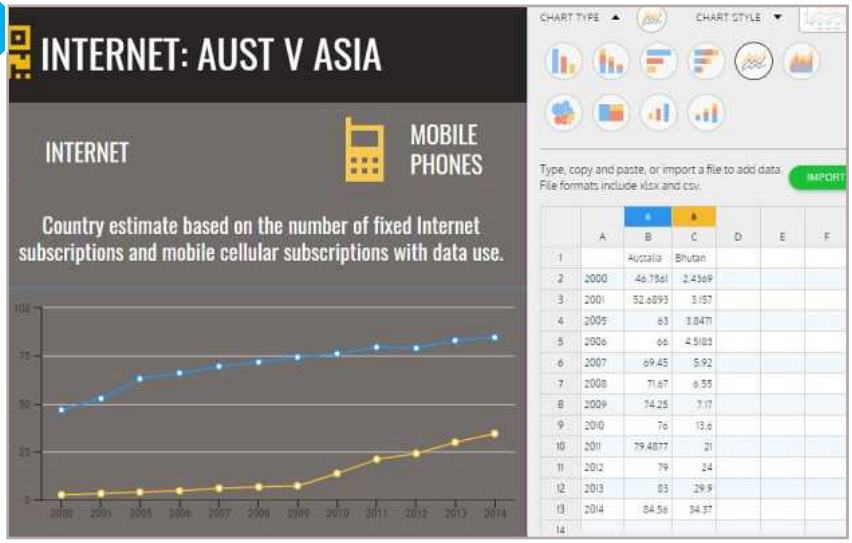
Most of these tools work in a similar way. There are plenty of infographic templates to choose from. Choose a style that relates to your topic.

Below you can see I chose a technical looking template called “Industry Report” It has some nice icons I could update and a chart I could change to suit my data. Fig 2.8 shows what can be done with the template. I have changed the heading to “Internet Aust V Asia” I was able to add a mobile phone icon from the library of icons available.

You can also see on the right hand side in Fig 2.8, that I am able to enter data into a table and choose from a range of graphs to add to my visualisation.

Professionals use these online tools every day to report on projects, research and financial operations.

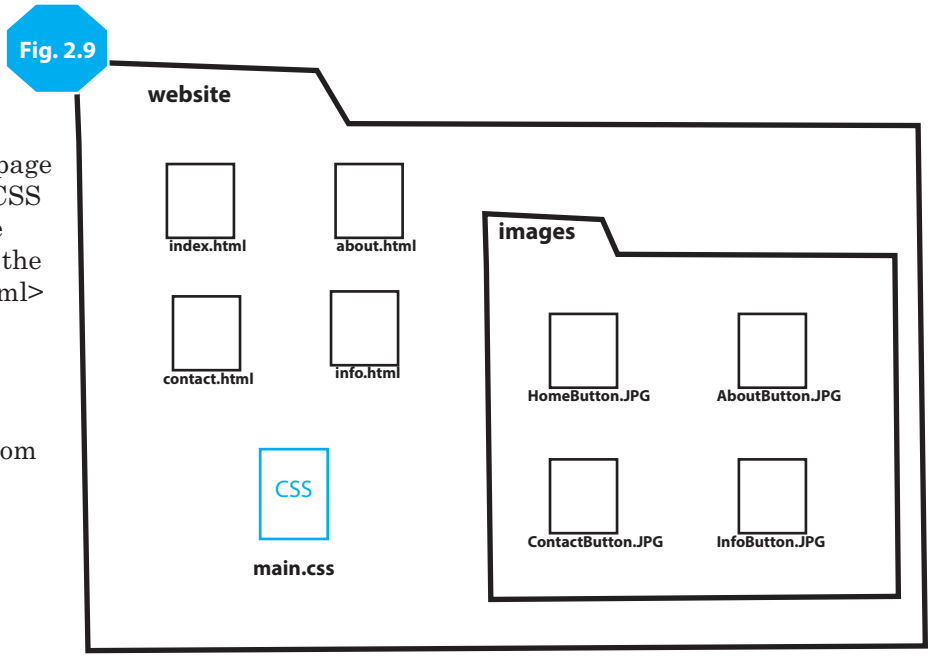
Fig. 2.8



Web Development II

It is essential that students are familiar with the concepts in 1a Foundation ICT Skills about the foundations of HTML code and file management.

In this chapter we will explore Cascading Style Sheets (CSS). CSS controls the formatting of the webpage while HTML organises and controls the content. CSS can be incorporated into a webpage in the <head> tag, but in this example, we are going to use a single separate document that controls all the webpages in the website. In Fig 2.9 we have our original website from Chapter 1a, but there is an additional file called "main.css". This will control the formatting of each tag used in the webpages.



Using the same HTML from page 21, we will add a link to the CSS stylesheet. You can see in the code below that the link is in the box after the <!DOCTYPE html> tag. It must be between the <head> tags before the body.

It is a different type of link from the <a> link tag.

```
<!DOCTYPE html>
<head>
  <title> My First Website </title>
  <link rel="stylesheet" type="text/css" href="main.css">
</head>
<body>
<center>
<h1>Heading</h1>
<table>
      <tr>
        <td> <a href="index.html"><img src="images/HomeButton.jpg"></a> </td>
        <td> <a href="info.html"><img src="images/InfoButton.jpg"></a> </td>
        <td> <a href="about.html"><img src="images/AboutButton.jpg"></a> </td>
        <td> <a href="contact.html"><img src="images/ContactButton.jpg"></a> </td>
      </tr>
</table>
</center>
This is some content written on the page.
<p>
<img src="images/picture.jpg">
</body>
<html>
```

CSS code looks very different to HTML. It doesn't use the < and > brackets to create tags. Instead it uses the curly brackets { and }.

The HTML in the top right uses three tags:

1. <body>
2. <h1>
3. <p>

Below it is the CSS that will control those three tags. Between the curly brackets for body is "background-color: linen;" All of the page will contain that linen colour.

(Don't forget we need to use the American spelling of "color" and 'center" in our coding.)

In the CSS for the <h1> tag there are a number of controls:

- a black background,
- text is white
- text is centred
- text is size 20px
- text font will be a sans-serif typeface.

The <p> tag is also controlled :

- white background
- black text
- aligned left
- 12px size
- text font is a serif typeface.

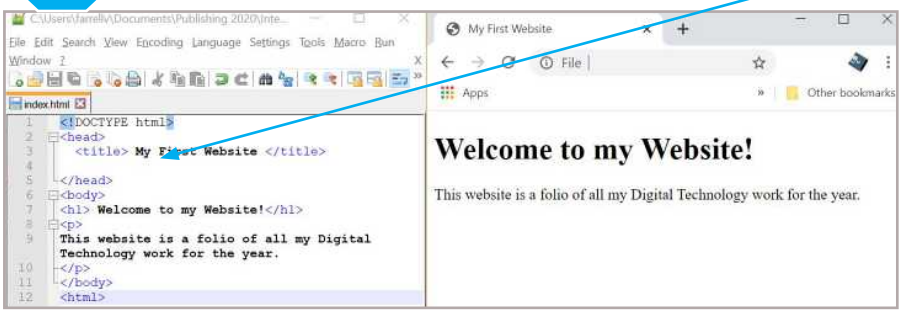
```
<body>
<h1> Welcome to my Website!</h1>
<p>
This website is a folio of all my Digital Technology work for the year.
</p>
</body>
```

```
body{
        background-color: linen;
}
h1 {
        background-color: black;
        color: white;
        text-align:center;
        font-size: 20px;
        font-family: Helvetica, Geneva, Arial,
        SunSans-Regular, sans-serif
}
p{
        background-color: white;
        color: black;
        text-align:left;
        font-size: 12px;
        font-family: Georgia, "Times New Roman", Times, serif;
}
```

In figure 2.10 you can see the difference between the basic web page and the web page with the added CSS. The link to the CSS file can be added to line 4 of the index.html file.

```
<link rel="stylesheet" type="text/css" href="main.css">
```

Fig. 2.10



w3schools.com

For more techniques, visit w3schools.com. It is the World Wide Web Consortium website for all web development tutorials.

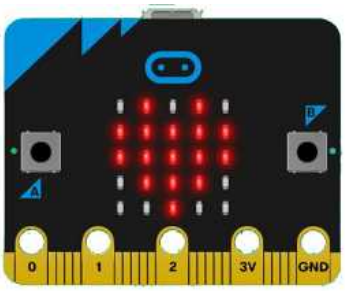
Intermediate

Microbit Programming

It is essential that students are familiar with the concepts in 1a Foundation ICT Skills on Turtle Programming. Those instructions are an introduction to Python code.

In this unit we will be creating more interactive programs in Python using a Microbit.

A Microbit is a small computer with a display made of 25 LED lights. It has two buttons for interaction and pins to connect to other electronic devices such as headphones. Microbit.org contains lessons and an online platform where you can create your Python code: python.microbit.org/v/2.0



The online platform is on the left and it shows a default program.

To add this program to your own Microbit, you select the "Connect" button or "Download" and place the file on your Microbit via file manager.

To ensure your code will run on a Microbit, the first line must be:

```
from microbit import *
```

In the code above, on line 5 is the first line of the executable code:

```
while True:
```

This is the beginning of a loop. All lines of code that are indented under "while True" will be repeated. If the lines that follow "while True:" are not indented, it will not run!

So, the lines that will be repeated are on 6, 7 and 8. Line 6 will display the words "Hello, World!" scrolling through the 25 LED display. Line 7 will display a static heart shape - but it will disappear before you even see it if you do not follow it with a 2 second sleep. Microbits count time in milliseconds (1000 milliseconds = 1 second)

```
1 from microbit import *
2
3 while True:
4   if button_a.is_pressed():
5     display.show(Image.HAPPY)
6   else:
7     display.show(Image.SAD)
8
```

In the code on the left, you can see the code begins with the import statement on line 1, and on line 3 is the loop.

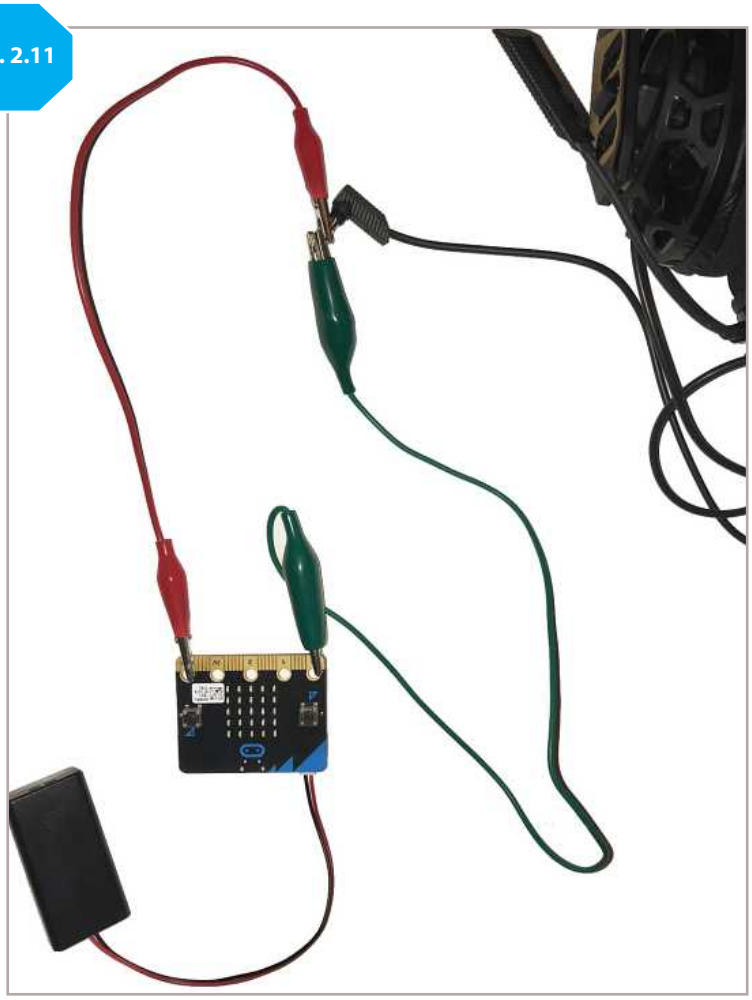
The Microbit has two buttons. The A button is on the left and the B button is on the right. The loop in this code displays a SAD face continually until the A button is pressed.

In the code on the right, you can see music as an extra import on line 2. The Microbit as a small speaker and has a library of melodies. On line 4 you can see the code used to play a melody called "BA_DING".

```
1 from microbit import *
2 import music
3
4 music.play(music.BA_DING)
5
```

A classroom full of BA_DINGs would be a bit unpleasant so let's use some alligator clips to connect to a pair of headphones. In Fig 2.11 you can see how the head phones plug has both clips attached. The other ends are connected to the GND pin (ground) on the Microbit and the first pin 0. If the Microbit is not connected to the computer with the USB cable it will require its own power source of two AAA batteries.

Fig. 2.11



There are plenty of exercises online for Microbit classes, but here are a few ideas that might be fun for the classroom.

- Set up a maze with Microbits that display arrows left and right using:

  display.show (Image.ARROW_W) and display.show(Image.ARROW_E)

- Program a set of traffic lights for an intersection.
- Use the Microbit to test run the Egg Drop experiment using the accelerometer at 8g using:

  input.on_gesture(Gesture.EIGHT_G, on_gesture_eight_g)

- Testing FlashCard algorithms where students are given code on flashcards and asked to put them in the correct order then test it on the Microbit.
- Write a melody using notes and durations:

  music.play('C4:4') plays the note C for 4 beats.

  music.play('E4:2') plays the note E for 2 beats.

The microbit.org website contains plenty of activities and solutions, but do not be seduced into using the blockly interface. At Intermediate level you should be learning to code with a real programming language. Look for the Python logo when doing your research online.

Python editor

Photoshop

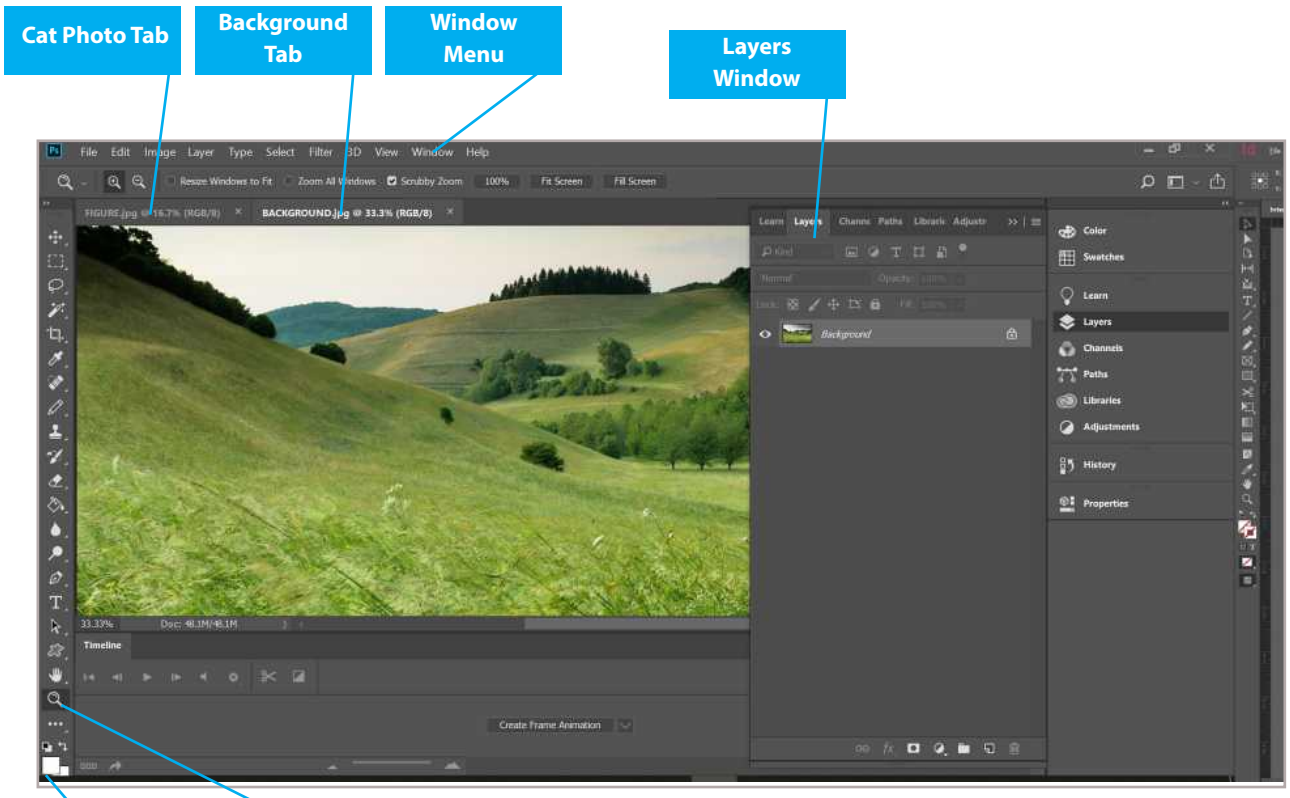
Adobe Photoshop is software that specialises in editing photographs. Over the years it has developed other functions as well, but it is primarily designed to edit photographs. In this exercise students will learn how to:

- identify pixels
- use layers
- investigate digital colour
- use the clone tool
- use selection tools.

To begin with students must have two photos: 1. a background image such as a landscape and 2. a figure on a white background such as a person or animal.

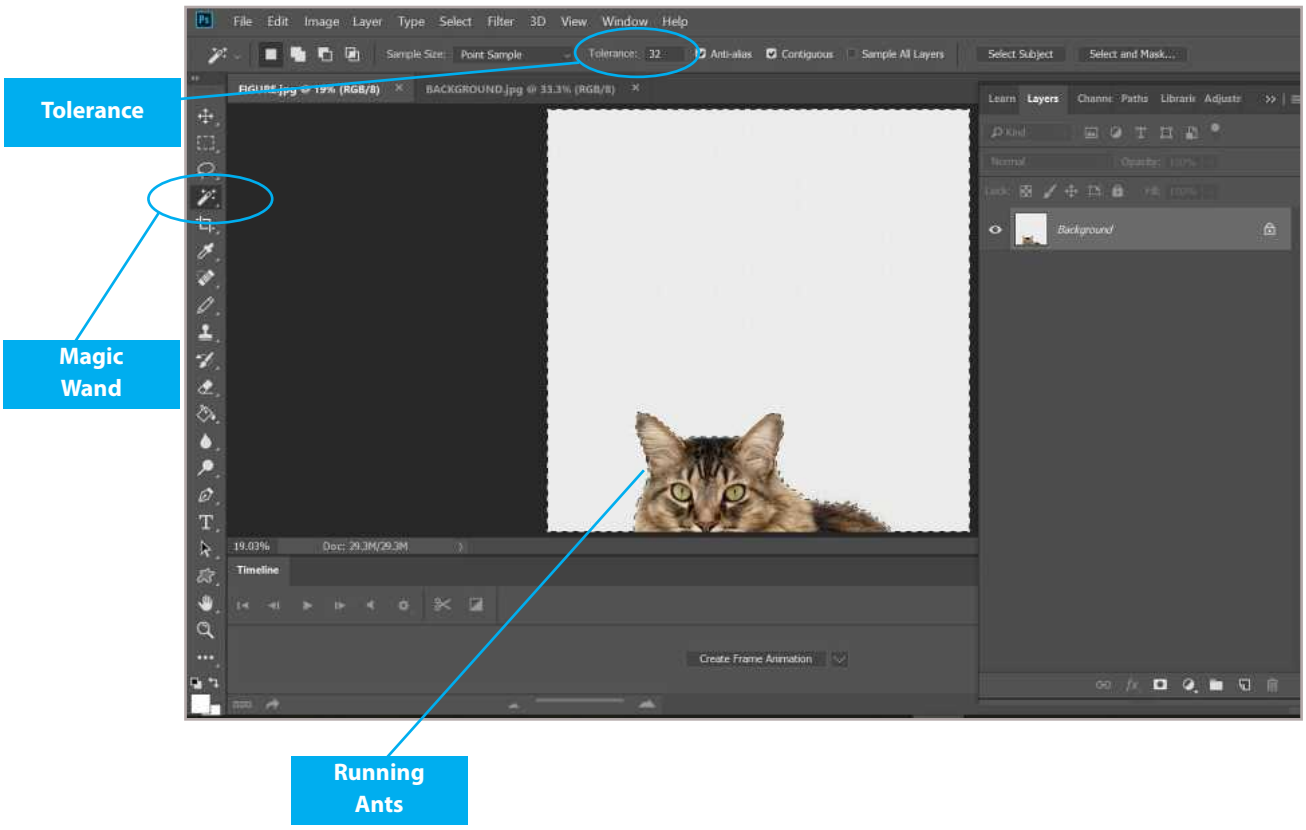
Open Photoshop and then open both of your photos by going to the "File" menu then choosing "Open".

Fig 2.12 is how you need to set up your screen.



To access the Layers Window, select "Layers" under the "Window" menu.

When we have different sections of an image on different layers, we can edit them separately without affecting the other layers. This will become very useful in this exercise.

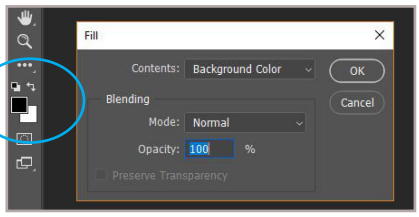


In the screen above, you can see I have selected the Magic Wand. If you can't see it on our toolbox, click on the fourth icon down and hold down your mouse until the two options appear. Some tools are hidden in the toolbox this way. Select the Magic Wand. This is a SELECTION tool. It selects pixels of the same or similar colour. Now look at the Tolerance at the top of the screen (circled above). This number determines how similar the colours will be to be added to a selection. If we are dealing with a plain white background, 32 tolerance will be fine.

Open your figure photo (I have my cat open) and click your Magic Wand anywhere in the white background. It will 'select' the pixels in the background and this will be indicated by a moving dotted line we call "running ants". We are going to remove these pixels from the image by selecting "Delete" on the keyboard.

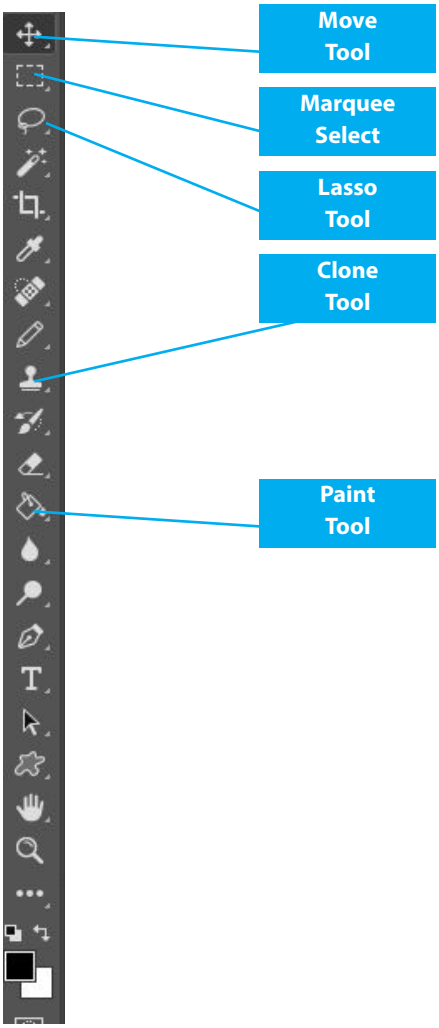
When you hit "Delete" a window will appear and ask you if you want the Background Colour or the Foreground colour. This is referring to the Colour Picker. You can see in the image on the right, that black is in the foreground and white is the background. To reset your colour picker o black and white, just click on the reset button above.

Hit 'OK' and you now have an empty background with no shadows.



While the background is still slected, we can go to the "Select" Menu at the top of the screen. From here choose "Inverse", This will now completely select your figure. You can COPY this selection and go to your Background image and PASTE!

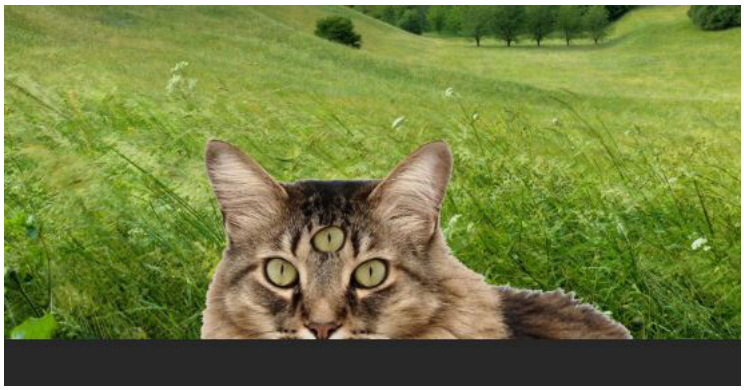
Now if you check your Layers window it will have two layers now with the background image and the figure on top.



On the left you can see the tools we will be using for the rest of the exercise.

The Move Tool allows you to move the image, the Marquee and Lasso allow you to select areas of the image. The Paint tool allows you to fill an area with one colour.

We are going to use the Clone tool. This allows us to copy pixels from one area of the image to another area. The image below shows how the right eye of the cat has been copied onto another part of its face.



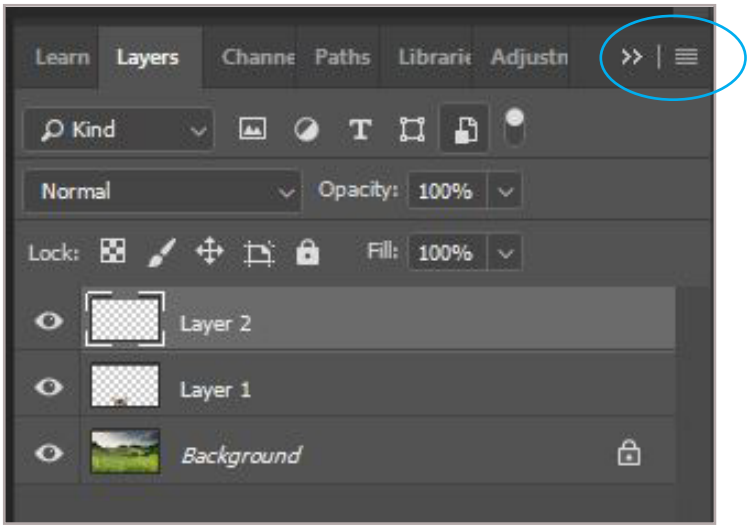
There is a trick with the clone tool and it takes a couple of steps:

1. Select the Clone Tool
2. Move your cursor to the section you want to copy (Eg. right eye)
3. Hold down the Alt key and click the mouse once
4. Go to where you want to place the copy and click and drag your mouse (paint in the right eye)

Now we have our freakish figure - let's give them laser vision!

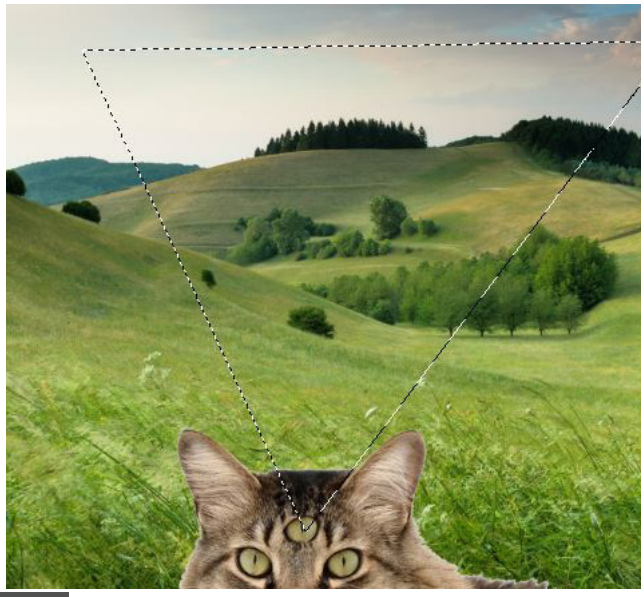
We need to create a NEW Layer!
Go to the layers Window (see right).
Select the lines on the top left (circled) .
Select New Layer...

We are going to create a section of colour using another selection tool.



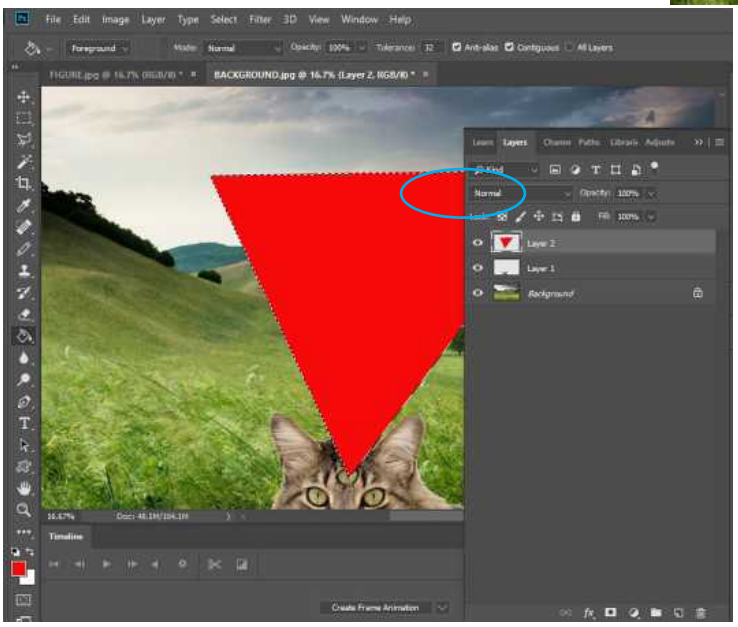
Make sure your New Layer is selected. Now let's use the Lasso. This allows you to draw a selection area. If you hold down the lasso tool you can choose the Polygonal Tool which allows you to create straight sided shapes. You only need to click once for each corner to create this shape. See below, I have created a triangle with my Polygonal Select tool.

While the section is still selected, let's grab a colour. Choose a colour that contrasts with the background. In the image below, you can see I used the colour picker to choose red.



I then chose the Paint Tool which looks like a paint can. I simply clicked the paint can in the selected triangle on the top layer. Now I have a red shape coming out of my cat's third eye.

Spooky!



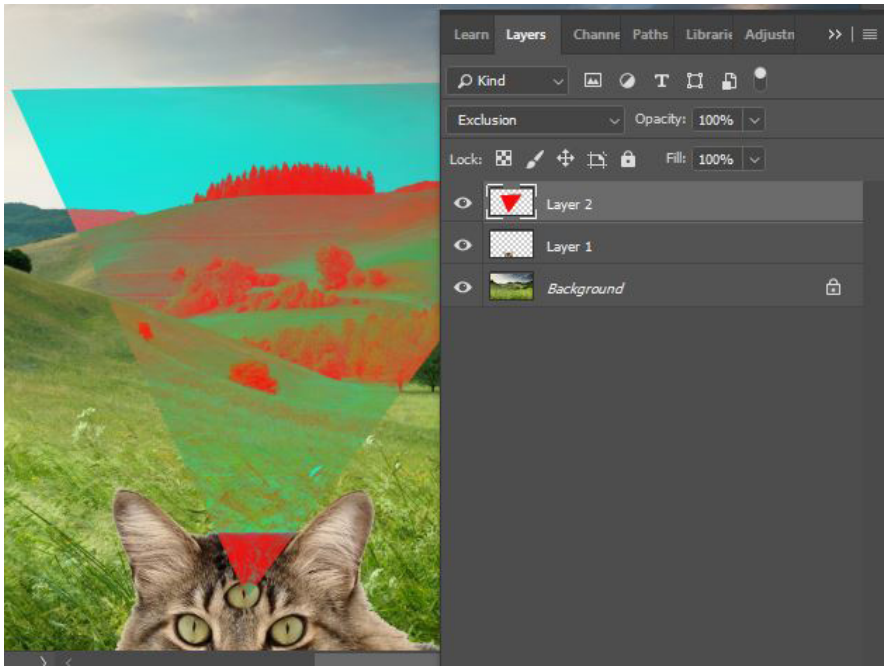
While we have our top layer with the triangle selected we can play around with how the layers interact with one another.

In the image on the left you can see the word "Normal" circled.

This is a pull down menu that allows you to choose from a wide range of effects.

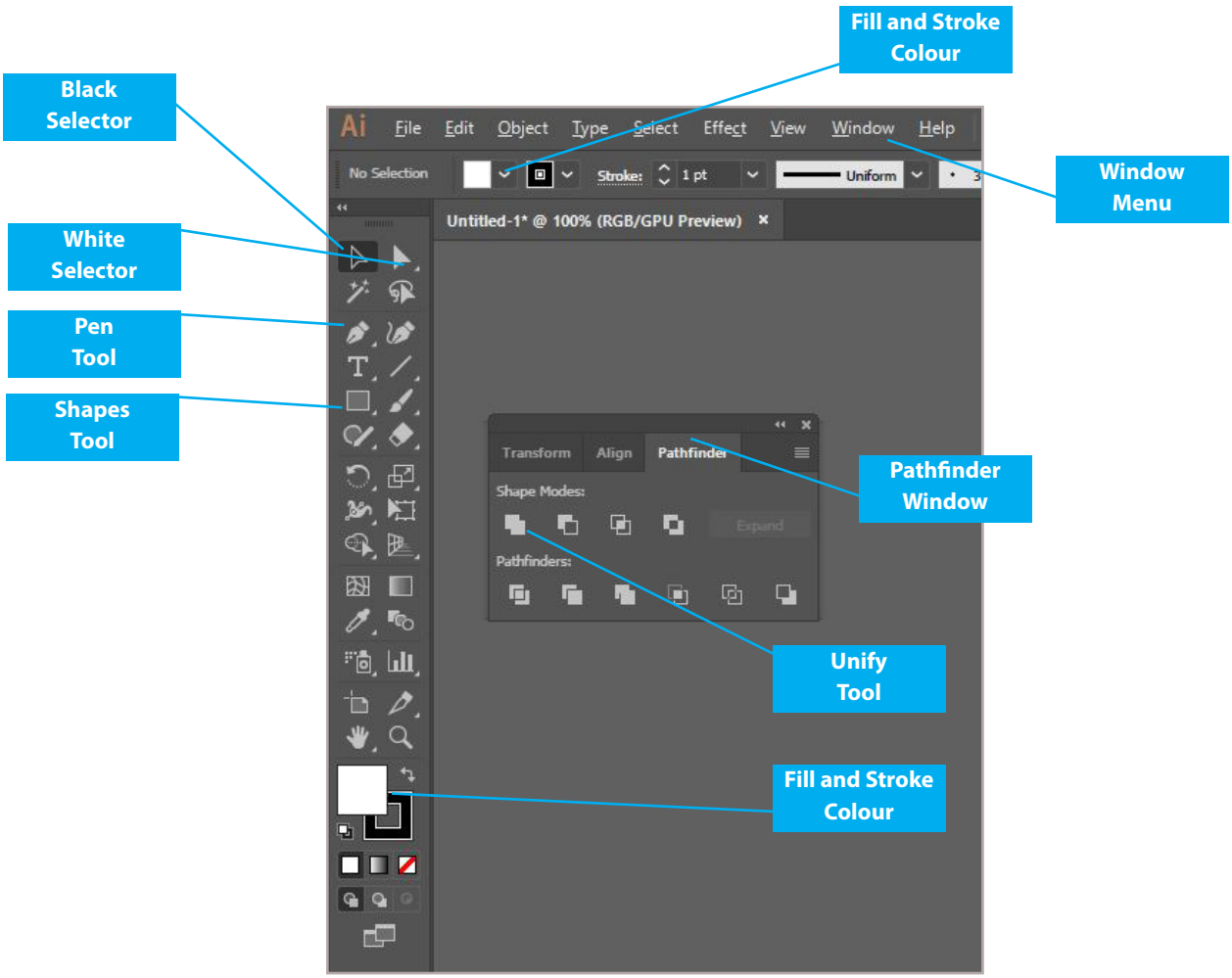
Click on the pulldown menu and choose one. I have chosen Exclusion in my example below.

You can create a lot of fun images using photographs with these basic tools. Enjoy!



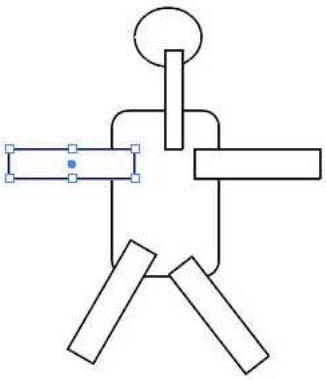
Illustrator

Adobe Illustrator is software that specialises in creating illustrations. Users can create and edit drawings by making paths and filling those paths with colour. In the window below you can see the tools we will be using in this exercise.



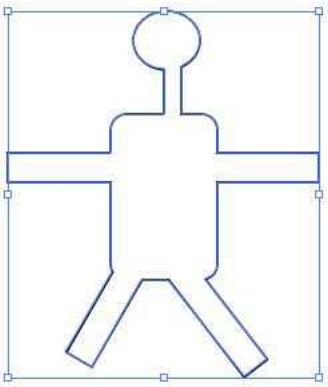
When you open Illustrator, select New and A4 as the size of your Artboard. Make sure you have white as your Fill colour and black as your Stroke colour. This will create shapes with white inside and a black outline. Using various Shapes Tools ,(just hold down the mouse to reveal the different shapes) create a human figure out of separate objects. You can see mine below. I have made a figure out of five rectangles, a circle and a rounded rectangle. I rotated the legs by holding down the mouse while using the Black Selector tool. If you hold the cursor near a corner it will allow you to rotate the object.

Now we need the Pathfinder Window. You can access it under the "Window Menu". Click and drag the Black Selector to select all the objects. Select the Unify Tool and see your objects blend together to create an outline.



This process converts many paths into a single path.

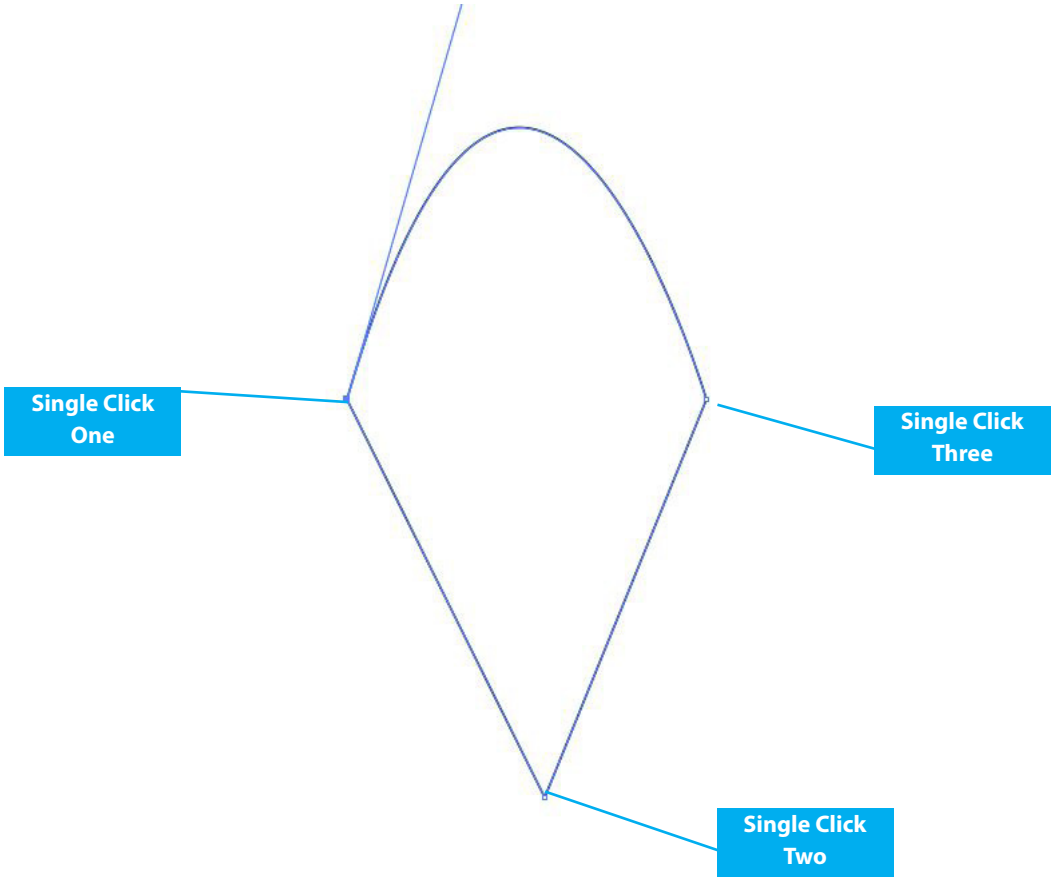
You can see on the left that each object can be selected separately and the little squares appear. These are called handles and can be used to edit the shape. After the pathfinder has combined them, the handles relate to the whole image.



PEN TOOL

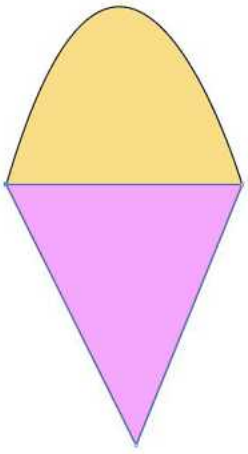
Most commonly, Illustrator users create their illustrations with the Pen Tool. This allows the user to create detailed drawings. Be warned, however, it can be tricky to use.

The first thing we will create is an ice-cream cone. The cone is easy. See the image below, click once at each point to create the V shape of the cone.

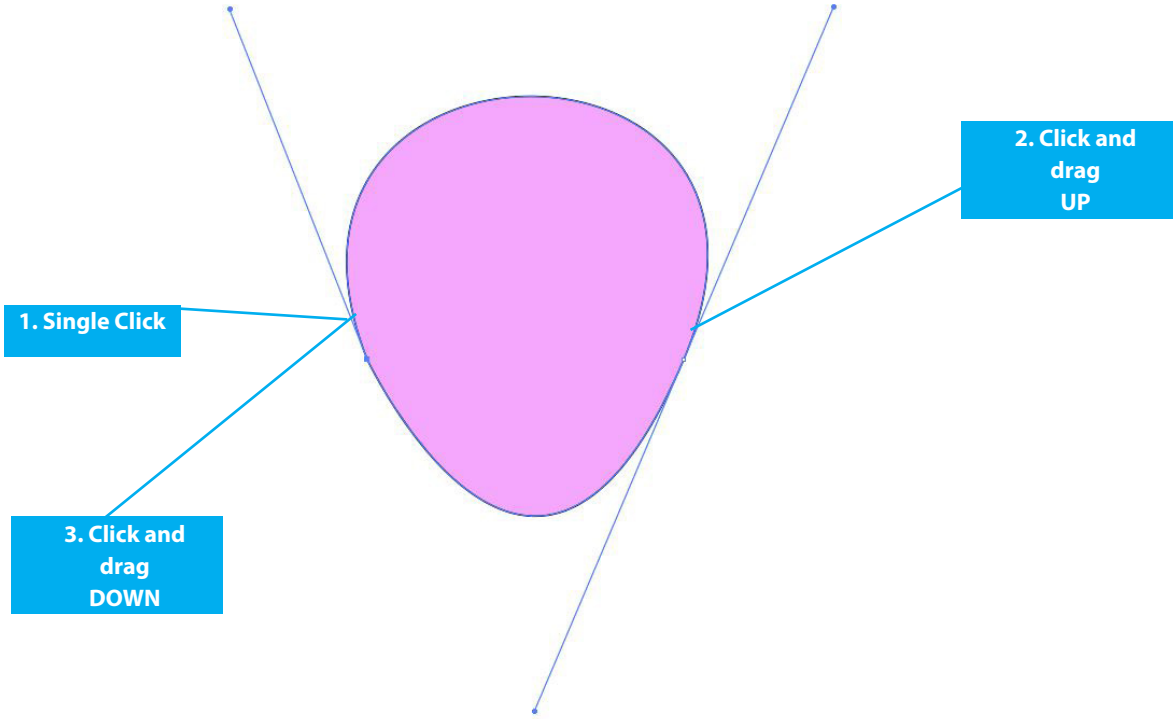


To create the curve, simply return to the first spot for Click One and Click and Drag. This means you hold down the mouse button and move the mouse DOWN. A curve will appear. You can control the curve by continuing to move your mouse while the button is pressed down. Release the mouse button to preserve your curve. Now you can select a colour from the Fill and it will fill the whole shape. I filled in my whole shape with yellow.

Now we need to deselect the shape by clicking anywhere outside of the shape with the Black Selection tool. We can now draw a new triangle over the top. I chose a Fill colour and created my triangle by just using single clicks on each of the three corners. Don't forget to complete the shape with a click on the first corner again. Now you have created your first drawing!



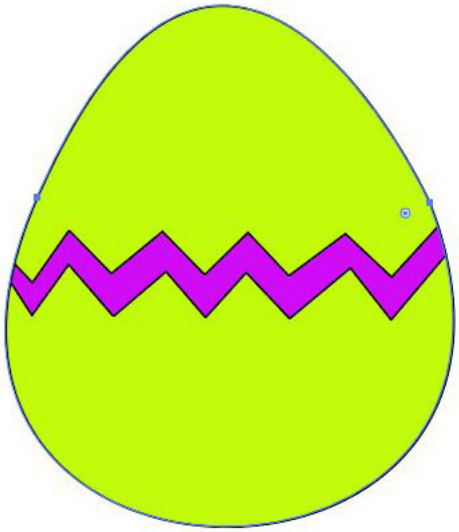
Now we are going to create an Easter Egg. We only need three clicks to create the egg shape, but two of them must be Click and Drag. In the diagram below, you can see the first click is a single click, then a second click is made and dragged UP. This creates the bottom curve. Then the final click and drag needs to be on the first click to complete the egg. Drag DOWN and it will complete the top of the egg.



With the egg selected we can choose a different colour. Deselect the egg by clicking away from the object and select the pen tool again. We are going to create a zigzag pattern across the egg. Remember the last click must be on top of the first click to complete the shape. When you are drawing straight lines with the pen tool, you only need to click once to create the line. If you want to draw angles, simply single click on each corner. Curves require a base click then a click and drag to control the curve.

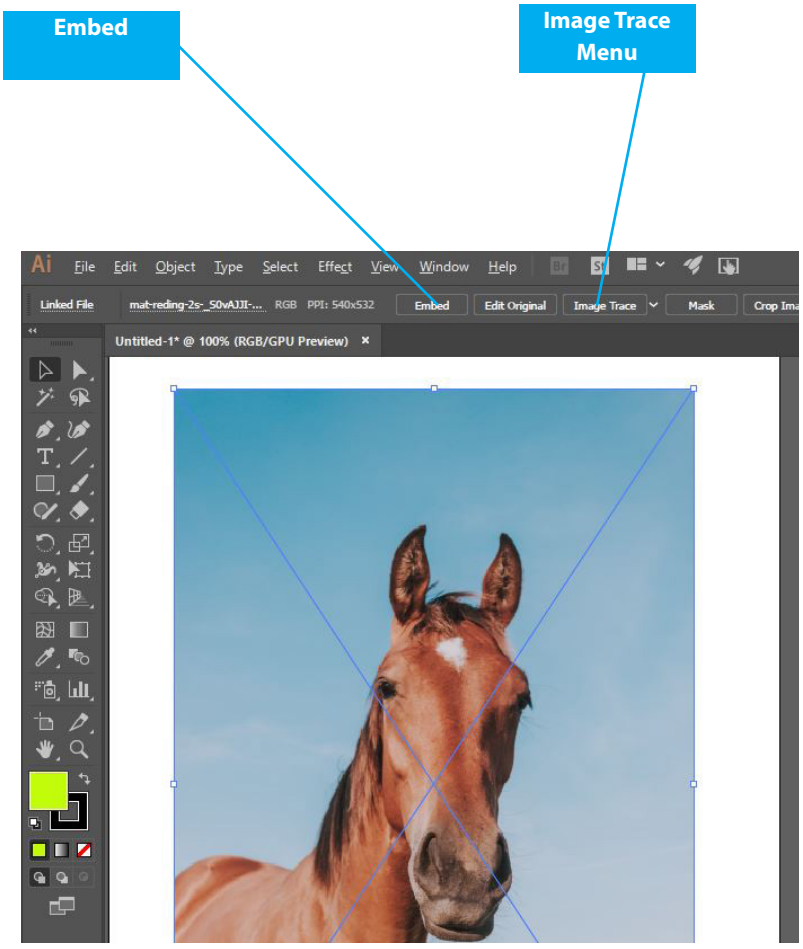
You can see my egg below. The pointy side of the egg is facing the top. All I did was use my Black Selection tool to select it all and rotate it using the corner handle.

The pen tool is tricky and might take a few goes to get it right.



TRACE TOOL

The third and final way we will create a drawing in this section is to use the Trace tool. Illustrator can import a Raster (photographic) image and convert it to a Vector image. This can be a useful skill in developing illustrations if you are struggling with the pen tool.



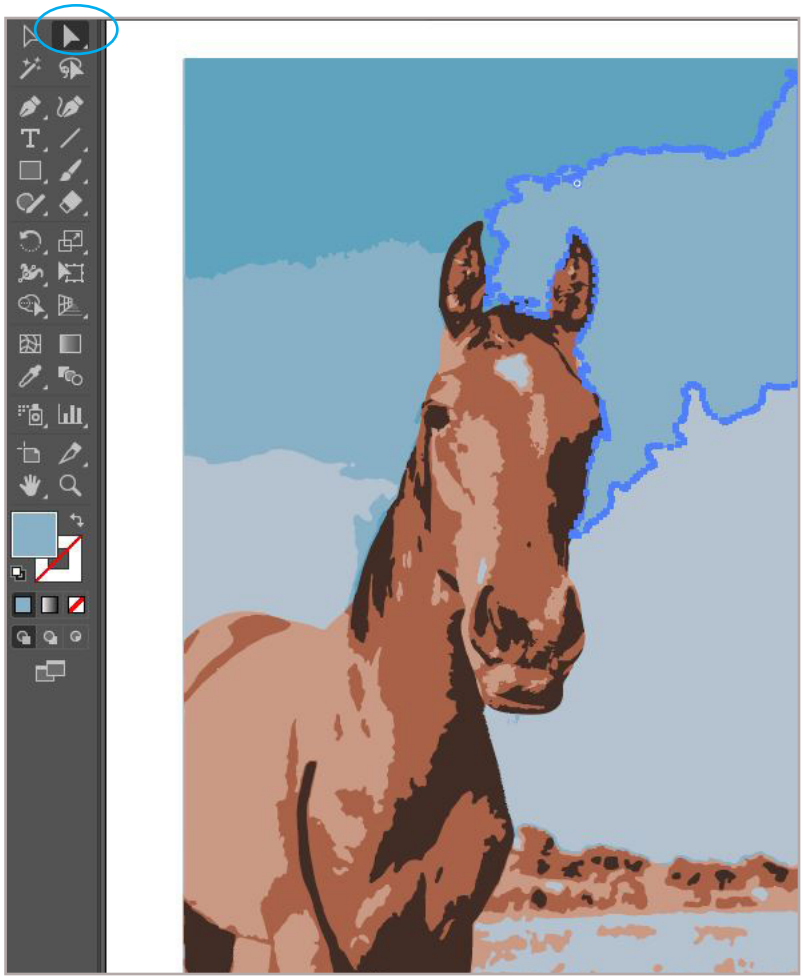
With this technique we can continue to use the A4 Artboard. We are going to use a photograph that we have saved on our computer. The easiest to manipulate, is an image of a figure or object on a plain background. I have chosen this photo of a horse. Most of the background is blue sky so it might be fairly easy to isolate the horse from the background.

To add the photo to your Illustrator Artboard, go to the FILE menu then the select PLACE. You can browse for your photo to add it. If your picture is too large, simply use the Black Selector tool on a corner and resize it to fit your page.

With the photo selected you are going to click on the Image Trace Menu which should reveal many options including: 3 Colours and 6 Colours.

I have chosen 6 Colours here. There maybe a pop-up window that asks for you to proceed. Just say OK.

The result will be more graphic than a photograph. You can see in the images below that the image on the left is selected as one single box, but the image on the right has each colour selected separately. To do this, select the Embed button.



Once you have used the Embed, each colour is a separate object.

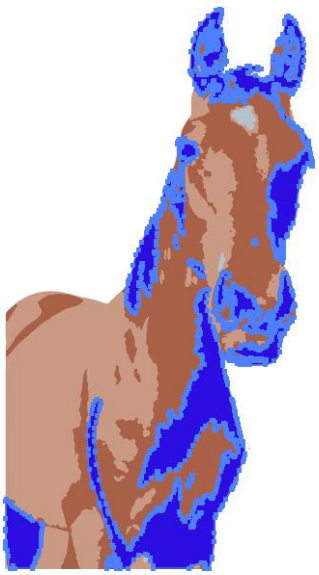
Now we can use the White Selection tool (circled). This allows the user to edit each section. In the image on the left, you can see a section of sky is selected. I can now delete that object, or change the fill colour.

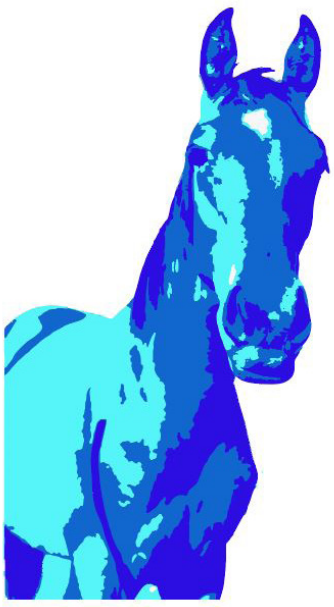
What I intend to do with my horse picture is delete all the background objects and change the colours within the horse figure.

I used my White Selector tool and deleted all the background shapes. The section of land at the bottom got a bit tricky, but you can zoom in and remove all the objects. This resulted in the image below on the far left.

Now for some fun and creativity!

Using the White Selector, I selected the dark brown. While it was selected, I chose the Select Menu at the top. Under the Select Menu, I chose “Same” and then “Fill Colour”. This selected ALL the dark brown objects in the image. I then chose a dark blue with the Colour Fill and the result is the centre image below. I did the same thing for the mid tone and the lighter brown to create a full blue horse! I think this looks pretty cool!





2a. Intermediate Digital Technology Knowledge

Data Analysis

Before we can investigate Data Analysis, we must first focus on the properties of data. In the Foundation chapter we looked at Binary code and how it can "digitise" all kinds of data for use in digital systems. We looked at the five main data types (Numbers, Text, Images, Sound, Video) and how they can be formatted into different file types.

Data Types

In this chapter we are going to investigate data more closely. There are many types of numerical data, for example:

- Integers (Whole numbers)
- Floating Point (Decimal)
- Currency
- Percentage
- Calculated

We also have a data type called Boolean which is only TRUE or FALSE.

Fig. 2.12

Store	Employees	July	%
Hawthorn	10	$ 152,000	16.9
Kew	5	$ 78,254	8.7
Camberwell	12	$ 256,123	28.5
Richmond	8	$ 78,000	8.7
South Yarra	8	$ 45,235	5.0
Toorak	7	$ 65,200	7.3
Surrey Hills	5	$ 45,123	5.0
Balwyn	9	$ 78,450	8.7
Waverley	10	$ 100,020	11.1
Total		$ 898,405	
Highest		$ 256,123	

We enter different types of text data into digital systems such as:

- Categories from lists
- ID Numbers
- Written facts
- Links from websites
- Email addresses

Fig. 2.13

We even use images to collect data into a system:

- Bar codes
- QR Codes

0 705632 441947 >

Can you find examples of the following data types: in Figs 2.12 and 2.13?

Category

Percentage

Boolean

Integer

Currency

Activity 1

Data Analysis

Data Analysis is the process of turning data into useful information.

There are four main areas of Data Analysis:

1. Data Collection
2. Data Manipulation
3. Data Representation
4. Data Interpretation

1. Data Collection

We collect data all the time. We hear our friends talking, read books, listen to teachers and our parents and look at content on the internet. These are data sources, the places and people we source our data. Some data sources are more reliable than others. For example, reading something your friend shared on social media is less reliable than something your teacher will tell you, or what you find in a text book. A very important feature of data is "authenticity". Authentic data has been collected and published by reputable sources.

Let's look at some authentic sources for data collection:

- Government websites
- Scientific Institutions and publications
- Textbooks
- Authorities
- Experts
- First-hand observers of an event

Data Sources can be divided into two types, primary and secondary. You are most familiar with collecting from secondary sources by reading textbooks and googling information online. Secondary sourced data has been collected and has already been published by someone else. Primary sources are where you collect the data yourself by:

- Asking questions of friends and family.
- Creating an online survey.
- Observing an experiment.
- Conducting an interview.

Activity 2

Can you identify an Authoritative Source of data for the following topics?

Melbourne Weather

Population of India

The exact time of your birth

The temperature that sugar melts

The most popular sport at your school

The Australian Copyright laws

Where your teacher was born

The price of a litre of milk

In this chapter we will focus on collecting data from secondary sources online. There are large data depositories online from government and other specialist organisations. The United Nations has a huge online database that allows you to collect data from countries around the world going back decades. The Australian government has data available online about the population as well as other specialist scientific data. Below is a list of authentic data sources where you can collect data for analysis.

United Nations: http://data.un.org/

Australian Bureau of Statistics: https://www.abs.gov.au/

Bureau of Meteorology: http://www.bom.gov.au/climate/data/

World Health Organisation: https://www.who.int/data/gho/data/countries

Google Public Data: https://www.google.com/publicdata/directory

Gapminder: https://www.gapminder.org/data/

Central Intelligence Agency: https://www.cia.gov/library/publications/the-world-factbook/

These data sources allow you to download data sets that you can analyse. You can collect data from different locations and compare the data and look for relationships or trends.

2. Data Manipulation

Sometimes you need to manipulate the data in order to analyse it. For example, in the table below you can see some figures relating to two countries, India and Japan. They have been taken from different datasets where Japan had data for the years 1967 onwards, but India did not have any data until 1974. To make a meaningful comparison between the data collected, Japanese data before 1974 should not be considered. In this example the Japan data between 1967 and 1973 can not be used to compare these two countries. Once that data is removed, you can graph the data against the same time frame. You can see in the graph below, both axis are the same scale and you can see the true comparison between the countries during the same years.

Another form of data manipulation is the use of formula. You might also need to compare averages, maximum and minimum data. These can be calculated using spreadsheet formulas. These formulas do not change the data, they analyse the data further, so it can be more readily interpreted. When you are confronted with an entire spreadsheet of data from 1967 to 2009 you might find it easier to look at the average of each decade or when the maximum or minimum occurred. How you organise and manipulate the data will determine how you will represent the data in a graph. Let's look at the dataset in Fig2.14.

Year	India	Japan
1967		450000
1968		460000
1969		460000
1970		460000
1971		440000
1972		430000
1973		450000
1974	2940000	460000
1975	2940000	460000
1976	3180000	480000
1977	3180000	470000
1978	3180000	490000
1979	3350000	510000
1980	3520000	550000
1981	3690000	620000
1982	3860000	670000
1983	4030000	680000
1984	4200000	680000

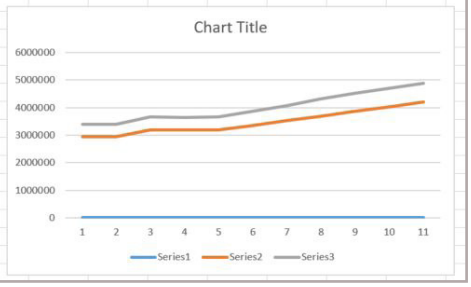


Fig. 2.14

Australian Bureau of Statistics

62270DO001_201905 Education and Work, Australia, May 2019

Released at 11:30 am (Canberra time) 13 November 2019

Table 14 Highest non-school qualification: Level and main field–By age and sex, Persons aged 15–74 years with a non-school qualification

	Males									Females						
Main field of highest non-school qualification	15–19 years	20–24 years	25–29 years	30–34 years	35–44 years	45–54 years	55–64 years	65–74 years	Total	15–19 years	20–24 years	25–29 years	30–34 years	35–44 years	45–54 years	55–64 years
Natural and physical sciences	0.0	20.5	21.2	24.3	41.7	40.4	36.5	26.2	217.9	0.0	19.5	24.9	37.9	55.7	42.9	29.3
Information technology	2.9	28.1	45.2	53.5	108.0	61.2	23.0	8.4	333.6	0.0	3.7	9.6	22.4	34.4	15.0	7.6
Engineering and related technologies	12.7	90.2	173.8	183.6	356.2	334.3	336.2	240.6	1,725.5	1.6	7.3	17.7	22.0	36.5	35.1	21.0
Architecture and building	4.0	47.2	80.2	76.0	123.1	120.8	103.4	58.6	612.0	0.0	8.3	16.7	13.2	13.7	8.2	4.7
Agriculture environmental and related studies	0.0	12.8	16.4	10.5	33.0	29.6	35.2	28.5	168.3	3.7	10.9	13.9	11.5	18.5	17.0	8.4
Health	1.6	14.9	38.8	41.0	60.4	51.9	46.3	37.0	290.8	8.0	70.2	122.5	116.4	180.2	161.2	156.5
Education	0.8	3.8	16.1	19.4	35.8	34.2	43.8	35.2	190.7	2.2	30.4	64.9	71.2	142.3	142.4	121.4
Management and commerce	8.5	82.8	122.6	155.2	264.8	217.4	157.6	96.7	1,104.6	18.3	114.9	176.5	221.2	375.3	308.7	216.0
Society and culture	5.4	39.0	70.9	62.3	103.0	95.1	81.4	46.0	502.6	18.9	94.2	148.9	129.7	256.6	225.7	181.0
Creative arts	3.2	24.2	47.6	34.7	46.8	33.7	18.0	15.7	222.0	9.1	46.9	54.6	33.2	76.5	51.0	29.0
Food hospitality and personal services	5.9	24.1	31.9	31.8	41.8	33.8	23.0	18.6	208.8	20.5	48.9	54.8	41.6	87.9	72.7	40.1
Total	50.3	388.1	676.6	701.3	1,224.6	1,074.4	919.4	617.6	5,652.3	85.0	461.5	715.5	733.0	1,299.0	1,099.9	827.8

The source of this data is the Australian Bureau of Statistics (ABS) and it was collected in May of 2019. The data pertains to the number of people in Australia who have completed various qualifications after, or instead of, school. Because I have an interest in Technology, I have highlighted the Information Technology row. We can see that the data has been broken up into age groups. You can see below that the table is divided into Male and Female. We can see the totals circled indicate that more than three times the number of males have Information Technology qualifications than females. We can also see that there are more male teenagers with IT qualifications, (usually a TAFE qualification) and no female teenagers. It might be interesting to investigate what kinds of qualifications males and females complete and perhaps break the groups into generations: Zoomers(<25), Millenials (25 - 35), Gen X (35 - 55), and Boomers (>55). We can easily use SUM formula to calculate the totals for each generation.

		Males									Females								
6		15–19 years	20–24 years	25–29 years	30–34 years	35–44 years	45–54 years	55–64 years	65–74 years	Total	15–19 years	20–24 years	25–29 years	30–34 years	35–44 years	45–54 years	55–64 years	65–74 years	Total
16	Main field of highest non-school qualification																		
17	Natural and physical sciences	0.0	20.5	21.2	24.3	41.7	40.4	36.5	26.2	217.9	0.0	19.5	24.9	37.9	55.7	42.9	29.3	9.9	217.3
18	Information technology	2.9	28.1	45.2	53.5	108.0	61.2	23.0	8.4	333.6	0.0	3.7	9.6	22.4	34.4	15.0	7.8	6.8	101.6

In the table below you can see I have created a NEW spreadsheet and added the data from row 18 in the table above. I added the column labels and used the =SUM() formula to calculate the totals for each of the generations. Now we can start making some observations about these groups of people. Gen X seems to be the dominant generation with Information Technology qualifications in both male and female. I wonder why that is? Is it because there are more Gen X people in the community? Let's investigate!

	Qualifications in 2019	MALES									FEMALES								
2		15–19 years	20–24 years	25–29 years	30–34 years	35–44 years	45–54 years	55–64 years	65–74 years	Total	15–19 years	20–24 years	25–29 years	30–34 years	35–44 years	45–54 years	55–64 years	65–74 years	To
3	**Information Technology**	2.9	28.1	45.2	53.5	108.0	61.2	23.0	8.4	333.6	0.0	3.7	9.6	22.4	34.4	15.0	7.8	6.8	10
4		Zoomers		Millenials		Gen X		Boomers			Zoomers		Millenials		Gen X		Boomers		
5		31.0		98.7		169.2		31.4			3.7		32.0		49.4		14.6		

In Fig 2.15 is the spreadsheet that outlines the total number of people in Australia. Each of the ABS downloads contains more than one table and the first table usually contains the summary statistics, such as a break down of the population. You can see it shows how many people in the total population in each age group for each state, and in Australia.

So let's see if Gen X is in fact the largest generation within the Australian population. We can add up the generations again from the totals and use a graph to show the proportions.

I used a SUM formula to add up the Australian totals for each generation and put them into a table so I could graph the total population proportions.

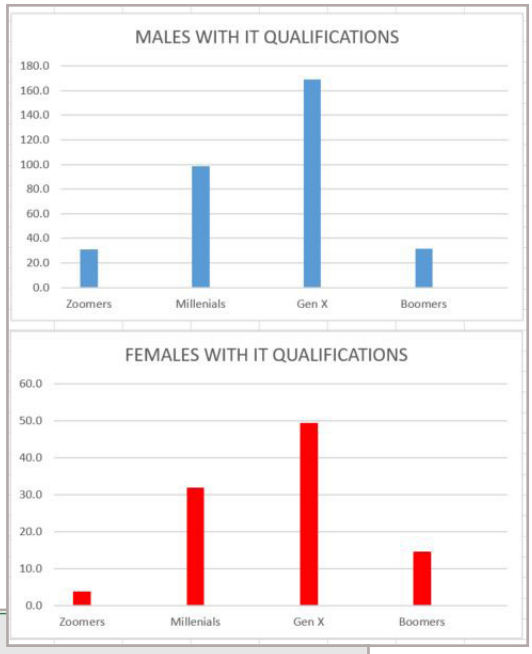


Fig. 2.15

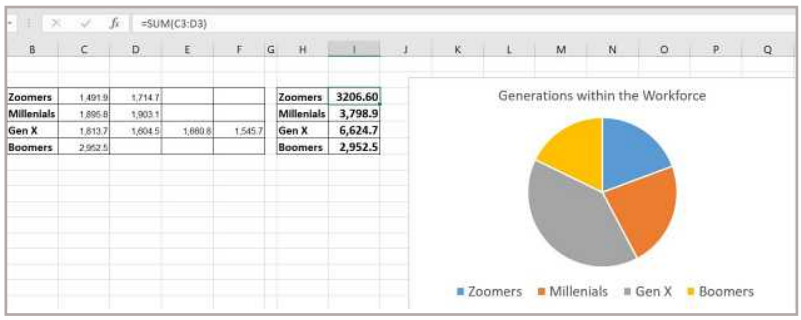
Australian Bureau of Statistics

Education and Work, Australia, May 2020
Released at 11:30 am (Canberra time) 11 November 2020

Table 21 Current study: Persons aged 15–64 years, 2020

	15–19 years	20–24 years	25–29 years	30–34 years	35–39 years	40–44 years	45–49 years	50–54 years	55–64 years
TOTAL POPULATION									
State/Territory of Usual Residence									
NSW	466.3	549.3	610.6	611.2	578.1	508.4	524.4	482.2	943.3
Vic.	383.3	477.3	537.1	531.0	491.3	421.5	426.4	402.1	739.8
Qld	316.0	332.8	361.6	356.0	348.4	319.9	344.3	314.9	597.4
SA	101.6	113.4	117.1	116.2	113.9	103.8	111.1	110.8	221.3
WA	154.4	164.2	183.4	201.4	195.7	174.1	175.1	165.9	306.7
Tas.	31.2	31.3	34.2	32.7	32.1	30.2	34.3	34.1	74.3
NT	13.3	11.8	17.2	20.1	16.9	15.4	15.0	13.8	23.7
ACT	23.6	33.0	33.7	34.2	34.3	29.9	28.5	25.1	43.8
Remoteness areas									
Major Cities	1,076.1	1,359.2	1,500.4	1,480.5	1,411.9	1,216.5	1,221.6	1,101.6	1,985.9
Inner Regional	281.6	229.8	245.8	273.1	253.7	244.6	307.4	273.9	605.4
Outer Regional	112.6	110.2	127.1	124.6	119.9	117.0	112.8	139.0	314.7
Remote & Very Remote	20.3	17.9	25.5	27.9	29.4	25.6	17.3	30.0	46.0
Sex									
Male	765.5	878.8	952.8	937.8	897.3	795.3	818.6	753.1	1,439.7
Female	724.8	835.9	944.8	967.1	916.9	809.7	842.6	793.0	1,510.9
Persons	**1,491.9**	**1,714.7**	**1,895.8**	**1,903.1**	**1,813.7**	**1,604.5**	**1,660.8**	**1,545.7**	**2,952.5**

Here is what we found in the table on the right. The largest group surveyed is the Gen X generation, then the Millennials then the Zoomers. I created the pie chart in the spreadsheet so I could see quickly and easily how large the Gen X group was in relation to the rest of the population surveyed in 2019.



This may explain why there are more Gen X people with Information Technology qualifications in the working population, because Gen X is the largest generation currently working.

With some online research I found some interesting reports that stated there has been a "general decline of enrolments in Information Technology subjects over the past 20 years in Australia". A study commissioned by the Australian Council of Deans of Science 2018: http://www.acds.edu.au/.

With a bit more digging I was able to identify another possible reason why Gen X is the generation with the most Information Technology qualifications. Personal computers became affordable and very popular in the 1980s. This was the time when Gen X were in school. Gen X kids taught themselves how to program and built software and games and other digital technology. They were the first generation on the World Wide Web and tinkering with network technologies: https://www.computerhistory.org/

By the time the Millenials came along in the late 90s and early 2000s, digital computing was a lot more user friendly with graphical user interfaces, but the technology was a lot more complex. Younger generations use digital technology that has been developed by others, but are less likely to experiment and create new digital technology solutions themselves.

3. Data Representation

I have represented the data in two charts in my analysis, so far. I have represented the relative proportions of the population in a pie chart and the comparisons of the generations with IT qualifications are represented in a bar chart.

Understanding data representation is important because choosing correct graphic types is crucial for making the data easy to understand. There are dozens of types of graphics that can illustrate the relationships and make up of the data. Below are eight common types, pie charts, bar graphs, scatter plots, flowcharts, line graphs, venn diagrams, timelines and matrix.

Types of Graphs

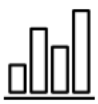
Scatter Plots show the relationship between two or more variables like a person's height and weight.

Pie Charts show proportions or percentages.

Flow Charts show the order in which events or processes occur.

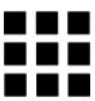
Timelines show the history of events over time.

Line Graphs show data against time.



Bar Graphs compare data from different sets.

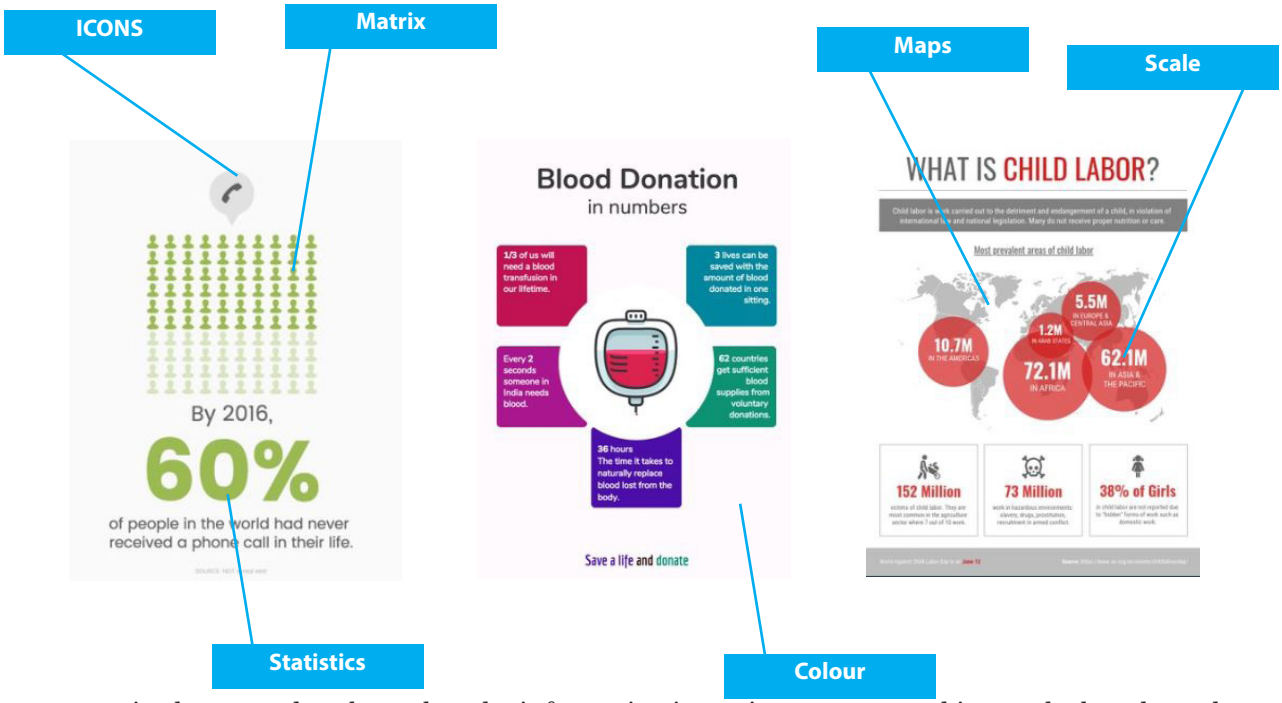
Venn Diagrams show relationships between topics.



Matrices shows proportional make up of data.

Intermediate

Charts and graphs are not the only way to represent data. Below are a couple of examples of infographics from the online infographic tool, Venngage.



You can see in the examples above that the information is not just represented in graphs but through other types of graphics. The proportion of 60% is illustrated in the infographic on the far left, using 100 icons of people. This illustrates the meaning of the value, which provides impact on the viewer. The infographic is presenting the incredible fact that 60% of people in the world in 2016 had never received a phone call. The middle graphic uses repeated shapes united by the outline of a circle around the central icon. The use of colour draws your eye from one shape to the next. This has much more impact than a list of dot points. The graphic on the far right shows data illustrated on a map which makes it easier to understand where the data is related to. The scale (or size) of the bubbles that contain the numbers of children used for child labour are related to the values. This draws your attention to the scale of the problem.

3. Data Interpretation

In fig 2.16 you can see my infographic that I created from the data I sourced from the Australian Bureau of Statistics.

I have represented the data, but have not interpreted the data. Interpreting data is finding information through the process of analysing it.

When interpreting data, a data analyst must try to see the differences between correlation, causation and just coincidence.

Correlation is a relationship between two variables. An example of correlation is when children get older, they get taller. As they get taller, they get heavier. This means there is a correlation between age, height and weight.

Causation is a relationship where one variable causes another. An example of causation is rainfall causing the grass to grow. As the rainfall increases, so does the height of the grass. (Unless you mow regularly).

Coincidence means there is no relationship.

Interpretation is drawing conclusions from your data. To investigate the relationship in the data, it helps if you have chosen data that is related in some way.

When I began my investigation into Information Technology qualification data, I did not expect the highest values to be Gen X. I had supposed that Millenials would be the holders of the most IT degrees. This assumption could be called an hypothesis. A hypothesis is a statement that you make before you conduct an experiment or investigation. The analysis of the results tests that hypothesis. You may already be familiar with this process in science classes.

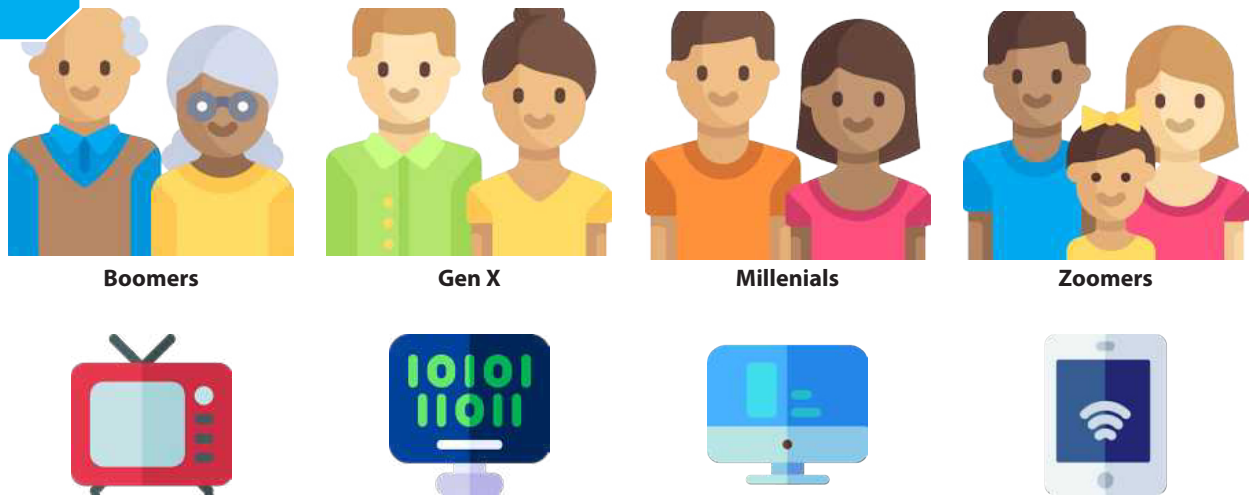
My interpretation of the data I collected and analysed from the Australian Bureau of Statistics is the following:

> *Generation X were the first to use computers in the home and these were much simpler devices in the 1980s. This generation was more likely to investigate, experiment and create digital technology and therefore most Australians with IT degrees are from this generation.*

This indicates that the relationship between the generations and the IT qualifications is correlation. Their age does not cause the qualification, but there is a correlation between the age of the individual and whether they have an IT degree.

It is possible to add a statement like this to my infographic, or possibly create a more graphic interpretation of this statement.

Fig. 2.17



Activity 3

Discussion and Activity Questions:

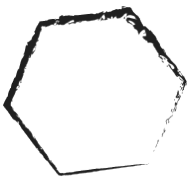
1. What do the four icons of the generations tell you in Fig. 2.16?
2. How could you use the icons in Fig.2.17 to illustrate the interpretation of the data?
3. How could you improve the infographic in Fig. 2.16
4. Do the two charts in Fig. 2.16 clearly show the disproportional representation of Gen X?
5. Which graphic type would better represent the numbers of Gen X with IT qualifications?
6. Find infographics online that use the eight graph types.
7. Develop your own version of the infographic for the data in Figs 2.14 and 2.15.
8. Discuss which infographics developed in your class are effective, and why.

Elements and Principles of Design

When creating anything on a computer, such as an infographic, a web site or a programming app, it is important that the design is right for the job. In this topic we are going to examine the nature of design. The purpose of good design is to ensure that anything we make is easy to understand. We want the people who read our infographics, or try to use our programs or websites, to find them attractive, professional, readable, and easy to use and understand.

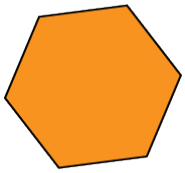
The building blocks of design are the elements.

Elements of Design

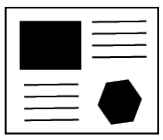


Line: We use line to organise space - horizontal, vertical, diagonal, dotted lines, curved lines, thick and thin lines (weighting). In the example on the left, you can see a shape created out of a rough line that looks like it has been painted with a brush.

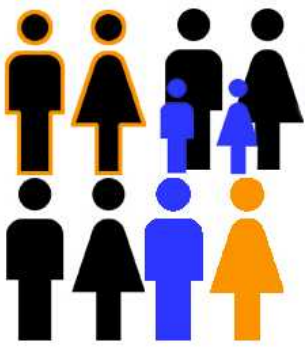
Shape: Shapes can be used to organise text, icons or images. Shapes are two dimensional forms. In the example on the left you can see a white polygon with a black line and a black solid polygon.

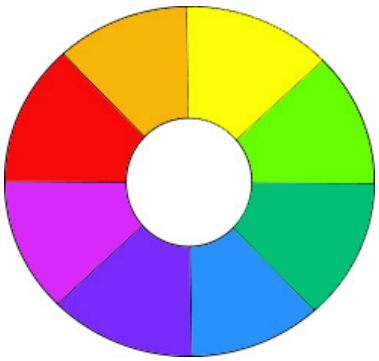


Colour: Colour brings life to our designs. We can use muted colours (low in saturation) or bright colours (high in saturation). Colours can be warm (yellows, oranges, and reds) or cool (greens and blues). They can be dark or light. Colours have relationships with one another around the colour wheel. Colours near each other are analogous and opposite are complementary. The use of the same colour in different lightness and darkness is monochromatic.



White Space: White space, sometimes called negative space, is space in the design not used, or left unfilled. It is important for designs to not look too crowded to make sure they are easy to read. Sometimes a lot of white space is left to make the design feel airy or light. The example on the left shows the space left around the text and the illustrations to give a balanced feel.





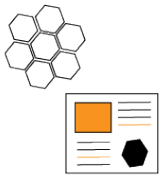
Activity 4

Tasks:

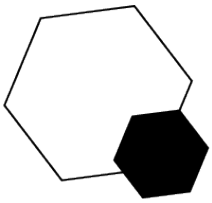
1. **Create a colour wheel in illustrator and photoshop.**
2. **Find different examples of each element of design through an online search of infographics.**
3. **Create a poster about the elements of design using the examples you found.**

We use the elements of design in different ways. How we use colour, line, shape and white space determines how successful our design is. Principles of design are the application of the elements to create a successful design.

Principles of Design

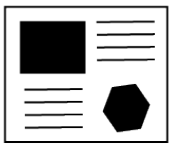


Repetition: Good design often uses repetition to create a unified look. Repeated use of line weighting, colour and shapes improve the cohesiveness of the design. In the example on the left you can see the repetition of shape and colour.



Scale: The use of scale or proportion can illustrate relationships. The example of the left shows a large polygon with a small polygon. The same shape is treated differently to illustrate a point of difference is size.

Emphasis: Emphasis can be used to illustrate importance to a section of the design. In the example on the left you can see the pattern of polygons is interrupted with the use of colour to emphasise that shape.



Balance: Good design contains balance. This means both sides of the design have an equal amount of content and white space. If the content is not symmetrical, balance can still be achieved by altering the size of images and the weighting of text. In the example on the left you can see there is a layout of text and images. Despite the images having different shapes, the arrangement looks balanced from both top and bottom and left and right sides.

Contrast: To make text readable, contrast is required. Black and white has a high contrast, while light grey on white is low contrast. Contrast provides impact and makes for visual interest.

Graphics by Venngage 2020

Activity 5

Tasks:

1. **Identify the principles of design in the infographics above.**
2. **Create a wall display of infographics that illustrate each principle of design.**
3. **Create a poster about the principles of design using Illustrator.**

Interface Design

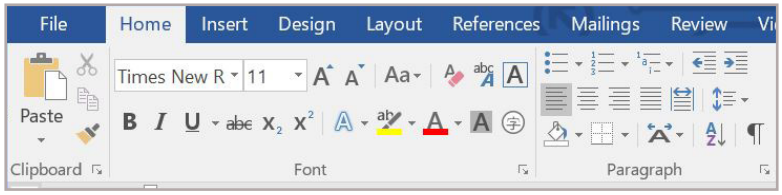
An interface allows communication between the digital technology and the human user, and is often called "User Interface" (UI). It is often seen on a screen and contains various features that allow the user to control the software. The simplest interface is the Google home page. It contains one input box for the user to type in keywords to be searched. Once the keyword is searched it returns the results, each result is headed with a live link to the online information.

More complex interfaces use multiple input and control features. When using Microsoft Word you can access "Ribbons" across the top of the screen. Each ribbon is a panel of controls accessible through the menu items listed horizontally across the screen. The interface continues inside the Word document page where the user has a variety of keystroke and mouse controls.

There is more to designing websites and software interfaces than creating an attractive-looking screen with nice colours and cute buttons. When you are creating an app or a website, design is a crucial aspect of how it will function. In order to avoid your end user feeling lost while navigating through the screens or pages to find what they need, there are a few design rules that need to be applied.

Simple and easy to use:

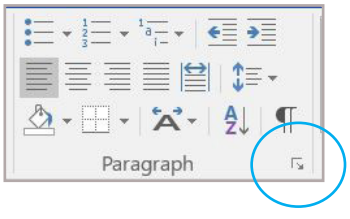
The best interfaces are simple. They use interactive elements that are common and recognisable so that the user can easily understand what to do. Avoid unnecessary elements that can confuse the end user. Make sure you use clear language and recognisable icons. In the figure below, you can see some recognisable icons. How many can you identify?



Consistency:

Good interfaces are consistent through the use of common user interface (UI) elements. By using common elements in your UI, users feel more comfortable and are able to get things done more quickly. It is also important to create patterns in language, layout and design throughout the site to help facilitate efficiency. Once a user learns how to do something, they should be able to transfer that skill to other parts of the site.

In Microsoft Word you find consistency in the order of menus. On each ribbon, the menu does not change. It stays in the order: Home, Insert, Design, Layout, References etc. In the figure below you can see the Paragraph section of the Home ribbon in Microsoft Word. Circled is an icon that implies that the section will open further if it is clicked. More controls are available in the new section revealed. This icon is repeated throughout each section of ribbon on each menu. Can you find other examples of consistency?



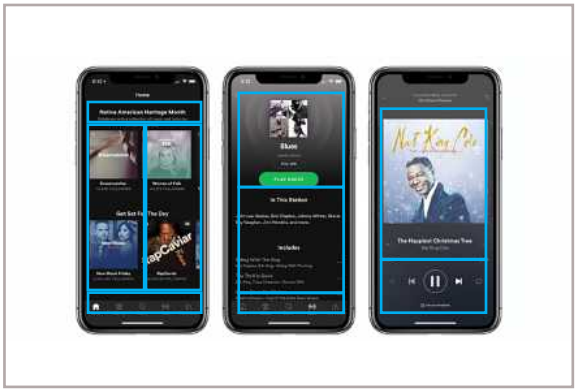
Grid Based Layout

Every web page, magazine spread, app interface or software design is based on a design using a grid. Each page layout needs to be constructed in terms of horizontal and vertical dividing lines, otherwise known as rows and columns. The content on the pages should be structured based on importance. Careful placement of items can help draw attention to the most important pieces of information and can help the user to find what they are looking for. In Fig 2.17 you can see examples of grid layouts. The first is a newspaper from 1945. All the text sits in horizontal rows and vertical columns. The second (top right) is a screen shot of Alta Vista, the most popular search engine in the late 1990s. It is structured in a similar way to the newspaper making the most of tables to control the information in columns.

Fig. 2.17


The New York Times.

FIRST ATOMIC BOMB DROPPED ON JAPAN; MISSILE IS EQUAL TO 20,000 TONS OF TNT; TRUMAN WARNS FOE OF A 'RAIN OF RUIN'



Intermediate

The smart phone emerged and became popular in 2007. Mobile phone apps (short for applications) had to address the smaller screen space, breaking up the interface into sections, often centred. You can see the Spotify interface above that continues to use the grid layout. Notice also that there is a lot less content on each screen, making it easier for the user to read. Finally, you can see above, a screen from Facebook in 2020. It has a clean menu across the top and three columns. Each column is broken up into sections in a similar way to mobile phone layout. As the technology becomes more sophisticated, interfaces need to be simplified.

Hierarchy of Fonts:

Typography is the use of different fonts or type faces to organise information to make it readable. Let's look at the text box below. All the text is the same type face, font size, font weighting and colour. It is not very readable.

Cybersafety
How to keep your data safe while using the internet.
By Victoria Farrell
1. Always use a VPN
A VPN protects all your interactions online by creating a virtual private network. It keeps all your online activities private and anonymous.
2. Use Anti-Malware Software
Protection software keeps your data safe from viruses and other types of malicious software. Anti-Malware software often includes master password protection and financial transaction protection.

Cybersafety

How to keep your data safe while using the internet

BY VICTORIA FARRELL

1. Always use a VPN

A VPN protects all your interactions online by creating a virtual private network. It keeps all your online activities private and anonymous.

2. Use Anti-Malware Software

Protection software keeps your data safe from viruses and other types of malicious software. Anti-Malware software often includes master password protection and financial transaction protection.

The two boxes above contain the same text in the same space. The box on the left has no heirachy of typography while the one on the right uses a range of different text formatting that makes it easier to read. Typeface is often referred to as a "font". Typefaces include Arial, Times New Roman and Verdana. These are different letter designs. Weighting (bold text / regular text) is a measure of how fat each line is for the letters. Type size assists in identifying the most important text and headings from the rest of the detail. Case can be used to provide a style change. The byline (name of author) is presented in all capital letters. Alignment is where the text is placed, left, right or centred. White Space allows "breathing" space for the text. The paragraphs in the formatted box (right) uses smaller text, but with the added 'white space', it is much more readable. How many changes can you see between the two boxes?

Feedback:

When designing a digital interface, it is important that the system responds to the user with relevant feedback. If the user forgets to enter data that is required, feedback can be provided in the form of a pop up window that reminds the user to enter the data. Always inform your users of location, actions, changes in state, or errors. The use of various UI elements to communicate status and, if necessary, next steps can reduce frustration for your user.

Intermediate

Activity 6

Design Tasks:

1. Investigate a website, mobile app or application software and identify:

1. How is the design easy to use?

2. Describe how it uses consistency.

3. Identify how it uses a grid layout.

4. Describe how it organises the hierarchy of typography.

5. Explain how it provides feedback to the user.

2. You are a web designer and you must use all the interface design principles to design a website for one of the following organisations:

*** Pet Supplies Store**

*** Bicycle Repair Store**

*** Local Grocery Store**

*** Community Cricket Club**

*** A Law Firm**

3. Convert the content below into a screen design for a website.

Canberra Dog Rescue

We care about dogs

If you find a dog with out contact information on their collar please call 89762385.

We have a large number of unclaimed dogs ready for adoption. Our featured furries today are:

Jeremy. Jeremy is a 2 year old fox terrier cross with black ears with a big heart. He is looking for a forever home.

Samson. Samson is an older dog looking for someone who doesn't mind having white hair all over their couch. Samson is looking for a loving home.

Penny. Penny is a bit of beagle and a bit of something else. She is still only a puppy at 6 months old but she has a lovely smile.

If you are looking to adopt a dog there is a pet owner licence you will need to complete first. Complete the licence and your application for pet ownership will be reviewed.

All dogs are microchipped, vaccinated and wormed. We provide suggestions on best care, food and other regular health treatments.

1066 Northbourne Ave, Canberra

Digital Images: Raster & Vector

When we use computers, we take for granted that there will be colours in our interfaces, photos on our social media, icons in our menus and diagrams in our presentations. There are two kinds of image files that can be displayed or edited on a computer or other digital device. These are called Raster and Vector.

Raster:

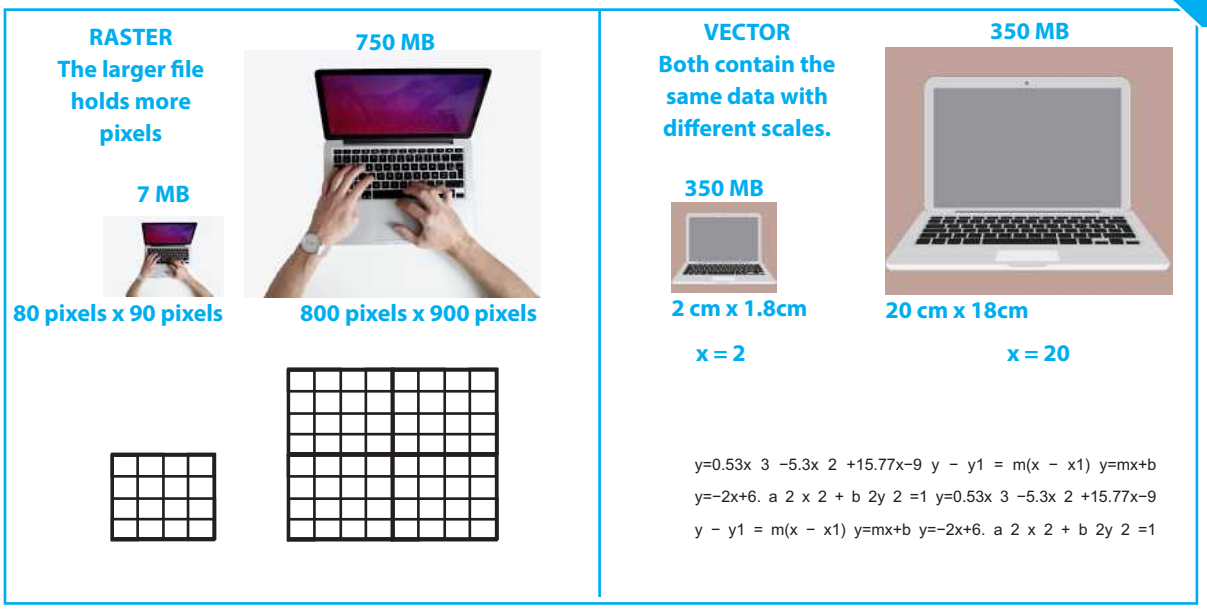
In Fig 2.18, you can see an example of a photograph of a laptop, and a diagram of a laptop. The photograph in the top left is a raster image. Photographs are made up of thousands of pixels each containing a single colour. You can see in the photograph, a close up of the pixels. When you zoom in on a raster image it will pixelate into separate single colours.

Fig. 2.18

Vector:

Vector images are created from drawn objects that can be any size or shape. They can be filled with a colour and outlined with a colour. If you zoom in on a vector image they never pixelate because an object is stored mathematically. This means the shape of the object is described by an equation. In Fig 2.19 you can see how the increase in the size of a simple vector image does not increase the size of the file, while the increase of a raster image changes the size of the file because it changes the number of pixels. You can see below that the only difference in the two vector images is the value of variable "*x*".

Fig. 2.19



Intermediate

Editing Raster Images

Photoshop is the most commonly used software for editing raster images. Other software includes:

- Paint
- Corelpainter
- Paintshop Pro
- GIMP

All these applications allow you to edit the colour in the pixels. There are a number of different ways colour is digitised. We can use the three additive primary colours: red, green and blue. You might be more familiar with subtractive primary colours: red, blue and yellow in your Art class when using paint. When we are dealing with light, the primary colours are red, green and blue. In Fig 2.20 you can see the colour picker window from Photoshop. There are three types of colour codes.

1. RGB (red, green, blue) code. The largest value for each of the three primaries is 255 which indicates the maximum brightness of each colour, while 0 (zero) is the minimum. This produces 256 levels of brightness of each primary colour. The value 256 is 2^8 which indicates this is 8 bit colour.

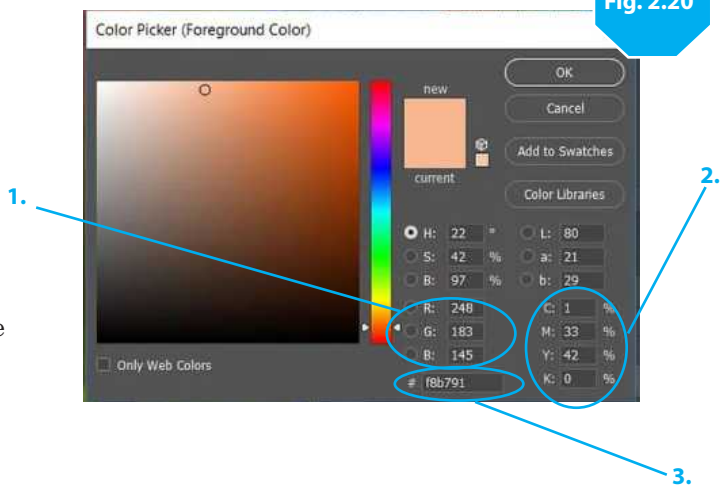
2. CYMK Indicates a colour system you may be more familiar with if you have a colour printer at home. CMYK indicates the subtractive primary colours used in printing (cyan, magenta, yellow and black). The colour value selected would use 1% cyan ink, 33% magenta ink and 42% yellow ink.

3. This value is called a hexadecimal number. It is made up of values from 0 to 9 then A to F. The hexadecimal number system is base 16 which means it has 16 symbols to create all the numbers.

0,1,2,3,4,5,6,7,8,9,A,B,C,D,E and F.

A = 10, B=11, C= 12, D=13, E= 14 and F = 15.

Fig. 2.20

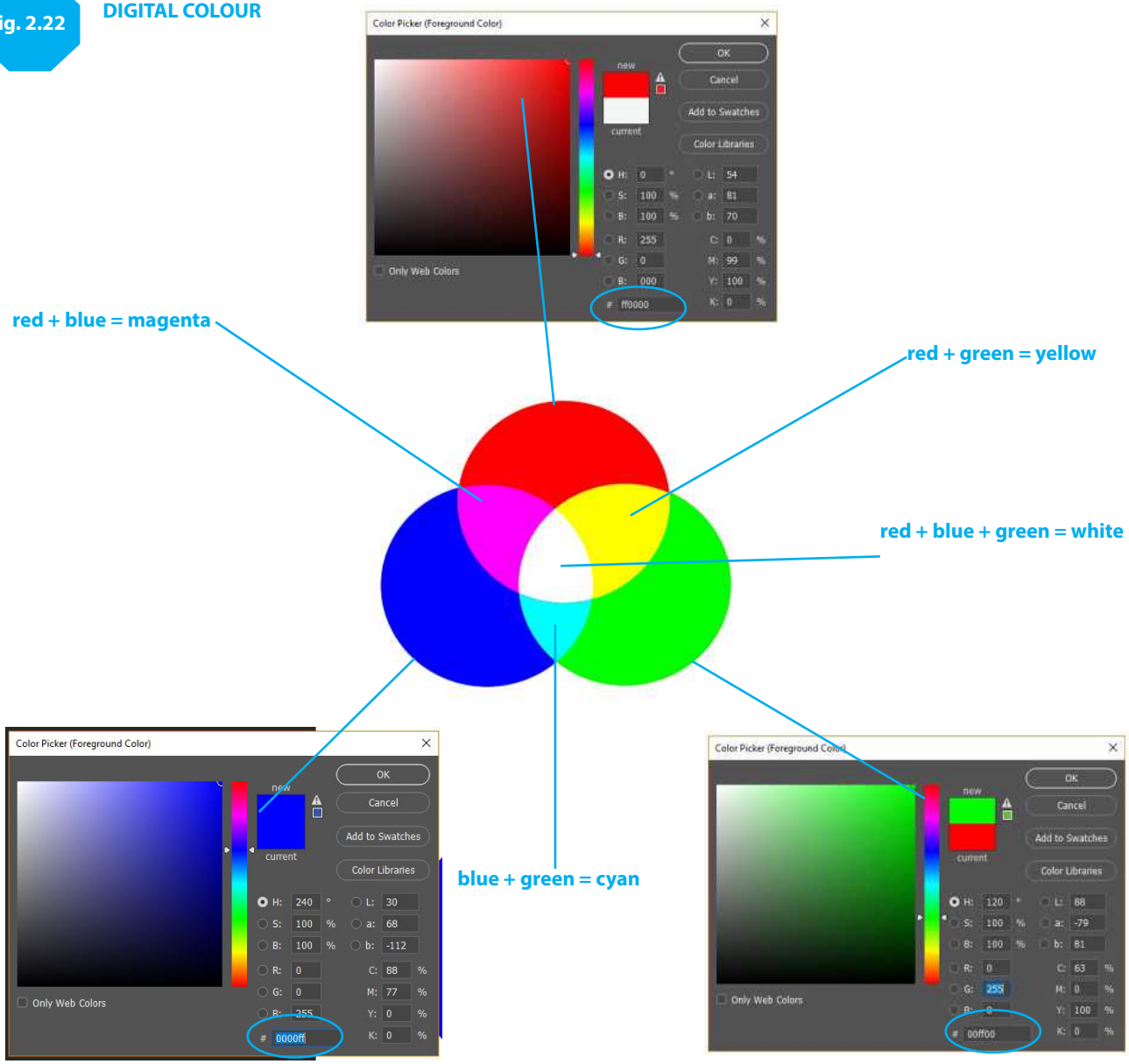


When we use hexadecimal to control colours we put a hashtag in front (#) and group the symbols in pairs for red, green and blue. In Fig 2.21 below you can see some hexadecimal values broken down into red, green and blue value pairs to create different colours. You need to think about the colours as light rather than paint or ink. If you add more red, the colour get lighter, not darker. So if we have a value such as #994433 you have a moderately high value of red (99) but both green (44) and blue(33) are both low values. This would result in a dark, but not a very vibrant, red. The best thing you can do is to experiment with the colour picker in Photoshop. See if you can predict the colour for various values and vice versa.

Fig. 2.21

RED	GREEN	BLUE	
#00	00	00	If we have all zeros, this means all the lights have been turn all the way down. This is the hexadecimal for BLACK.
#FF	00	00	The red values are at maximum while the others are at zero, results in RED.
#00	FF	00	With only the green values at maximum, the colour result is GREEN.
#FF	FF	FF	If we have all F values this means all the lights are turned to maximum. This is the hexadecimal for WHITE.
#7B	7B	7B	All the values are the same which means no primary will dominate. The result will be a GREY.

Fig. 2.22 DIGITAL COLOUR



Coloured light behaves differently to paint and ink. The more coloured light you add, the lighter the result becomes. Figure 2.22 above shows that if you combine the maximum amount of each of the three colours it will result in white. You can also see the colour picker window for each of the primary colours. Can you find the RGB code, the CYMK code and the hexadecimal code for each of the three primary colours?

Activity 7

Tasks:

1. **Look at the following hexadecimal numbers and see if you can guess what colour they are:**
   #F59000, #05B1E9, #0008EF, #888888, #439AE1, #FF1493.
2. **Use Photoshop colour picker to check the colour of each hexadecimal number.**
3. **Open a photograph in Photoshop and use the eyedropper tool to select a colour from a single pixel. Investigate how many different colours are contained in a small section of the image.**

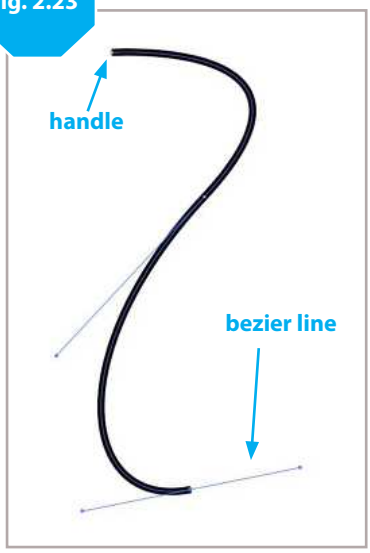
Editing Vector Images

Illustrator is the most commonly used software for editing vector images. Other software includes:

- Microsoft Word
- Corel Draw
- Computer Aided Drawing (CAD)
- Vectr

All these applications allow you to edit the outlines and fill colours of objects of any size and shape. Objects are edited using handles or anchors and bezier lines. When a line is drawn it can be edited using the little squares at each end. You might be familiar with this when using shapes in Microsoft Word or PowerPoint. When we click and drag to adjust the size or shape of an object we use these little handles, see Fig 2.23. In drawing software such as Illustrator, we need to be able to control the nature of the line when creating curves. We use a more sensitive controller called a bezier line. This allows the user to adjust the depth and slope of curved lines when drawing a more complex shape.

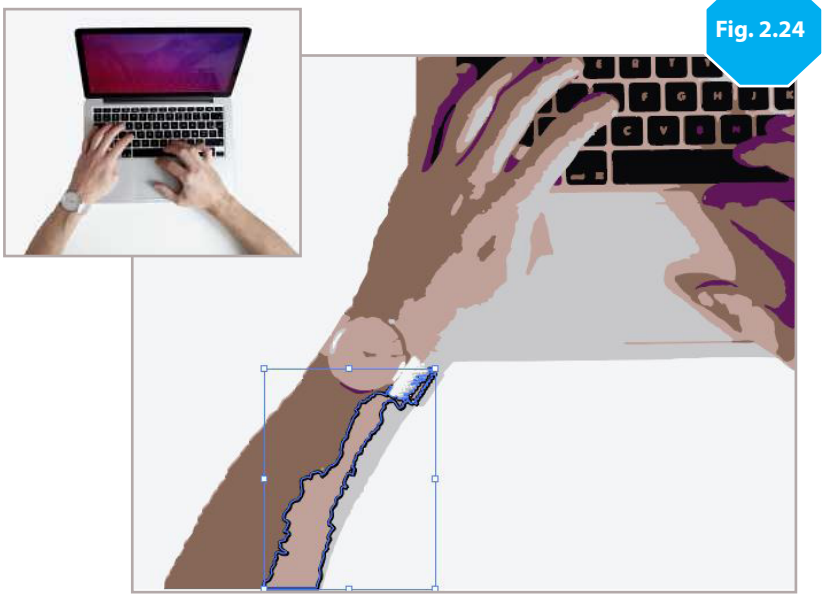
Fig. 2.23



Raster images can be converted to vector images by limiting the number of colours and creating areas of similar colour to make separate objects. In Fig 2.24, you can see our laptop photograph has been converted into a more graphic image. Clearly a version of our original photograph, but now it no longer is made of pixels. You can see the section of the user's arm selected as a single object. It no longer contains the millions of colours from the photograph to create realistic gradients and details.

How many colours are in the vector image of the laptop in Fig 2.24?

Fig. 2.24



Activity 8

Tasks:

1. **Using a photograph of yourself or a cute animal - use the vectorising instructions from the first half of this chapter to convert the photograph into a cartoon.**
2. **Use the draw tools in Illustrator to create a stylish hat on the cartoon.**

The Internet and the World Wide Web

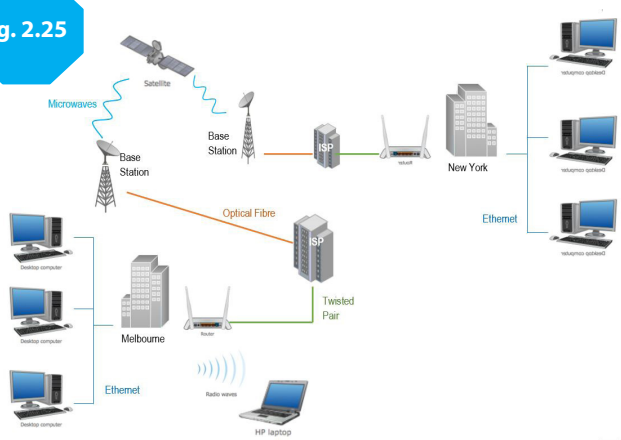
We often use the terms “internet” and “the web” interchangeably, but they are very different things. The internet is a network of devices that shares data around the earth. The World Wide Web is the data that we can access via the internet that links to other data, allowing use to browse through pages and pages of websites.

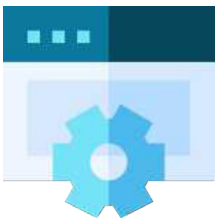
The Internet

The internet is made up of computers that are online all the time to allow people access to the data stored on them. The computers are connected to the global network through Internet Service Providers (ISP). These are organisations with the technology to provide a gateway to all the other computers available on the global network.

You can see in Fig 2.25 all the devices that make up a connection between two computers. The internet is made up of specialised computer systems called web servers, gateways (ISP), base stations, satellites. The internet relies on a variety of connection technologies such as ethernet cables, optical fibre cables, twisted pair (telephone wires) and microwaves. You could also include your local WiFi (radio waves) as they connect your laptop or other mobile devices to your home network. You also have an “Internet Router” that connects your home network to the internet.

Fig. 2.25





The World Wide Web (www)

The World Wide Web is made up of the data and coding that you are able to browse with your internet browser such as Google Chrome, Internet Explorer, Safari or Firefox. Your browser uses web addresses to access the data. This is called a URL (Uniform Resource Locator). The URL is made up of the protocol, the domain name, the path and the file name.

Fig. 2.26

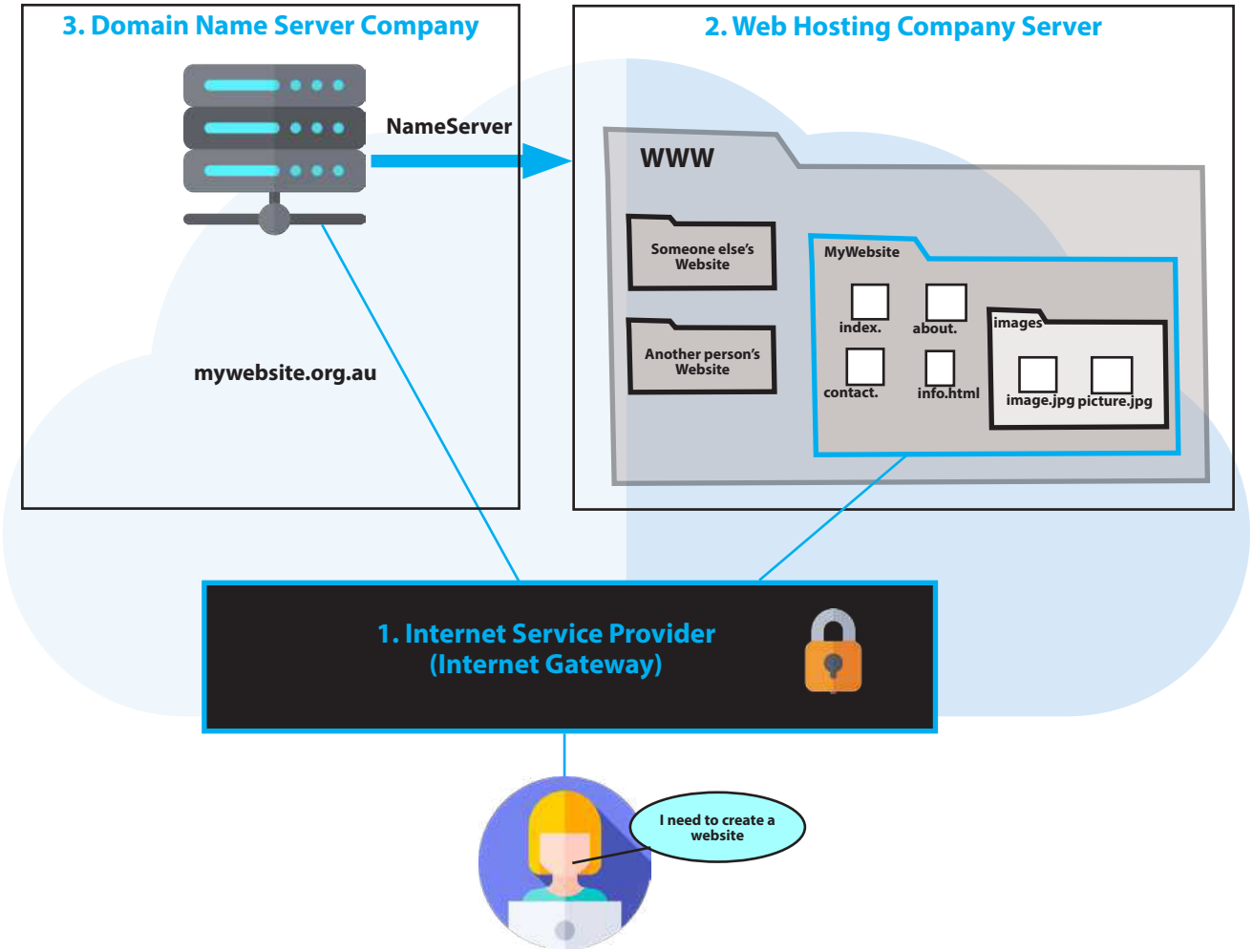
You can see in Fig 2.26 a familiar-looking URL. The https (HyperText Transfer Protocol Secure) is the protocol, or rules used to share the data across the internet. This means you will access the file at the end of the URL using https communication technology. The domain is a special name that is paid for by the owner of the website. The owner of the miccimool.com.au domain, paid a domain server company a few hundred dollars to register and control that domain name for the next few years. You can create your own domain registrations at various domain servers such as:

- https://www.netregistry.com.au/
- https://www.crazydomains.com.au/

The path section of the URL is the access route through directories (or folders) to get to the file. The file is an HTML file. The vast majority of all data on the World Wide Web is formatted using HTML (Hypertext Mark Up Language). You should have some experience with writing HTML by now, and you should be familiar with putting your image files into a folder called “images”. This would mean your link to an image file would include the path “images”.

Intermediate

Fig. 2.27 The three services you need for a live website online.



In Fig 2.27 you can see there are three services you need to ensure your website is online and available on the World Wide Web. First you will need to access to the internet. An Internet Service Provider (ISP) allows for access to the Web. An ISP is the gateway to the internet and there are many private companies that provide that service. In Australia the largest companies are Telstra, Optus and iiNet. You pay a monthly access fee.

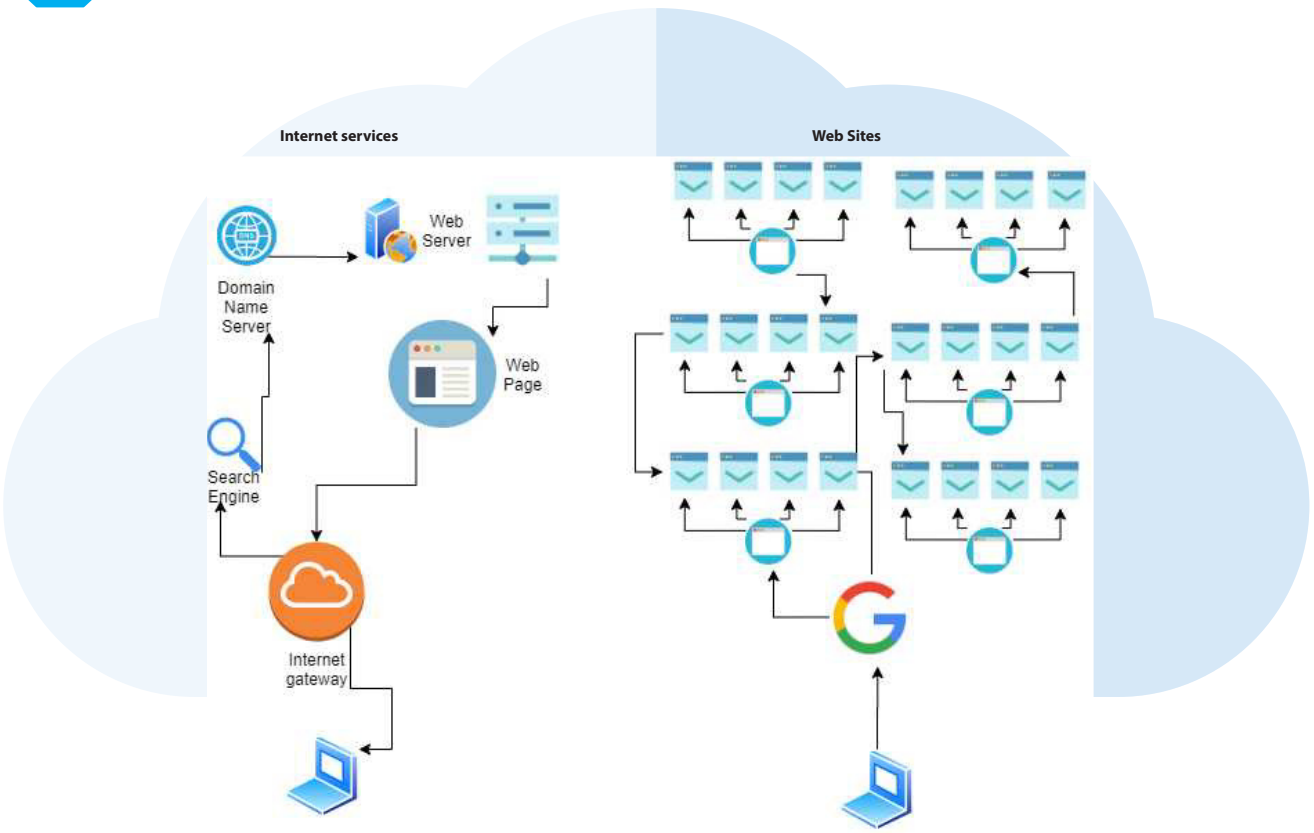
Next you need a web hosting company to provide you with some server space for your website. You rent web server space so that anyone online can access the web files of your website. Web servers are large computers with server software that are on 24/7 and allow any computer to access the files. They also have special security software to keep your files safe.

Finally you need a domain name. A domain name is the special and unique name for your web address or URL. We need to find one that is not currently being used, and to do that we go to a Net Registry site or Domain Name Server company(DNS). You type in the domain name you want and see if it is available. There are some names that are restricted such as .gov and .edu. These can only be used by government or educational organisations. Once you find a domain name that is available, and that you like, you can pay to reserve the name for your website. Once reserved, you can control a name server that identifies your domain name and your web host. This is called "pointing". When someone types your URL into their browser, signals will be sent to your DNS which will then point to where your website is hosted.

Sometimes it is easier to use the same company as a DNS and a web host. Sometimes you can save a lot of money by shopping around for good deals.

Fig. 2.28

The Internet & World Wide Web.



In Fig 2.28 you can see how the laptop at the bottom left can access information on a website via the internet. The laptop on the right is doing the same thing but the illustration is of what the user sees as they browse the World Wide Web. The Web is the interconnected files linked using HTML and other codes to allow browsers to access information. The internet is the technology that stores and delivers the web files containing the information.

Activity 9

Tasks:

1. **Using what you learned in the Networks topic in this chapter, create a diagram using the web tool www.draw.io to illustrate how to set up a website. Include all the Communication hardware and Media required.**
2. **Research Domain Name Server companies online and find out how much it would cost to create a domain name of your choice.**
3. **Research what is the difference between using .com and .net?**
4. **Using the web development skills from this chapter, create a website that displays your diagram created for Question 1 above, and present information about both the internet and the World Wide Web.**

Social and Ethical Issues

With the creation of new technologies come many social and ethical issues.

- Cyberbullying
- Security
- Piracy
- Plagiarism
- Social Isolation
- Reliance
- Ergonomics & Health
- Cyber Safety
- e-Waste

Intermediate

Cyberbullying

Cyberbullying is when an individual is attacked via social media or digital devices to embarrass or hurt that person. It is often a persistent attack that can impact the victim 24 hours a day. It can go unnoticed by friends, family and teachers and the bully can get away with ongoing and relentless attacks on the victim. It can occur anywhere on social media, instant messaging, forums, SMS or chat. It can include sending, posting, or sharing negative, harmful, false, or mean content about someone else. Cyberbullying can also include sharing personal or private information about someone else causing embarrassment or humiliation.

A highly publicised case of cyberbullying is the story of Amanda Todd. Amanda was a 15 year old girl from Canada who was stalked and relentlessly humiliated by a male adult. Her case became famous because she uploaded a YouTube video using a series of flash cards to tell her story of being blackmailed into exposing her breasts via webcam and consequently being bullied and physically assaulted at school. The video went viral after her death when she suicided in 2012. It took five years for the 38 year old perpetrator to be found and sentenced. Amanda was not his only victim.

Cyberbullying is at an all-time high and it doesn't seem to be slowing down. Bullies who used to be in the school yard threatening to beat up someone if they didn't give them their lunch money, are now online posing as anyone they want to in order to avoid being caught. The consequences of cyberbullying are harsh for both the victim and the bullying perpetrator. The pain caused by relentless attacks can result in young people wanting kill themselves as a result of the psychological pain inflicted. Due to the insidious nature and dangerous outcomes of all forms of bullying, it has been identified as a crime in Australia. The laws that protect Australians from cyberbullying include the following Commonwealth legislation:

- Fair Work Act 2009
- Criminal Code Act 1995
- Telecommunications (Interception and Access) Act 1979
- Privacy Act 1988
- Disability Discrimination Act 1992
- Human Rights and Equal Opportunity Commission Act 1986
- Racial Discrimination Act 1975
- Racial Hatred Act 1995
- Sex Discrimination Act 1984.

To ensure you are not involved in cyberbullying here are a few things to keep in mind:

- Always think about what you post. What would your family or teachers think, if they saw it?
- If you witness bullying online and say or do nothing about it, you are complicit. Always report bullying. It is a crime.
- Talk to an adult you trust about any messages you get or things you see online that make you feel sad, hurt or scared.

What to do if you are targeted and you become a victim of cyberbullying:

- Tell a teacher or adult family member.
- Do not retaliate.
- Keep records of the attacks such as screen shots of the texts or images. Make sure you record the date and time it occurred.

Security

With so much of our personal and financial data online, it is crucial to make sure it is secure. We secure our smart phones and laptops with passwords and usernames, and our credit cards with PIN numbers. Security of data is a very important specialisation area. Cybercrime is on the increase and all organisations must stay one step ahead of the criminals at all times to ensure that their customers do not lose faith in their service.

When data travels from one location to another, such as an email, a purchase transaction or information on a website, it is possible for that data transfer to be intercepted. Online stores and banks need to ensure they have special encryption to protect data that transfers when a customer makes a purchase or accesses their bank accounts.

Photo by Petter Lagson on Unsplash

In April 2020, Facebook experienced a massive data breach. The personal information of over 250 million Facebook user profiles were discovered for sale on the dark web. This means cyber criminals had managed to gain direct access to the Facebook data servers. They copied the data and placed it online so it could be sold to criminals for other illegal purposes such as fraud. This was a huge breach of privacy for those Facebook users who had their data copied and sold.

As all organisations are reliant on email, online banking and internet shopping to operate, new legislation needed to be developed to protect people from cybercrime. The Criminal Code Act 1995 was updated to include cybercrime offenses such as:

- Unauthorised access to computer networks
- Unauthorised destruction of data and information
- Unauthorised impairment of electronic communications, including denial of service attacks(DDOS attacks)
- The creation and distribution of malicious software (for example, malware, viruses, ransomware)
- Dishonestly obtaining or dealing in personal financial information.

There are many ways you can protect your data while online.

1. Use a VPN service when you are online. This protects the transfer of data from you computer to other web servers.
2. Keep your operating system up to date.
3. Use anti-malware software to check for viruses and other malicious software.
4. Take care to not post personal details online.
5. Don’t share passwords.

Piracy

Photo by ConvertKit on Unsplash

Before our music and movies turned digital, it was harder to make copies of them without losing quality. Digital media makes exact copies and the internet allows for those exact copies to be distributed illegally.

With analogue media, musicians, movie makers and TV producers all made a lot of money selling their art through broadcasts and through what was known as mechanicals (CDs, DVDs, records, cassettes, VHS). Since the advent of services like Apple music and Spotify, musicians are not getting paid as much as they did in the past. Online pirating of TV shows and movies is impacting on the income the production companies can get for their products.

In the late 1990s the teenager Shawn Fanning developed peer-to-peer file sharing software so that he could share and trade music files with his friends. He called his software Napster and it soon became a world-wide shareable application where everyone was accessing copies of mp3 music files without paying for them. The use of Napstar impacted on CD sales to such an extent that the heavy metal band Metallica, along with dozens of other famous musicians, filed a court action against Shawn Fanning. Peer to peer networks that share movies and TV shows are now illegal and users can be prosecuted.

Today we are buying fewer CDs and relying on legal streaming services like Spotify and Apple music. Musicians do not get paid as much from streaming services as they did selling mechanicals, so some artists cut deals with services. In 2016 Beyonce signed an exclusive deal with the streaming service "Tidal" for her album "Lemonade". You could buy it on iTunes, Amazon Music, or the physical copy at record retailers, but Tidal remained the only place where you are able to legally hear the record without purchasing it until mid 2019. This forced fans to buy her album.

Photo by ConvertKit on Unsplash

Plagiarism

All digital media is easy to copy. Nothing is easier than copying and pasting something you find on the internet. One thing your teachers will tell you at school is, "Don't submit work that you did not write!". Now this may not be a crime for a student submitting work at school, but in the real world, it can have frighteningly expensive repercussions.

While a student at school or university, educators have access to software that can check if you have plagiarised text from another source. It can search text files and image files for exact matches in seconds. Depending on your school's policy on plagiarism, you might end up with a zero mark or a detention. At university you will be given far more devastating consequences. If you plagiarise research you can lose your place in the degree you are studying, or be asked to leave the institution. Universities are becoming more and more strict with the rules. Academics can expect to lose jobs and research funding if they are found to be using text taken and used without acknowledgement.

As an author, I have taken great care to acknowledge the authors of photographs used from unsplash. I have also made sure that I acknowledge the designers of the icons included in the book, even though I have paid for their use. All the text in this book is in my own words.

Consequences for plagiarism include:

- Academic or professional reputation is destroyed
- Legal and financial costs.

Famous musical artists are sued for "stealing" another composer's song. Many of these cases end in costly legal battles where the performer must pay the original owner of the copyright a lot of money. George Harrison from the Beatles wrote a song called "My Sweet Lord" that was musically identical to a song released earlier by other artists called "He's So Fine". Harrison was taken to court and was told to pay over a million dollars.

In a recent crackdown on cheating and plagiarism in Australian universities, the Federal Government are considering harsher consequences including jail sentences of up to 2 years and fines in excess of $200,000. It is in everyone's best interest that academic and other formal content producers research and create their own written and graphic material.

Social Isolation

Photo by Sasha Freemind on Unsplash

When people become obsessed with computer games or communicating with people online, this can isolate individuals from real human interactions. With the advent of internet access at home, some people have found comfort in relying on virtual interactions. A common issue with young people who are socially introverted is school refusal. This is where kids become too overwhelmed, frightened or emotionally disturbed to agree to attend school. It is not a prevalent issue in Australia, but in Japan it has become an epidemic.

The phenomenon is called hikikomori where young people lock themselves up in their rooms and refuse to leave to eat, attend school or, in some cases, wash. These people completely withdraw from society for months and even years. Due to social pressures and over protective parenting, families in Japan struggle to return these people to a normal life. Hikikomori sufferers spend most of their time playing computer games, and any social interaction they experience happens online.

This phenomenon is not limited to Japan. In Australia there have been many media reports about students playing the online game, Fortnite. These young people have refused to leave their computers, join family activities and meals, and even attend school, leaving their parents very concerned. Many young people were identified around the country as the new “shut-ins” or the “lost generation”. It is important that all computer users make time to get outside for exercise and to spend time with friends and family.

Reliance

It was just over a decade ago that the smart phone became available. Today everyone has a smart phone and relies on it for staying in contact with friends and family, reading the news, navigating with interactive maps, making appointments, browsing the internet, online shopping, playing games, listening to music, audio-books and podcasts and watching movies and TV shows. It is hard to imagine life without a smart phone.

Recent research has found that smart phone addiction is associated with hypertension, stress and increased heart rates in teens. Studies around the world have reported that young people experience stress when asked to hand-over their devices. Teenagers have grown reliant on connecting with their friends using digital devices. Some young people have struggled to use a road map, having relied for so long on Google Maps or GPS navigation tools.

If your teacher lost their laptop, it is likely that they would not be able to take the attendance for the class, write assessment tasks or read the many emails they receive each day. Everyone who draws a wage relies on digital technology to ensure their wages appear in their bank account regularly. Banks rely entirely on digital systems to function. They manage all financial transactions using networked servers so that people all around the world can access their money via automatic teller machines (ATMs), online payments and in-store debit payments.

What happens if something stops those digital technologies from working? Total reliance on digital technology can become an issue during natural disasters where mobile phone networks, electricity supply and internet access are wiped out. Often analogue radio broadcasts become very important to get information out to people. Think about what measures you have in place, if you lost your smart phone, access to the internet or electricity.

Photo by Christina @ wocintechchat.com

Ergonomics & Health

If you spend a lot of time working on a computer you need a workspace that supports your health. Your chair, access to natural light, being able to relax your eyes by looking out the window, the height of your desk all can affect your posture, your eyes and your general wellbeing. Ergonomics is the study of a healthy workplace. It focuses on designing a work environment around the human body, to ensure the health and safety of the worker.

Computers provide a challenge for employers. They require that the computer user is seated comfortably with;

- feet flat on the floor,
- elbows at right angles when using the keyboard and mouse,
- wrists straight when using the keyboard and mouse,
- head upright to see the screen,
- access to natural light,
- access to fresh air,
- background noise at a minimum,
- a comfortable temperature,
- and access to human support when required.

The Australian standards for screen-based workstations were published in 1990 to assist employers in providing safe workplaces for staff. Each state or territory of Australia has a government body that investigates work places that are reported as unsafe. Common issues that are raised by office workers include:

- Repetitive Strain Injury (RSI) due to prolonged and repetitive use of keyboard and mouse in a fixed position.
- Sitting for long hours without a break. Stretching and walking is required to keep your body mobile.
- Poorly designed workstations that do not allow the user to sit comfortably.
- Lifting or moving office equipment, supplies or furniture.
- Tripping over objects, most commonly power cables and other network cables.

Cyber Safety

There are a lot of things you need to be safe from online. People want to steal your identity, your money, your reputation and even your body. Some people like writing viruses to damage your computer or the data you have saved. Some people might want to meet you in the real world so they try to find out about all your personal information. There are different reasons why a malicious person may wish to target a child or adult online:

- Some derive pleasure from scaring people with threats, stalking or sending offensive information or images.
- Some want to steal your identity to obtain access to your finances or other assets.
- Some wish to become your *friend* so that they can take advantage of you. If an adult wishes to become a friend of a child, this is called "grooming". Adults groom children to take advantage of them in some way.
- Some want to publicly humiliate young people. This can be done by collecting photographs of their victims undressed or in other compromising situations.
- Some want to destroy your computer, your files, or hold your computer data for random.

In Queensland in 2007, a teenage girl called Carly Ryan was befriended online by a predatory adult man who lured her to meet him. The man abused and killed Carly and is now serving time for her murder and other crimes. This horrible event lead to "Carly's Law" that aims at limiting the harm online predators can do to young people.

Ongoing cyber attacks by ransomware viruses have shut down computer systems all over the globe, including Australian hospitals. In 2019 cyber criminals forced Victorian regional hospitals to go offline. This was devastating to the health care workers trying to keep up to date records of patients in their care. The ransomware shuts the owners out of their own computer system and demands payment for the system to be reinstated.

It has been daily news since the turn of the century that the personal data you enter major platforms such as Google, Facebook, Instagram and TikTok is being stolen and placed on the dark web for sale. When your data is bought by someone on the dark web, that person may be able to pose as you online to trick people you know to give them money, or hand over even more information. Banks now have a cyber

security department that monitors every bank account for unusual account transactions. It is a common occurrence for bank account owners to find transactions in their statements, where a purchase has been made, but they didn't make it. It is very common for people who buy things online to find unauthorised transactions on their statements and they need to send a query to their bank. The bank usually returns the money to the account owner and then investigates who made the transaction.

e-Waste

Each year a new digital product is released onto the market. A new iPhone, a new tablet, a new gaming console. With each new "must-have" product comes tonnes of old digital products thrown out onto the rubbish tip. Electronic waste is becoming a big issue and in some developing nations such as Thailand and India, it has become a legal and health issue.

Australian state governments have banned all e-waste from land fill, so there are a growing number of businesses who collect TVs, tablets, phones and other electrical appliances for recycling. Very little of it is actually recycled here in Australia, most is sent overseas. For many years it was sent to China, but in 2018, China implemented new laws about importing plastic and e-waste materials. This had a devastating impact on Australia. Previously, when you put your recycling out on the curb each week, it was being collected for China. Australian councils needed to find new markets for the e-waste. India and Thailand took up the new market.

Hundreds of thousands of tonnes of wires, plastic, electrical circuitry, computer parts, mobile phones etc. are redirected to South East Asian countries, despite most of the sorting and recycling companies located there, are illegal. The impact of the stockpiling and sorting of electronic waste is primarily on the natural environment. Most of this waste contains toxic elements such as lead, cadmium and mercury. When it rains, these toxic elements contaminate the drinking water people rely on.

Photo by Vilmar Simion on Unsplash

Chinese recycling businesses quickly set up in Thailand after China refused to take any more e-waste. Bangkok's agricultural areas have been devastated by the huge piles of e-waste dumped there. The businesses can make money from e-waste by removing valuable metals such as copper, gold and silver. The local workers who do the sorting are seriously affected by the fumes created by mixing all the materials out in the open sun and rain. Plastics break down and toxic elements leach out into the water draining away. The cassava farms in Thailand are seriously affected by the contaminated, water where toxic levels of manganese, lead, nickel arsenic and cadmium have been found.

Activity 10

Tasks:

In pairs, choose a social or ethical issue outlined in this chapter and investigate the following:

1. **Describe the problem the issue is causing. Use an example you have found online from a reputable source.**
2. **Use an example you have found from a reputable online news source where the issue has been raised in past 5 years.**
3. **Investigate what can be done to keep the issue from being a problem. (How to protect yourself, or find a solution or minimise the impact).**
4. **Present your findings to the class.**

Programming II

In the Foundation topic Programming I you would have read about:

- How pseudocode is used to write algorithms.
- Algorithms are solutions to a programming problem.
- Programs use variables to hold and control data as it is input, processed and output.
- We can control the order in which the variables and lines of code are run by the program by using decision and repetition control structures.

In this section we are investigating more complex uses of these control structures to create a basic artificial intelligence (AI). Below are two algorithms written in pseudocode. The top algorithm is a decision control structure and the one on the bottom is a loop that controls repetition. In an artificial intelligence we will need to combine these together to create a more complex solution. We want to write a solution that counts how many items are added to the shopping cart, adds up a running total and provides a discount if the customer buys more than 3 items.

```
START
  Read in Amount
   IF Amount > 3 THEN
         Total = Total - 20
         Display "You get a $20 Discount. Your final cost is" Total
    ELSE
         Display "Your final cost is" Total
   END IF
END
```

```
START
  Amount = "How many products do you want to buy?"
  Total = 0
  For Counter = 0 to Amount
      Price = "What is the price of product number " Counter
      Total = Total + Price
  Next Counter
  Display Total
END
```

The IF statement in the first algorithm checks the value "Amount" if it is over the value 3. If it is, a discount is applied. Otherwise there is no discount. The Loop asks the user how many products they want to buy. A "Total" variable is set to zero and a FOR loop controls the data entry. A FOR loop is a type of loop that counts how many times it repeats. In the case of this algorithm, it uses a variable called "Counter" which is set to zero then, each time the loop repeats, it adds another one to counter. There are two lines of code that are repeated - the first reads in the price of a product and the second adds the price to the total. The loop stops when "Counter" equals "Amount". Finally it displays the "Total".

Clearly those two algorithms need to be working together to make sure the user gets their discount when they order more than 3 items. Below is an algorithm that integrates both control structures. Underneath the algorithm are data tables that illustrate how it works.

```
START
  Amount = "How many products do you want to buy?"
  Total = 0
  For Counter = 0 to Amount
     Price = "What is the price of product number " Counter
     Total = Total + Price
  Next Counter
   IF Amount > 3 THEN
        Total = Total - 20
        Display "You get a $20 Discount. Your final cost is" Total
    ELSE
        Display "Your final cost is" Total
   END IF
END
```

```
Amount = 2
Total = 0
Counter = 0 to 2
Price = $20
Total = 0 + $20
Counter = 1

Price = $35
Total = $20 +35
Counter = 2

Total = $55
Your final cost is $55
```

On the left is the data entered, line by line, if the user enters only two items.

The discount is not applied.

On the right shows the data entered line by line if the user enters four items.

The discount is applied.

```
Amount = 4
Total = 0
Counter = 0 to 4
Price = $20
Total = 0 + $20
Counter = 1

Price = $35
Total = $20 +35
Counter = 2

Price = $10
Total = $55 +10
Counter = 3

Price = $15
Total = $65+15
Counter = 4

Total = $80 -$20
You get a $20 Discount.
Your final cost is $60
```

Activity 11

Tasks: Create an AI program

Using the structure provided, write an algorithm that asks the user how many pets they have. Once the user enters the number, it asks for the name of each pet.

If the user has more than 2 pets, the program could ask the user if they live at the zoo.

Make your algorithm fun. Get it to ask more questions and use more than just one IF statement and loop.

2c. Intermediate Assessment Tasks

Students are asked to respond to the Digital Technology knowledge by using the Information Technology Skills they have developed.

In Intermediate Level students learned skills in:

- Microsoft Excel
- Data Mining
- Visualisation Tools
- Web Development II
- Microbit Programming
- Photoshop
- Illustrator

Students developed knowledge and understanding of:

- Data Analysis
- Infographics and Visualisation
- Design Elements
- Web Development II
- Social and Ethical Issues
- Programming II

Project One Data Analysis Research Report

Students will be provided with some downloaded databases from Australian or International sources. Students may also find their own databases and have them approved by the teacher.

Students will conduct Data Analysis on the database using Excel spreadsheets. This will include data manipulation in order to investigate relationships in the data. Students will report on the relationships in the data using an infographic.

Students will investigate other evidence online related to the findings from the database. This needs to be from an authorised source and the web address is included.

Data Analysis Research Report Marking Criteria

Students will produce a report on their findings with the following sections:

Introduction:

Overview of the topic investigated.

Data:

Raw data in the spreadsheet.

Manipulated data in a spreadsheet.

Sources:

Name of the organisation and web address that published the database used in the report.

Name of the organisation and web address from where extra research has been included.

Data Manipulation:

Description of how the data was manipulated.

Include all formulas used in the manipulated spreadsheet.

Graphs and Charts:

Include all the separate graphs and charts produced from the spreadsheet.

Write a summary of findings.

Conclusion:

Create an infographic that includes all findings .

The infographic needs to use some key design elements.

A target audience should be identified.

Project Two Web Development

Students create a multi-page website designed for a Year 7 audience.

The students can publish content from:

- The completed Data Mining Report.
- What they learned about Raster and Vector digital images.
- How the internet and world wide web work.
- A report on a Social and Ethical Issue.

Web Development Marking Criteria

Students must include and effectively use the following HTML:

- A table
- A link to another HTML page
- An image
- An image link
- Paragraphs and Headings

Students must include and effectively use the following CSS in a separate file:

- Background colours for body and table elements
- Font controls
- Borders
- Link display controls

Students use appropriate design elements to ensure the website looks attractive and professional:

- Contrasting text from back ground to make it easy to read.
- Limited number of colours

Students should employ correct file management:

- Correct file names
- Correct file types
- Correct use of folders

Project Three Programming

Students create a Tamogotchi toy using a Microbit. The toy must be fed and pet or else it will die. The toy must display images to simulate moods and emit sounds when food or a pat is required. Students will use Python programming to code their Microbit.

Programming Marking Criteria

Students ensure their microbit:

- Displays different images depending on the mood.
- Performs different sounds to ask the user to pet or feed.
- Reads in if a button is pressed.
- IF statements to test if button A or button B is pressed, or both.
- A loop repeats instructions to ensure the longevity of the Tamogotchi.
- The final Tamogotchi must function with no mistakes in the code.

Project Four Infographic Report

Students create a poster using a combination of Photoshop and Illustrator to create an Infographic to educate an audience of Year 7 students on how the internet supports the World Wide Web.

Infographic Report Marking Criteria

Students must include:

- The use of three raster editing techniques in Photoshop.
- The use of three vector editing techniques in Illustrator.
- Correct inclusion of all the hardware components that make up the internet.
- Correct inclusion of all the data components that make up the world wide web.
- Use of appropriate design elements to create an attractive and engaging poster.
- All illustrations are correctly and clearly labelled.
- Headings make the content of the poster clear.
- A colour key is used for clarity.

Project Five Social and Ethical Issues

Students work in teams to investigate an issue and put together a presentation to the class. Students can create a website or a poster. They must research facts about the issue of their choice online and reference their sources. Students must incorporate some data analysis from a database. The databases may be provided by the teacher.

Social and Ethical Issues Marking Criteria

Students must include:

- A definition of the issue.
- A summary of the problems, or negative outcomes from the issue.
- Instructions on how to avoid harm from the issue investigated.
- An example of the issue from the news. Ensure the example is not included in this text book.
- Presentation is clear and easy to understand.
- Audience members are able to answer questions about the presentation content to prove that their presentation was easy to follow.
- Graphical presentation uses designing elements so it is pleasing to the eye.

Advanced Level

ACARA CURRICULUM

Digital Technology Knowledge and Understanding

ACTDIK034 Investigate the role of hardware and software in managing, controlling and securing the movement of and access to data in networked digital systems.

ACTDIK035 Analyse simple compression of data and how content data are separated from presentation

Digital Technologies Processes and Production Skills

ACTDIP036 Develop techniques for acquiring, storing and validating quantitative and qualitative data from a range of sources, considering privacy and security requirements

ACTDIP037 Analyse and visualise data to create information and address complex problems, and model processes, entities and their relationships using structured data

ACTDIP038 Define and decompose real-world problems precisely, taking into account functional and nonfunctional requirements and including interviewing stakeholders to identify needs

ACTDIP039 Design the user experience of a digital system by evaluating alternative designs against criteria including functionality, accessibility, usability, and aesthetics

ACTDIP040 Design algorithms represented diagrammatically and in structured English and validate algorithms and programs through tracing and test cases

ACTDIP041 Implement modular programs, applying selected algorithms and data structures including using an object oriented programming language

ACTDIP042 Evaluate critically how student solutions and existing information systems and policies, take account of future risks and sustainability and provide opportunities for innovation and enterprise

ACTDIP043 Create interactive solutions for sharing ideas and information online, taking into account safety, social contexts and legal responsibilities

ACTDIP044 Plan and manage projects using an iterative and collaborative approach, identifying risks and considering safety and sustainability

Suitable for all year levels

3a. Advanced ICT SKILLS

Spreadsheets

In the second chapter, we covered some basic skills in Microsoft Excel. We learned how to use formulas to calculate values. We used 'fill down' to make our calculations easier to replicate across large tables of data. Finally we created graphs and charts to illustrate our data.

In this chapter we will investigate more advanced processing techniques such as conditional formatting, IF statements and V LOOK UP tables. In this set of activities we will be using some data taken from The Humanitarian Data Exchange: **https://data.humdata.org/dataset/novel-coronavirus-2019-ncov-cases.** This data is updated daily from around the world on the number of COVID-19 cases identified, the number of deaths and the number of recoveries. The data sheets can be downloaded as CSV files (Comma Separated Values) which can be opened in Microsoft Excel and saved as XLS files for analysis. You can see in the excerpt in Fig 3.1, that the sheets contain the numbers for each date for each country.

You can see in Fig. 3.1 that the data begins on 22 January 2020. It appears no data is available before that date.

You can also see that Australia has been broken into separate states. Some other countries have also been broken into separate areas.

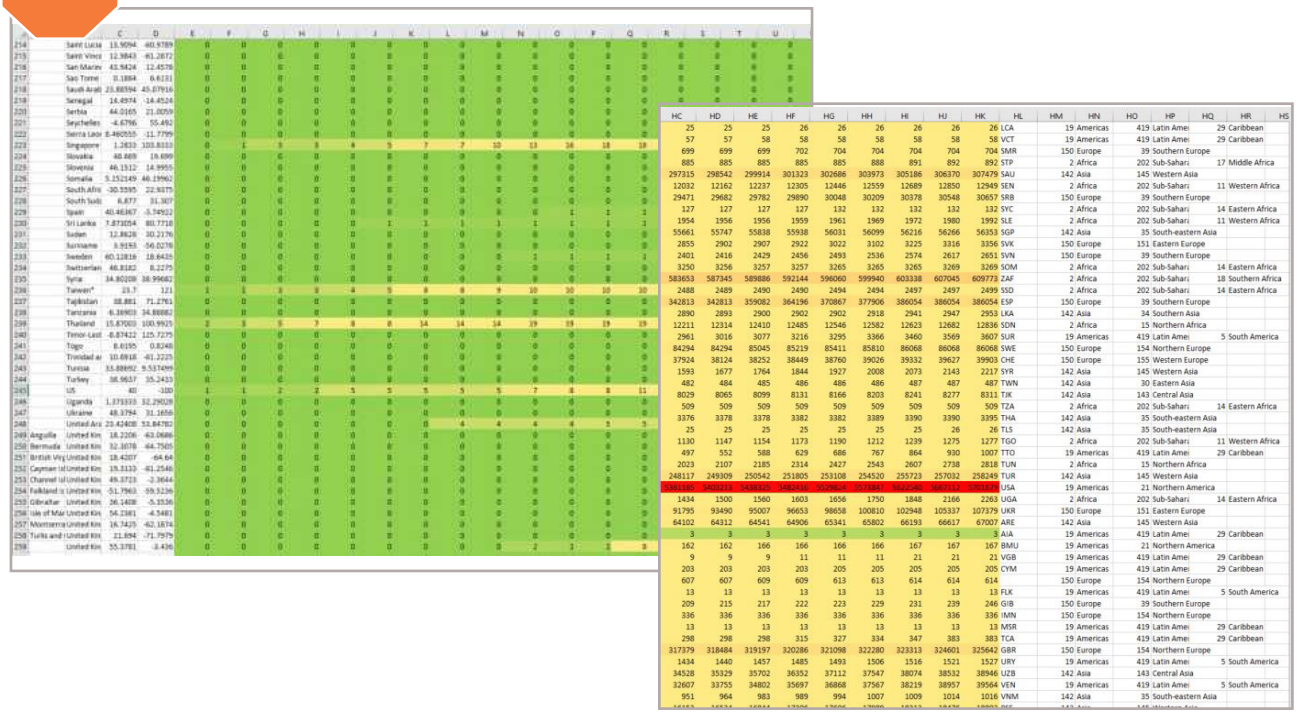
The data sheets contain COVID numbers for each day since 22 January 2020 for over 260 different regions and countries.

Fig. 3.1

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Province/S	Country/R	Lat	Long	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27/20	1/28/20	1/29/20	1/30/2
2		Afghanista	33.93911	67.70995	0	0	0	0	0	0	0	0	
3		Albania	41.1533	20.1683	0	0	0	0	0	0	0	0	
4		Algeria	28.0339	1.6596	0	0	0	0	0	0	0	0	0
5		Andorra	42.5063	1.5218	0	0	0	0	0	0	0	0	0
6		Angola	-11.2027	17.8739	0	0	0	0	0	0	0	0	0
7		Antigua ar	17.0608	-61.7964	0	0	0	0	0	0	0	0	0
8		Argentina	-38.4161	-63.6167	0	0	0	0	0	0	0	0	0
9		Armenia	40.0691	45.0382	0	0	0	0	0	0	0	0	0
10	Australian	Australia	-35.4735	149.0124	0	0	0	0	0	0	0	0	0
11	New Soutl	Australia	-33.8688	151.2093	0	0	0	0	3	4	4	4	4
12	Northern `	Australia	-12.4634	130.8456	0	0	0	0	0	0	0	0	0
13	Queenslar	Australia	-27.4698	153.0251	0	0	0	0	0	0	1	3	2
14	South Aus	Australia	-34.9285	138.6007	0	0	0	0	0	0	0	0	0
15	Tasmania	Australia	-42.8821	147.3272	0	0	0	0	0	0	0	0	0
16	Victoria	Australia	-37.8136	144.9631	0	0	0	0	1	1	1	1	2
17	Western A	Australia	-31.9505	115.8605	0	0	0	0	0	0	0	0	0
18		Austria	47.5162	14.5501	0	0	0	0	0	0	0	0	0
19		Azerbaijar	40.1431	47.5769	0	0	0	0	0	0	0	0	0
20		Bahamas	25.02589	-78.0359	0	0	0	0	0	0	0	0	0
21		Bahrain	26.0275	50.55	0	0	0	0	0	0	0	0	0
22		Banglades	23.685	90.3563	0	0	0	0	0	0	0	0	0
23		Barbados	13.1939	-59.5432	0	0	0	0	0	0	0	0	0
24		Belarus	53.7098	27.9534	0	0	0	0	0	0	0	0	0

The countries are organised in alphabetical order and the data is in chronological order. To best get a "bird's eye view" of the data, we could simply apply some formatting so we can see the values more clearly.In Fig. 3.2 you can see that the data has been allocated colours ranging from green through to yellow and then to red. This assists us in being able to make sense of so many values.

Fig. 3.2



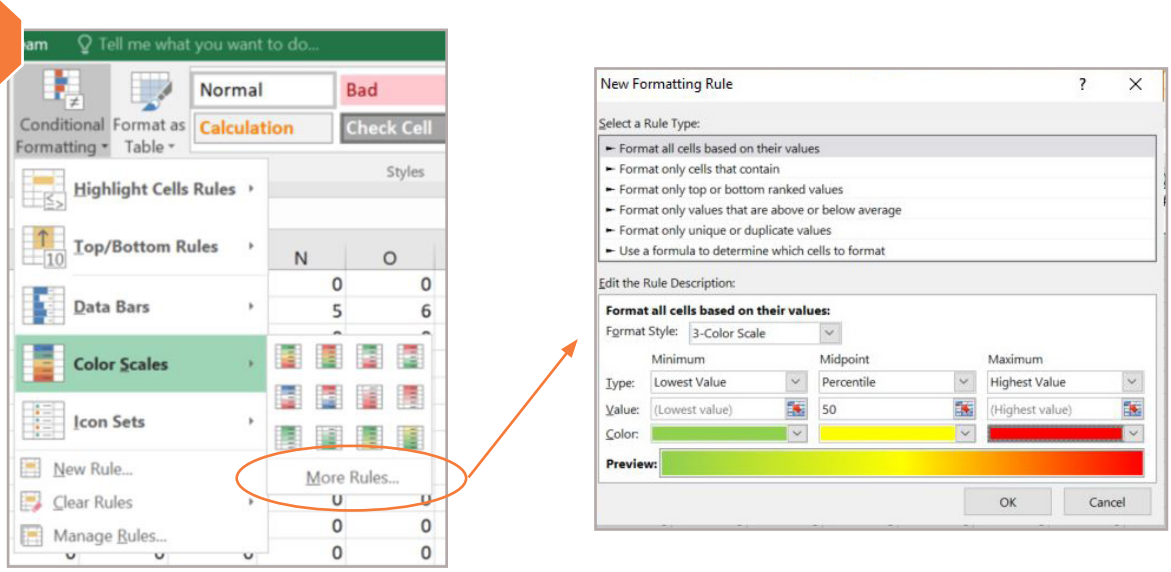
Advanced

We can see at a glance which countries started to have incidences of the virus, in the table on the left, while on the right you can see how one country is ahead of all the others in terms of COVID numbers. We have months of data for each country so it would take too long to investigate each value by hand, Microsoft Excel has the facility to allow for conditional formatting. You can select a table of data and identify a ranges of values to be allocated colours. This makes initial analysis of the data much easier.

Conditional Formatting

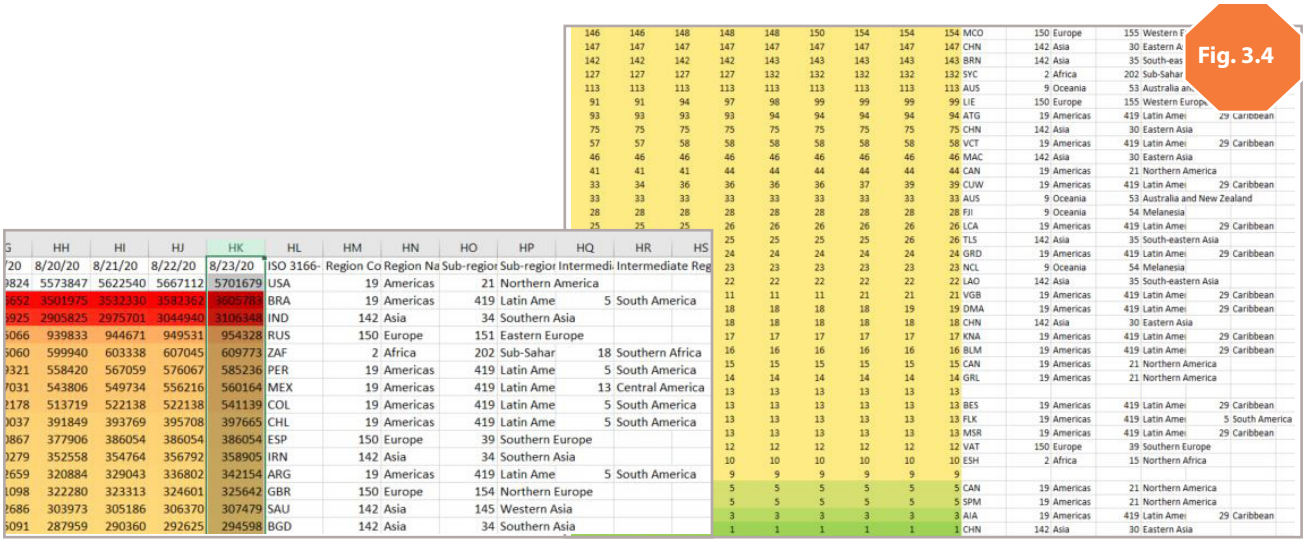
In Excel select the data you want to format, select "Conditional Formatting" from the home ribbon (See Fig 3.3.). There are a number of options, select the "Color Scales" then "More Rules...". It is in this new window that allows you to format your values. Select "Format all cells based on their values" then next to Format Styles choose 3 - Color Scale. This will sort the highest from the lowest values and allocate a colour for values in between. We have chosen green for the lowest value and red for the highest and yellow to indicate values at the midpoint. Try 50 or percentile at first and you will see that all the values turn yellow pretty quickly due to the speed of the virus' spread. Try 25 for percentile and you will see more variation in the early spread of the virus.

Fig. 3.3



Now if we select the last column of data we can easily find the names of the countries with the highest numbers of COVID cases as of 23 August 2020 when this data was accessed. At that time the countries with the highest incidences were: USA, Brazil and India. We can also see the countries with very low incidence on that final date. See Fig 3.4.

Fig. 3.4



HH	HI	HJ	HK	HL	HM	HN	HO	HP	HQ	HR	HS
8/20/20	8/21/20	8/22/20	8/23/20	ISO 3166-	Region Co	Region Na	Sub-regio	Sub-regio	Intermedi	Intermediate Reg	
5573847	5622540	5667112	5701679	USA	19	Americas	21	Northern America			
3501975	3532330	3582367	3605783	BRA	19	Americas	419	Latin Ame	5	South America	
2905825	2975701	3044940	3106348	IND	142	Asia	34	Southern Asia			
939833	944671	949531	954328	RUS	150	Europe	151	Eastern Europe			
599940	603338	607045	609773	ZAF	2	Africa	202	Sub-Sahar	18	Southern Africa	
558420	567059	576067	585236	PER	19	Americas	419	Latin Ame	5	South America	
543806	549734	556216	560164	MEX	19	Americas	419	Latin Ame	13	Central America	
513719	522138	522138	541139	COL	19	Americas	419	Latin Ame	5	South America	
391849	393769	395708	397665	CHL	19	Americas	419	Latin Ame	5	South America	
377906	386054	386054	386054	ESP	150	Europe	39	Southern Europe			
352558	354764	356792	358905	IRN	142	Asia	34	Southern Asia			
320884	329043	336802	342154	ARG	19	Americas	419	Latin Ame	5	South America	
322280	323313	324601	325642	GBR	150	Europe	154	Northern Europe			
303973	305186	306370	307479	SAU	142	Asia	145	Western Asia			
287959	290360	292625	294598	BGD	142	Asia	34	Southern Asia			

Now we can choose which data to investigate. I have chosen India, Italy and Vietnam because they all have very different shapes to their numbers. Vietnam had cases from the very beginning but kept the numbers very low. India did not get any cases till much later and the numbers escalated very quickly. Italy also had early cases but managed to stop the rise in numbers. See Fig. 3.5.

You can see in the tables below that the data for these three countries has been put into a separate spreadsheet to be compared.

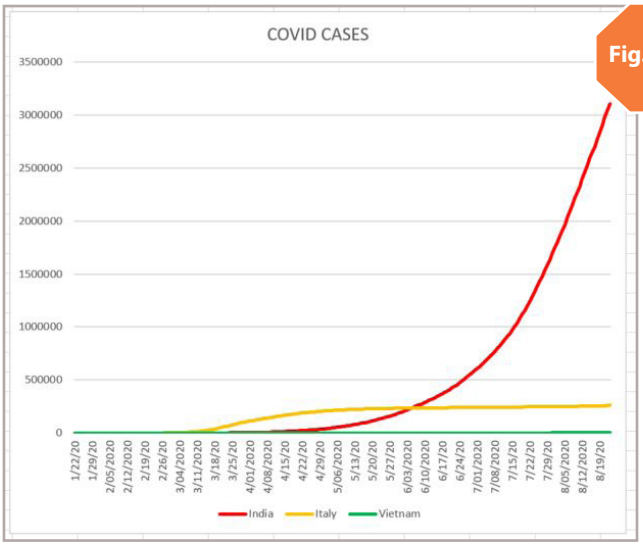
You can see that the end values on 23 August vary in colour, showing very different values.

The chart shows how Vietnam, despite having cases as early as 23 January kept very low values throughout.

Italy's numbers began to rise in March and April but then that increase slowed and the line plateaus.

India has a very different case where numbers emerge in April then rises very rapidly without any slowing down.

Fig. 3.5



	A	B	C	D	E	F	
1		1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27
2	India	0	0	0	0	0	
3	Italy	0	0	0	0	0	
4	Vietnam	0	2	2	2	2	
5							

HB	HC	HD	HE	HF	HG	HH	HI
8/17/20	8/18/20	8/19/20	8/20/20	8/21/20	8/22/20	8/23/20	
2702681	2767253	2836925	2905825	2975701	3044940	3106348	India
254235	254636	255278	256118	257065	258136	259345	Italy
983	989	994	1007	1009	1014	1016	Vietnam

It might be interesting to see when each country had their first cases. We can now return to our main spreadsheet and investigate further using IF Statements.

IF Statements

In Excel we can use formulas to test data. Very large values are difficult to read by eye. We are going to use a formula that can test the value in a cell. In the HH Column we can see the final COVID values from 23 August. Let's test these values to see how they are different. In Fig. 3.6 you can see that the following formula is entered into cell HJ2: =IF(HH2>1000000, "Very High", "").

The formula above tests the cell HH2. The condition is HH2>1000000 (in orange). It is testing to see if the data in HH2 is greater that 1 million. If the condition is TRUE, it will display "Very High". If the condition is FALSE it will display nothing. The open and closed inverted commas with nothing in between mean "nothing".

The formula in HK2 tests two conditions: =IF(AND(HH2>200000, HH2<1000000), "High", ""). You can see there are two conditions in a set of brackets; one tests whether HH2 is above 200,000 and the other tests if it is lower than 1 million. The beginning of this formula is the same IF Statement but includes "AND". This means both of the conditions must be met to be TRUE. If both conditions are TRUE, "High" will display in the cell. If one or both of the conditions are FALSE then nothing will be displayed. You can see in the Fig 3.6 below, that there are three columns. The last one is "Below 10,000".

Can you write the formula for "Between 10,000 and 200,000" and "Below 10,000"?

Fig. 3.6

HJ2 =IF(HH2>1000000, "Very High","")

	HD	HE	HF	HG	HH	HI	HJ	HK	HL
1	8/19/20	8/20/20	8/21/20	8/22/20	8/23/20		Over 1000,000	Over 200,000	Below 10,000
2	2836925	2905825	2975701	3044940	3106348	India	Very High		
3	255278	256118	257065	258136	259345	Italy		High	
4	994	1007	1009	1014	1016	Vietnam			Low

HK2 =IF(AND(HH2>200000, HH2<1000000), "High", "")

	HD	HE	HF	HG	HH	HI	HJ	HK	HL
1	8/19/20	8/20/20	8/21/20	8/22/20	8/23/20		Over 1000,000	Over 200,000	Below 10,000
2	2836925	2905825	2975701	3044940	3106348	India	Very High		
3	255278	256118	257065	258136	259345	Italy		High	
4	994	1007	1009	1014	1016	Vietnam			Low

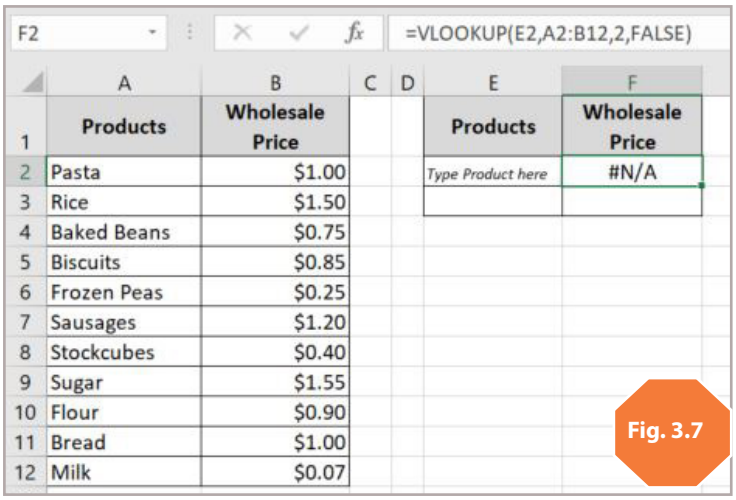
Advanced

V LOOK UP

When you are dealing with large amounts of data, a look-up table comes in handy. Before we apply it to our large COVID data sheet, let's look at a small data set. In Fig. 3.7, you can see a basic table of product names and their wholesale prices. This table is stored in the block A2:B12. This is the look-up table. If we want to know what the wholesale price is for a product we can use the cell E3. We type in the name of a product into E3 and the VLOOKUP formula in F3 loo,ks up the wholesale price for use. Here is the formula:

=VLOOKUP(E2,A2:B12,2,FALSE)

The VLOOKUP inspects E2. This is where we type the product we want to look up in the block A2:B12. If it finds the product name it will return the data in the column "2" of the look up table. FALSE indicates that it does not need to be an identical match - which means if a capital letter is not included, it will still find the data you need.



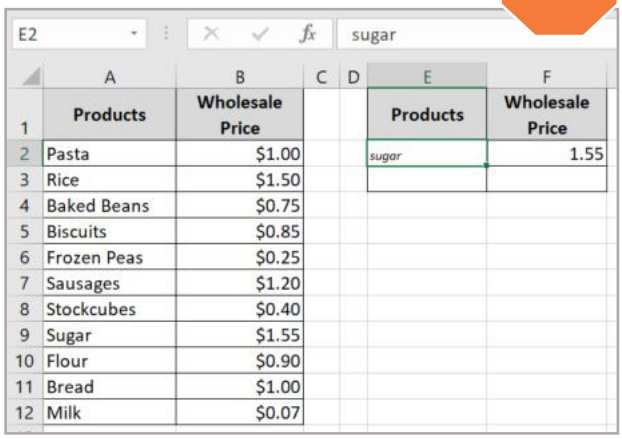
	A	B	C	D	E	F
1	Products	Wholesale Price			Products	Wholesale Price
2	Pasta	$1.00			Type Product here	#N/A
3	Rice	$1.50				
4	Baked Beans	$0.75				
5	Biscuits	$0.85				
6	Frozen Peas	$0.25				
7	Sausages	$1.20				
8	Stockcubes	$0.40				
9	Sugar	$1.55				
10	Flour	$0.90				
11	Bread	$1.00				
12	Milk	$0.07				

Fig. 3.7

You can see in Fig. 3.8 that the word "sugar" has been entered into cell E2. This is the cell being checked by our VLOOKUP formula. The formula looks up the block A2:B12 and returns the data in the second column of the block, which is 1.55.

You can also see that "sugar" has not got a capital letter, despite the capital used in the look-up table. If we did not use "FALSE" in our formula we would not have found the data returned.

Fig. 3.8

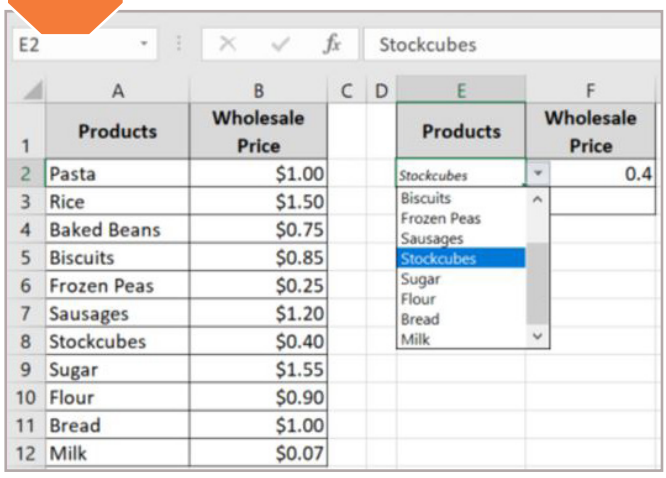


	A	B	C	D	E	F
1	Products	Wholesale Price			Products	Wholesale Price
2	Pasta	$1.00			sugar	1.55
3	Rice	$1.50				
4	Baked Beans	$0.75				
5	Biscuits	$0.85				
6	Frozen Peas	$0.25				
7	Sausages	$1.20				
8	Stockcubes	$0.40				
9	Sugar	$1.55				
10	Flour	$0.90				
11	Bread	$1.00				
12	Milk	$0.07				

This process can be very useful when you have a large data sheet and it is not easy to find what you are looking for. You might want to set up a data sheet for other people to use who are not as familiar with spreadsheets. Sometimes we can't assume the end user knows what to enter into the cell E2.

We can use another feature of Excel where we automatically put the list of options into a pull-down menu. You can see in Fig. 3.9 that E2 now has a pull down menu with a full list of Products to choose from.

Fig. 3.9



	A	B	C	D	E	F
1	Products	Wholesale Price			Products	Wholesale Price
2	Pasta	$1.00			Stockcubes	0.4
3	Rice	$1.50				
4	Baked Beans	$0.75				
5	Biscuits	$0.85				
6	Frozen Peas	$0.25				
7	Sausages	$1.20				
8	Stockcubes	$0.40				
9	Sugar	$1.55				
10	Flour	$0.90				
11	Bread	$1.00				
12	Milk	$0.07				

To use a list as a drop down menu is pretty easy:

1. Select the cell where you want the menu to appear (E2)

2. Select the "Data" ribbon.

3. Select Data Validation and a new window will allow you to enter, under Settings, "List".

4. You then identify the Source as =$A$2:$A$12 or simply click and drag the cells you want to include in your menu.

(Remember we use "$" to create an absolute cell reference so it will not change if we copy and paste our formula.)

Advanced

We can now use what we have learned to analyse our large data sheet of COVID cases. Below in Fig. 3.10, you can see that a new column has been created at the start of the data sheet (Column A). In A3, a drop down list of all the alphabetically organised country names has been created. In A5 a VLOOKUP formula is testing A3 for a country name and displaying the last value (the 218th column in the block). How did we know how many columns? We used Fill Across to count the columns. If you put 1 and 2 into adjoining cells and fill across, it will fill in all the values - counting how many columns are in the block!

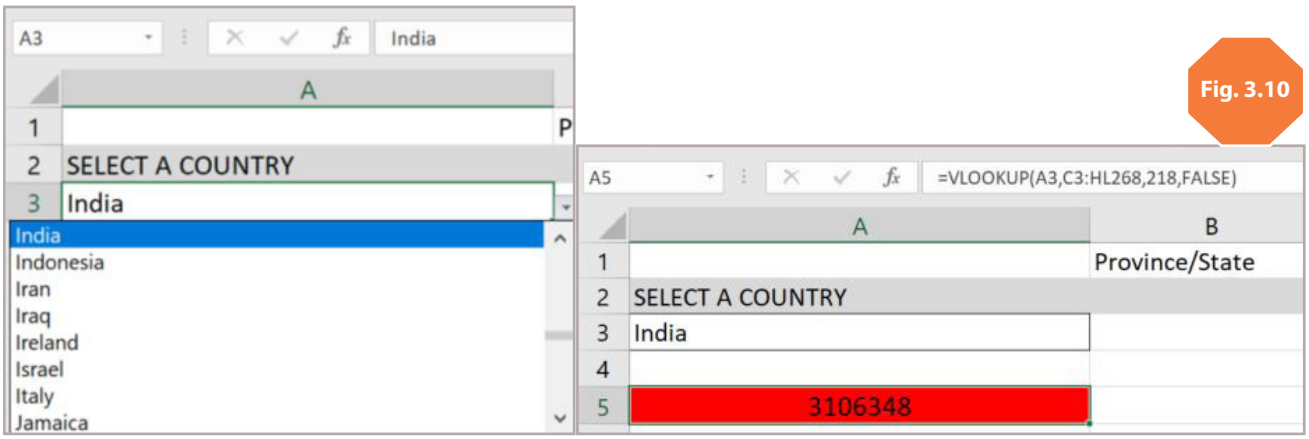


Fig. 3.10

There are plenty of other analysis techniques to assist in investigating the data. You can see the data for Australia and China has been broken up into separate regions, see Fig. 3.11. This data can be grouped together. Add a new row below the group and a SUM formula. Fill Across can quickly summarise all the values across the sheet.

Fig. 3.11

Victoria	Australia			-37.8136	144.963	0	0	0	
New South Wales	Australia			-33.8688	151.209	0	0	0	
Queensland	Australia			-27.4698	153.025	0	0	0	
Western Australia	Australia			-31.9505	115.861	0	0	0	
South Australia	Australia			-34.9285	138.601	0	0	0	
Tasmania	Australia			-42.8821	147.327	0	0	0	
Australian Capital Ter	Australia			-35.4735	149.012	0	0	0	
Northern Territory	Australia			-12.4634	130.846	0	0	0	
	Chile								
Hubei	China	30.9756	112.271	444	444	549	761	1058	1423
Hong Kong	China	22.3	114.2	0	2	2	5	8	8
Guangdong	China	23.3417	113.424	26	32	53	78	111	151
Zhejiang	China	29.1832	120.093	10	27	43	62	104	128
Henan	China	37.8957	114.904	5	5	9	32	83	128
Hunan	China	27.6104	111.709	4	9	24	43	69	100
Anhui	China	31.8257	117.226	1	9	15	39	60	70
Heilongjiang	China	47.862	127.762	0	2	4	9	15	21
Beijing	China	40.1824	116.414	14	22	36	41	68	80
Jiangxi	China	27.614	115.722	2	7	18	18	36	72
Xinjiang	China	41.1129	85.2401	0	2	2	3	4	5
Shanghai	China	31.202	121.449	9	16	20	33	40	53
Shandong	China	36.3427	118.15	2	6	15	27	46	75
Jiangsu	China	32.9711	119.455	1	5	9	18	33	47
Sichuan	China	30.6171	102.71	5	8	15	28	44	69
Chongqing	China	30.0572	107.874	6	9	27	57	75	110
Fujian	China	26.0789	117.987	1	5	10	18	35	59
Shaanxi	China	35.1917	108.87	0	3	5	15	22	35
Hebei	China	39.549	116.131	1	1	2	8	13	18
Liaoning	China	41.2956	122.609	2	3	4	17	21	27
Inner Mongolia	China	44.0935	113.945	0	0	1	7	7	11
Guangxi	China	23.8298	108.788	2	5	23	23	36	46
Tianjin	China	39.3054	117.323	4	4	8	10	14	23
Shanxi	China	37.5777	112.292	1	1	1	6	9	13
Yunnan	China	24.974	101.487	1	2	5	11	16	26
Hainan	China	19.1959	109.745	4	5	8	19	22	33
Gansu	China	35.7518	104.286	0	2	2	4	7	14
Jilin	China	43.6661	126.192	0	1	3	4	4	6
Guizhou	China	26.8154	106.875	1	3	3	4	5	7
Ningxia	China	37.2692	106.166	1	1	2	3	4	7
Macau	China	22.1667	113.55	1	2	2	2	5	6
Qinghai	China	35.7452	95.9956	0	0	0	1	1	6
Tibet	China	31.6927	88.0924	0	0	0	0	0	0

It is possible to chart the data across time (Line Chart) or chart comparisons between countries or regions (Bar Chart).

If we investigated Australia or China alone, we could compare the states and provinces as percentages of the total numbers and display the results in Pie Charts.

There is a range of data available including the number of deaths and the number of recovered cases. Some online research may yield extra information to shine light on the reasons why each country's data is different.

Can you think of other techniques we have learned, that we could apply to our COVID data?

Advanced

Databases

Microsoft Access allows you to create databases. Excel creates sheets otherwise known as flat-file databases, while Access creates Relational Databases. Relational Databases have more than one table in them. We are going to create the most basic relational database called a Transaction Processing System.

Tables

We are going to create two tables that hold records of people (customers) and things (products). Then we are going to create a working table that will create relationships between the two.

In Access you need to design the table in Design View and name it straight away. In Fig. 3.12, you can see the first table is being named "Customers". The "View" button in the top left is very important and it allows you to toggle between Design view and Datasheet view. Design view allows you to design the table. Datasheet view allows you to enter data into your designed table. To create a table, select it from the "Create" ribbon.

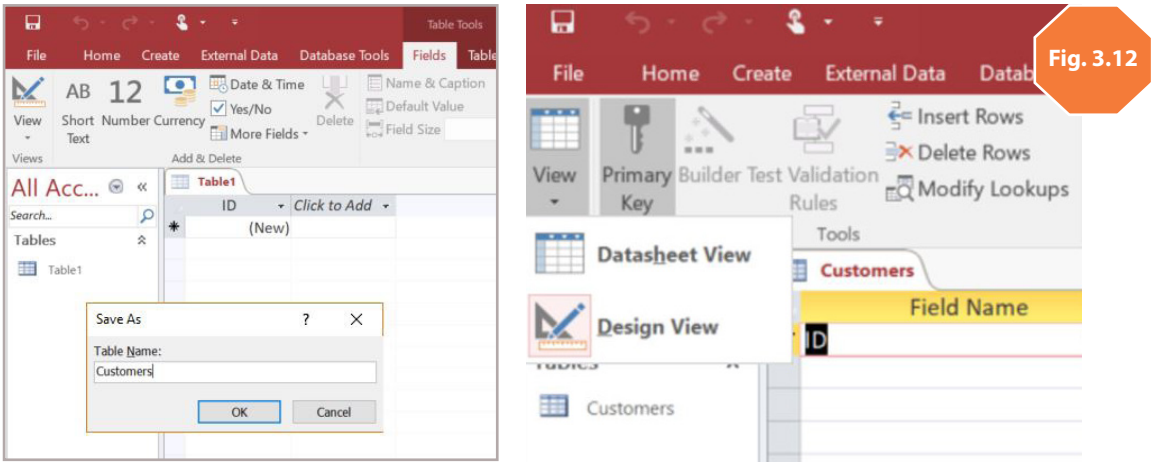
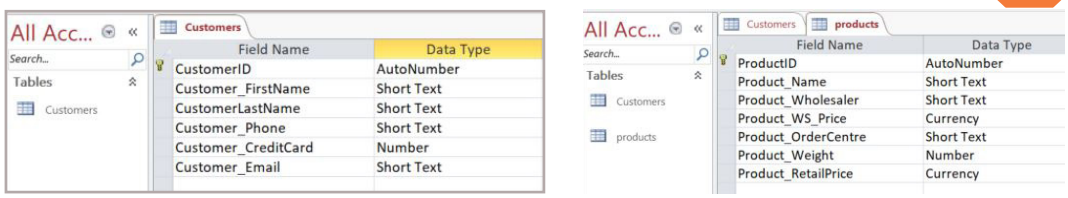


Fig. 3.12

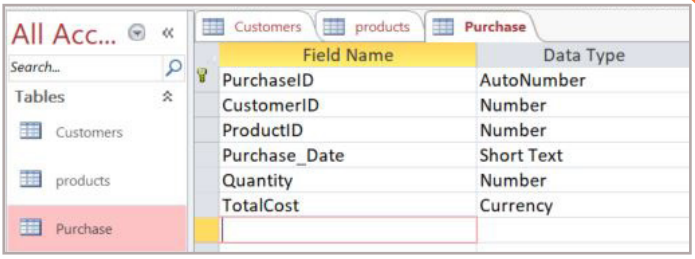
While in Design View, we need to create the two entity tables - one for customers and one for products. In Fig. 3.13, you can see the two tables in Design View. We organise the field names for each of the two tables. Both tables have an ID field that is Auto Number. We do not create data for this field. Allow Access to create unique ID numbers for each new record.

Fig. 3.13



Once we have two entity tables, we need to design the working table. The working table links the two entities in a transaction, such as a purchase. The working table creates a record for each transaction and only holds transaction data. It links the two entities by including their ID fields.

Fig. 3.14



In Fig. 3.14 above, you can see the working table in Design View. The Purchase ID is an AutoNumber, but the ID from the Customer table and the Product table are 'Number' type. This is because both of the IDs are already in the system if the customer is making a purchase of a product. We have added the fields we will need for an invoice. This table will do all the hard work for us.

Relationships

Now we need to get Access to connect all our tables. On the "Database Tools" ribbon is a 'Relationships' button. See Fig 3.15 below.

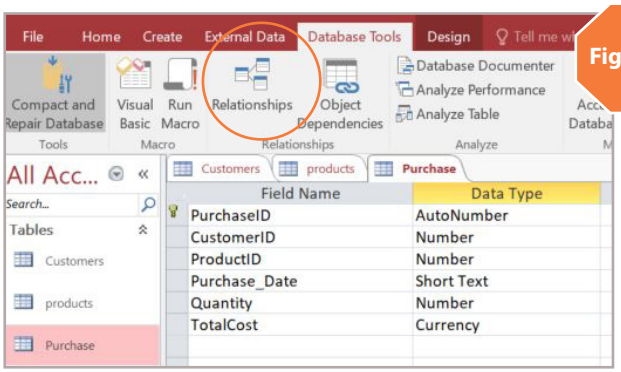


Fig. 3.15

We now need to add each of the three tables to the Relationship Schema. When we click on the relationship button a new window opens and we can add each of the tables to the schema. Select each table and click "Add". Arrange the tables on the screen with the two entities on the outside and the working table in the middle.

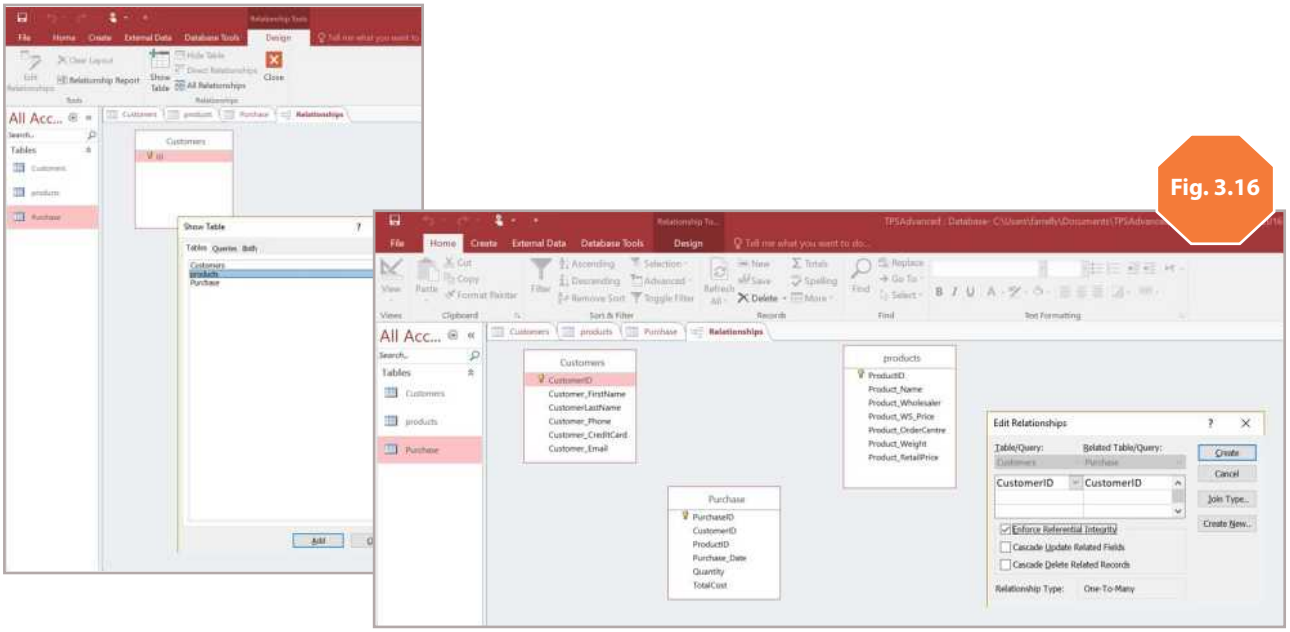


Fig. 3.16

Once you have your three tables arranged correctly (See Fig. 3.16 above), you will choose the CustomerID in the Customer table and drag it to the CustomerID in the Purchase table. This will open a new window where you can edit the relationship. Ensure the tables and fields are correct and check the box for "Enforce Referential Integrity" and click 'Create'. Do the same thing for Products ID. Drag from the Products table to the Purchase table. You should end up with a relationship schema like the one in Fig. 3.17 below.

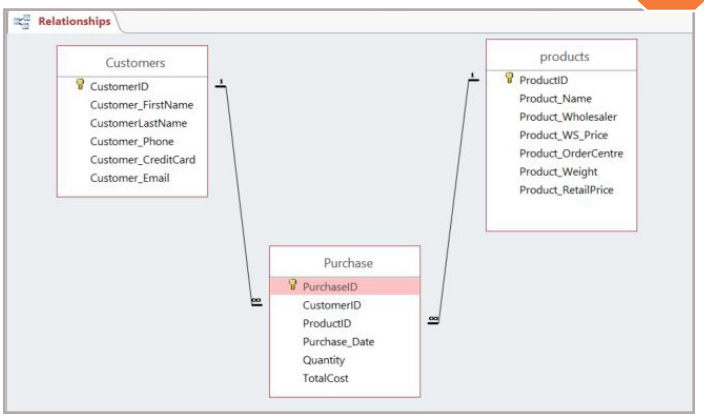


Fig. 3.17

If you are having trouble creating your relationships, close the table tags. Still having trouble? Check to see if your ID data types are correctly allocated. The ID in the entity tables should be AutoNumbers, and when entity IDs are in the Product table, they should be allocated to Number.

Make sure you close the relationship and save.

Advanced

Forms

We are now going to make the interface. Select your Customer table and go to the 'Create' ribbon again and select 'Form Design'.This will allow you to create a 'Form' or interface for your Customer table. Once the window opens to a grid, you can select 'Add Existing Fields'. This will allow you to access each field in your Customer table. See Fig. 3.18 below.

You can now click and drag each field from the field list on the right onto the gridded form layout to design your interface. Each field will create an input box and a label for each.

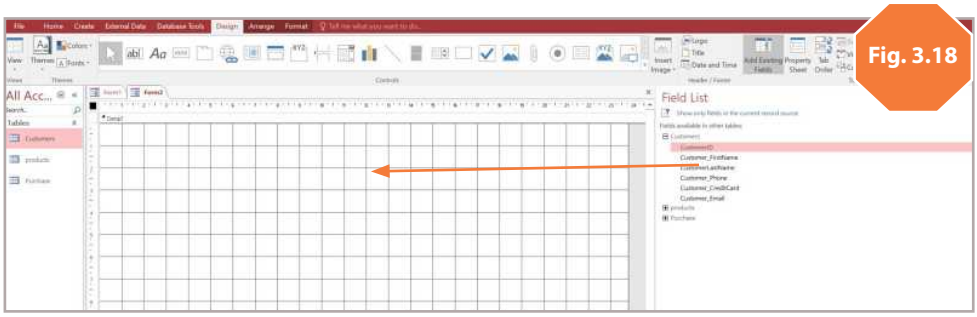


Fig. 3.18

You can see below in Fig. 3.19, that all the fields have been dragged into the grid. I have added a heading "New Customer Input Page" by using the label tool (circled) in the Design ribbon menu. Once all the fields are added and we are happy with the information on the form, we need to create some functions. If the end user of our database wants to enter a new customer, they need a button to create a new record. They also need a button to save the data. What if they need to delete a customer's records? Well, we can add each of these functions by clicking on the button icon (also circled) and drawing it on the grid. This automatically opens the Command Button Wizard. Select "Record Operations" and then "Add New Record" like the Fig. 3.19 below.

Fig. 3.19

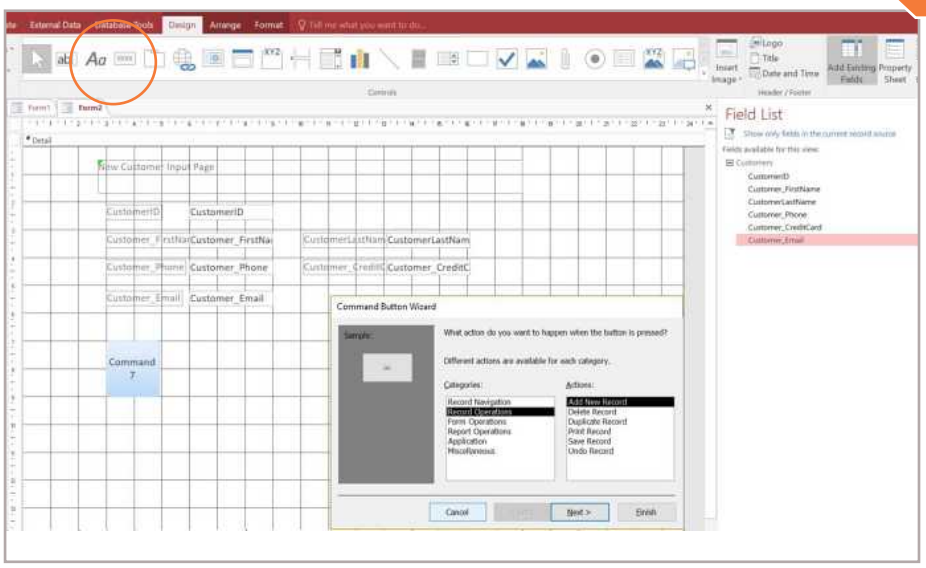
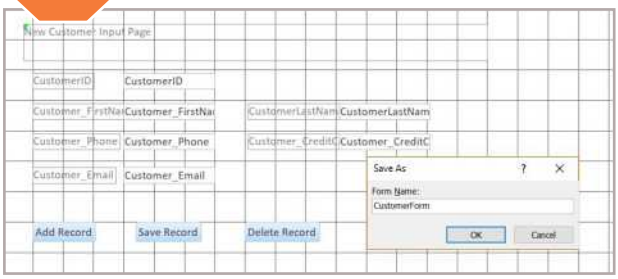


Fig. 3.20



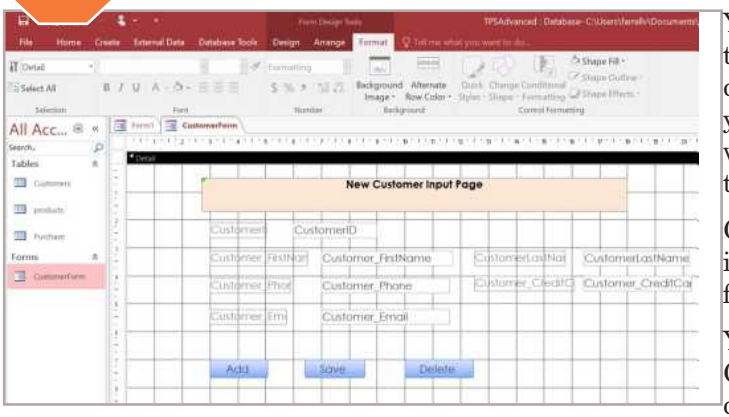
Create buttons for Add Record, Save Record and Delete Record and place them along the bottom or down one side of the grid. (See Fig. 3.20) You need to save your form and you should call it 'CustomerForm'. It is important that your Customer Table and your Customer Form are named clearly so you know which form will control the data in which table.

Each table and each form is a separate object and they open in separate tabs in Access. If something is not working, just check how many tabs you have open and close them using the X button on top right.

Advanced

Before we create our other forms, let's format our CustomerForm using the formatting tools on the Format ribbon. See Fig. 3.21 below showing the buttons with new fonts, colours and sizes. A bold heading makes the design look professional.

Fig. 3.21



You can also see in Fig. 3.21, the tables and the new form are listed in the window panel down the left. This is a list of all the objects you have created for your databases. If you want to open them, you only have to click on them.

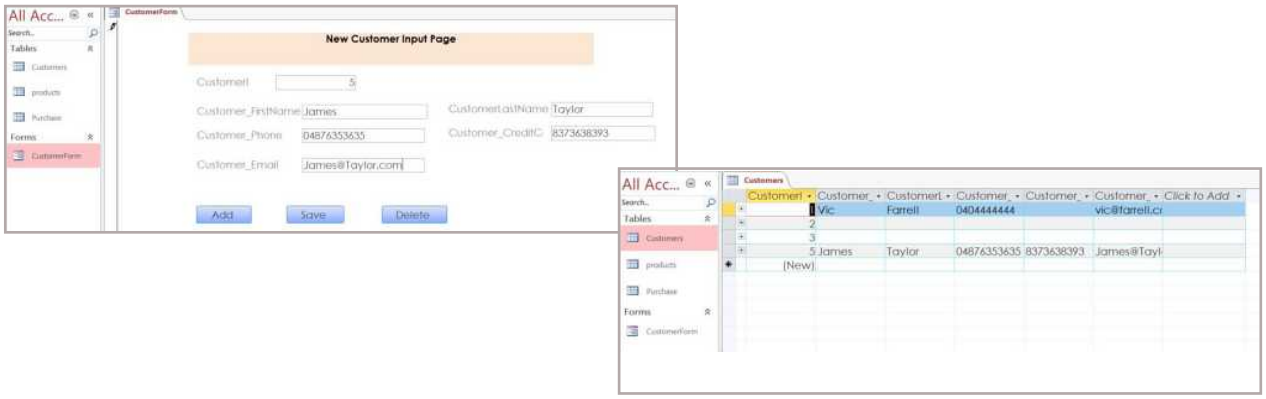
Close your current form and double click on its icon in the objects panel. You will see what the form will look like in action.

You can even try adding a new record to the Customer table. It is at this point students discover issues with their databases.

Sometimes a field will not allow you to enter data.

In this case, close all your object tabs and open the Customer table in Design View. Try changing all the data types to "Short Text" - this will fix any issues in the short term while you are building your database. Make sure all your tables are correctly saved.

Fig. 3.22



In Fig. 3.22 above you can see the Form View of the CustomerForm as it would be seen by the end user. You may need to fiddle with the labels and input boxes in Design View to make sure it all lines up and the text is visible. You can also see there are two records in the Datasheet View of the CustomerTable. There are also two records with no data. This can happen in the development process when you are testing your input form and fixing issues. Do not try to remove the empty records. Do not worry about the IDs for these records either. Each record created by the database must have a unique ID. You will need to be aware of your ID numbers in each table when testing the relationships later.

Go ahead and create a form for your Products table and for your Purchases table too. Use your forms to enter FIVE records into your Products table.

Take care when you enter some records into your working table Purchases. You must only enter CustomerIDs and ProductIDs that exist in your database. You can see in Fig. 3.22, that records 2 and 3 contain no data, and there are no records that exist after 5. If I was to use the current Customer table as it stands, I would only be able to use the CustomerIDs currently in the system: 1 and 5. You need to use the same logic with your ProductIDs. If they are not in the database, you can not process a purchase.

The next stage is to create a home page for the interface with buttons that will allow the user to navigate through the database.

To create a new form we choose the 'Create' ribbon and 'Form Design'. You can see in Fig. 3.23 there is a bold heading and a button with "Add a New Customer". This button opens the CustomerForm.

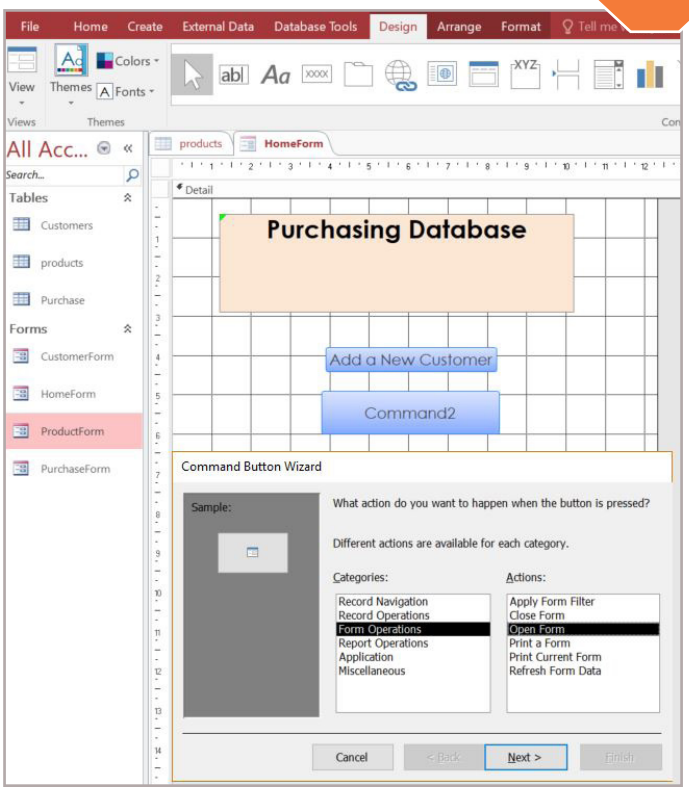
You can see in the Command Button Wizard, "Form Operations" is selected, then "Open Form". This allows you to create a navigation button between forms.

To complete your database navigation you will need buttons to the CustomerForm, the PurchasesForm and the ProductForm. You also need a button back to home. This is called making a navigation menu, in the same way you create a menu on a website.

You can also add a Quit button. The Category "Application" in the Command Button Wizard allows you to add a Quit Button.

Once you have finished your navigation design for each form, we are going to create two more objects.

Fig. 3.23



You can see on the left my final four forms that will be the user interface for the database.

I have kept the navigation buttons in the same format on each form to ensure it is easy to navigate.

The Quit button is in the bottom right which is a commonly used location for Quit buttons. It is red to alert the user that it will shut the database down.

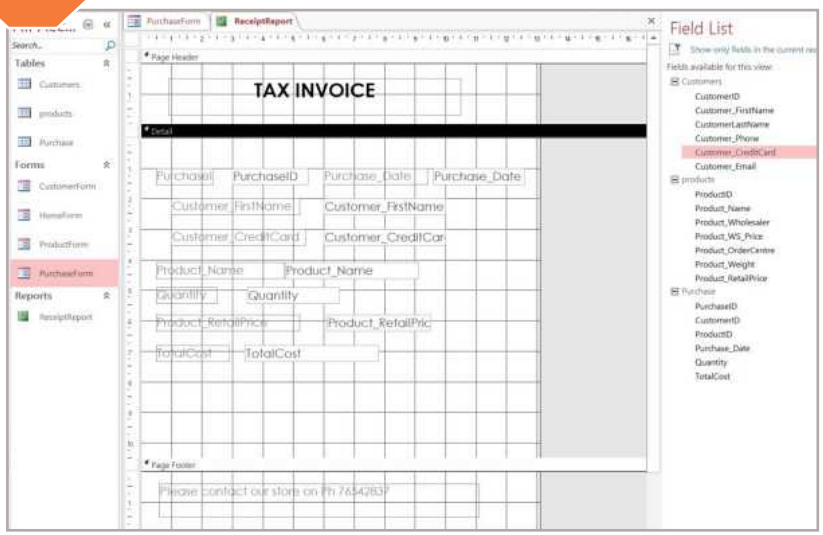
The Home button is located on the top left because this is the usual location for a home button on a website and in other applications.

Each form has a header clearly identifying the purpose of each form and the table fields are clearly displayed so the end user knows what to type into each input box.

By now you should have at least five records in each of your three tables. We are going to create a receipt for the customer. In Access we call any printable document from a database, a "Report".

We need to go to the 'Create' ribbon and select 'Report Design'.

Fig. 3.24



Reports

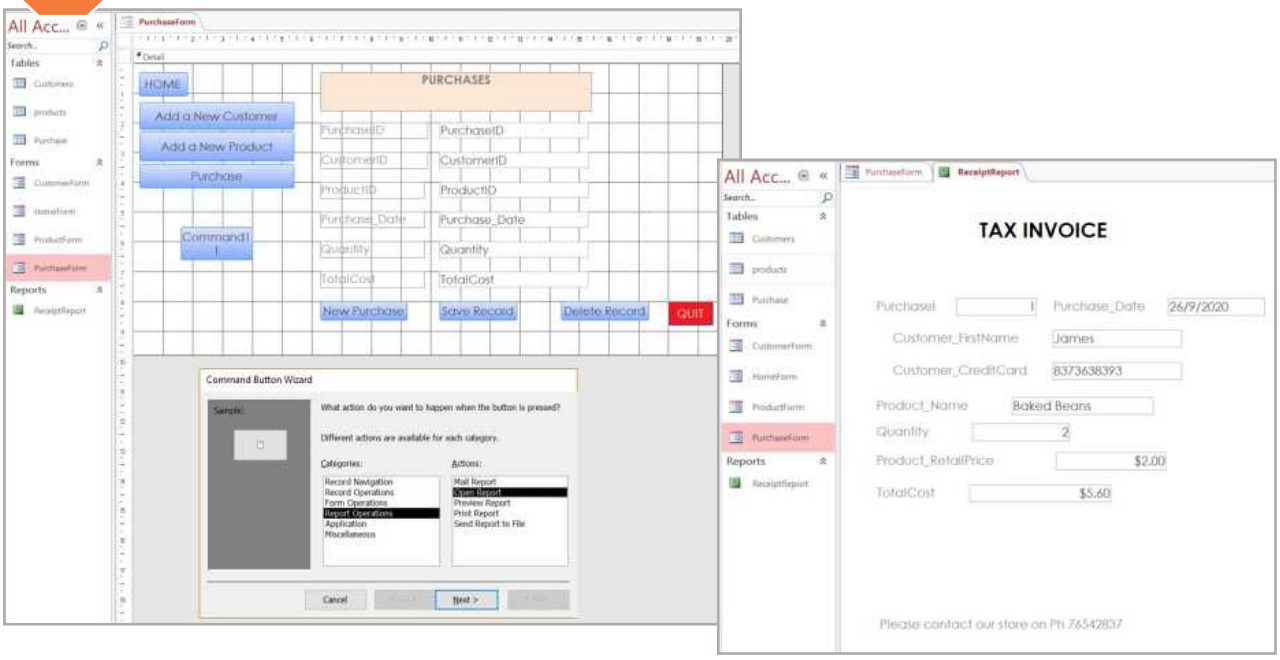
To design the report, we use the same method as designing the forms. This time, all the fields are available to be included on the report, not just the fields of one table.

The relationships between the tables will be able to access the rest of the data attached to the IDs and they can be displayed for printout here on the report, see Fig. 3.24.

You should save the report as a ReceiptReport. It will appear in your object panel on the far left under Reports.

To be able to make our report, we will need to create a button on our PurchaseForm. This will automatically load the data in the new Purchase record into the Report. In Fig. 3.25 below, you can see that the new button on the form has opened the Command Button Wizard. The category is "Report Operations" and the Action is "Open Report". If you have named your report clearly, saved it and closed the tab, it should appear after the next button is selected. You might like to label the button "Print Receipt". You can see the output from the button below.

Fig. 3.25



We have built a very basic relational database. The next stage is to create calculated fields such as the "Total Cost" field. We also need to include some queries to search for data. All these techniques will be explored in the Specialist subject "Transaction Processing Systems".

Advanced

Programming III

We have learned some basic programming skills in Python in previous chapters. We are going to use a fast development environment that allows you to use Windows objects to quickly and easily create an interface. The development environment is called Visual Studio Community and it is free to download from here: **https://visualstudio.microsoft.com/downloads/**

To use the free version of Visual Studio you will need to sign into a Microsoft Account. Once you have logged in and opened Visual Studio you need to create a New Project. Ensure your project setting is "Windows Forms App" (.NET Framework). You can search for it using the language: Visual Basic and the platform: Windows and Desktop.

You can see in Fig 3.26 below that we need to give our first project and solution a name. We also need to identify the location where the project will be stored. Be warned: Once you name your project and identify the location, you can not change it! Ensure you remember the name of the project, and where it is located before selecting "Create"!

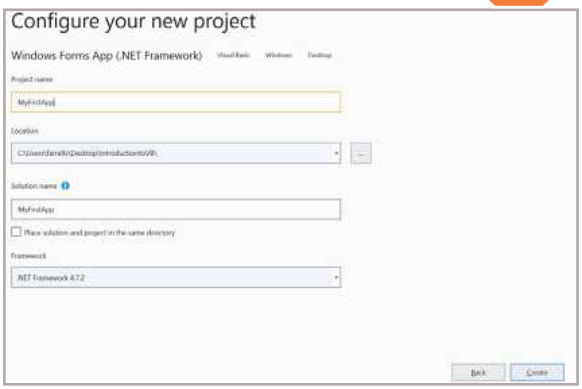
Once you create your project you will be presented with a blank form. A form is a window that allows you to create an interface between the user and the code you will write.

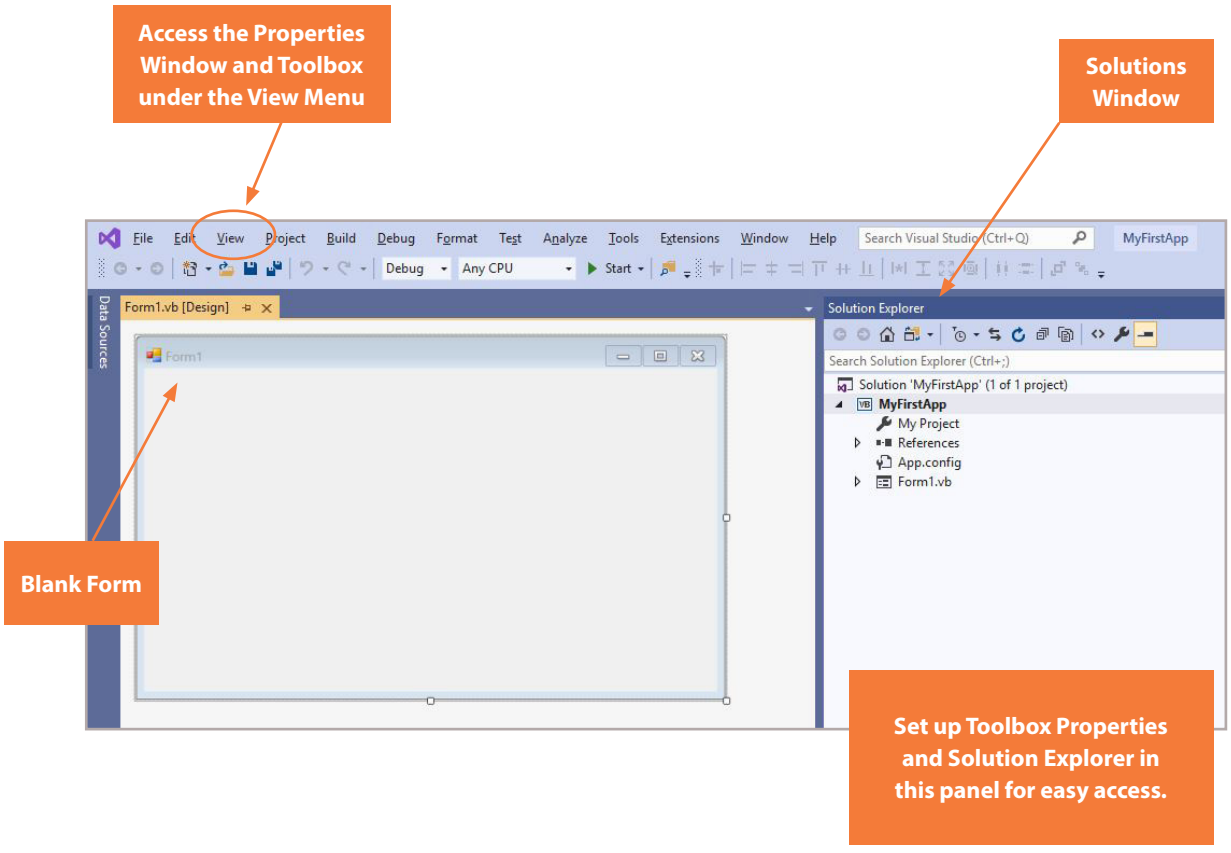
There are four things that need to be visible on our screen to start making an application:

1. a Form
2. the Solutions Explorer window
3. the Properties window
4. the Toolbox.

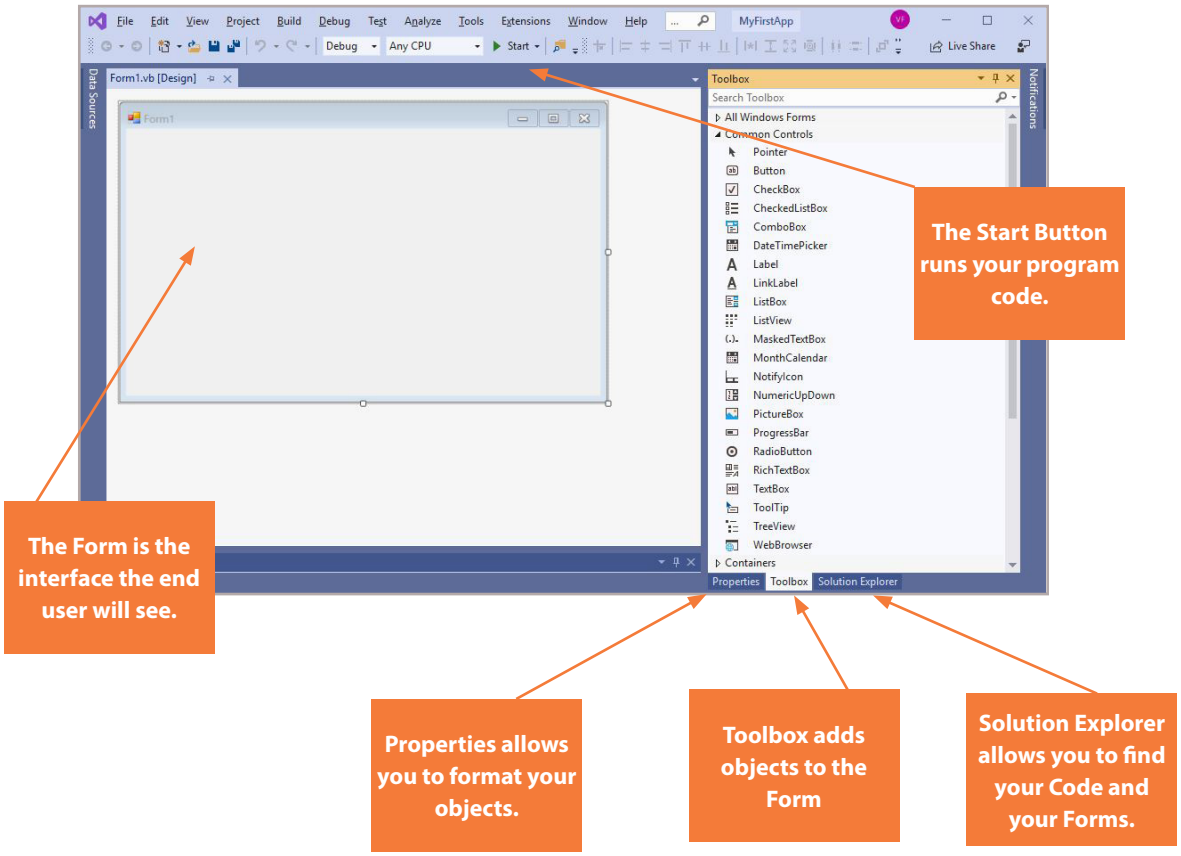
See the screen shot below for access and set up these resources.

Fig. 3.26





Advanced

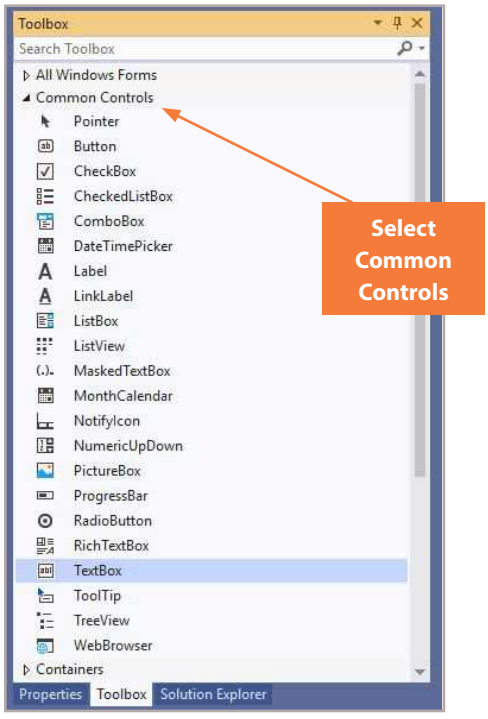


In the diagram above you can see the role of each of the four windows and the start button. So let's get started.

We are going to create a very simple program. It will read in two values and add them together, then display the answer on the screen. The first thing we need to do is design an interface to allow the data to be read in and then displayed.

We need two TextBoxes to read in the two values, a Button to execute the process of adding the numbers together, then a Label to display the answer.

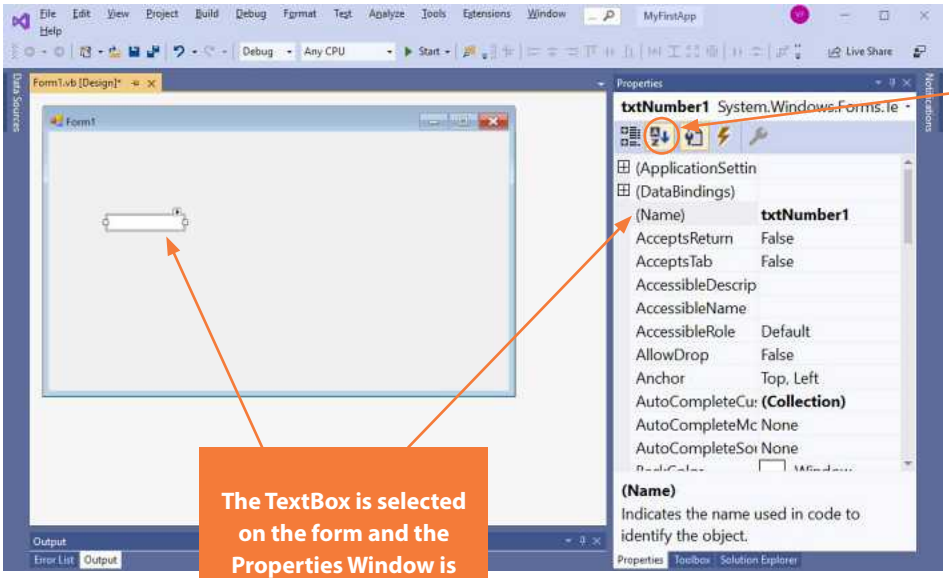
Select the Toolbox and set it up so that Common Controls are all visible. These are the tools we will need for all our programs.



Let's create an object on the Form.

1. Go to the Toolbox and select TextBox.
2. Draw the Textbox on the Form (Click and Drag).
3. While the TextBox is selected on the Form, open the Properties Window.

Advanced



In the diagram above, you can see that the Properties Window is set up in alphabetical order so that each property is easy to find. We use the (Name) property to change the name of the object selected. It is important that you name your objects so that it is clear what type of object it is, and what it is used for. In this case, the TextBox has been named txtNumber1. The 'txt' indicates that it is a TextBox and the 'Number1' indicates that it will be used to input the first number.

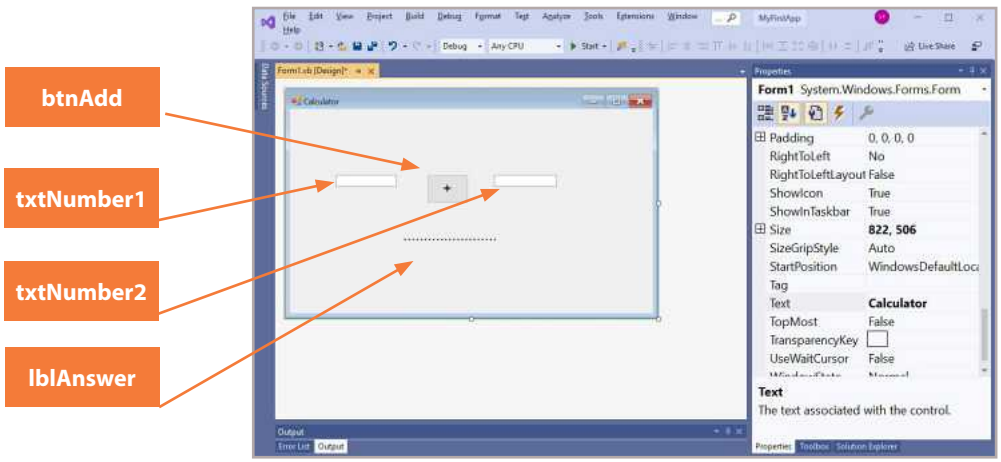
Let's add another TextBox and name it "txtNumber2".

Using the same techniques, add a Label object to the Form below and change the name to "lblAnswer". This time we are going to change another property in the label. We are going to put a line of dots in the "Text" property. This will display inside the Label. If you have the Properties Window set up alphabetically, you will easily find the Text property. You can also change the Text property on the Form. Click anyware in the Form and go to the Properties Window and change the Text property to "Calculator".

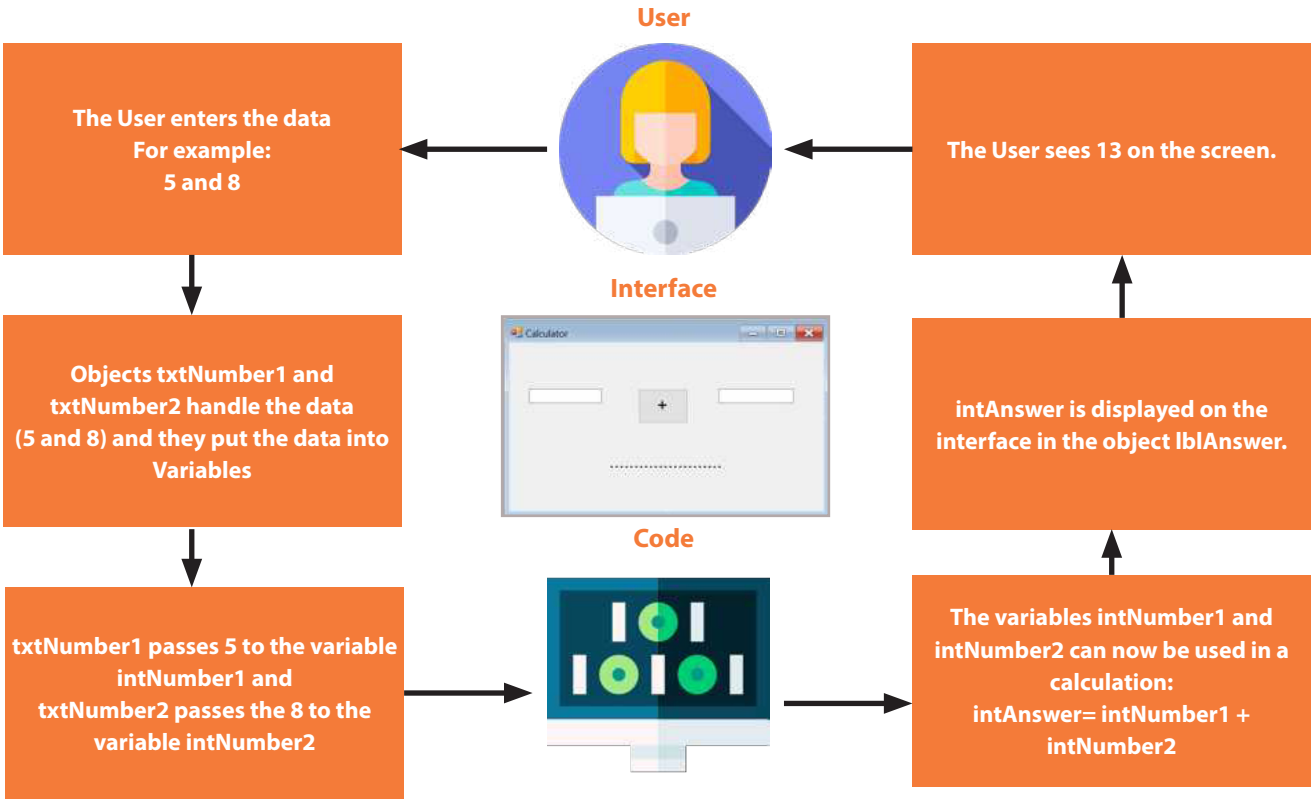
Finally we will add a button. Again we use the same process:

1. Go to the Toolbox.
2. Select the Button.
3. Draw the Button between the two TextBoxes.
4. While the Button is selected go to the Properties Window.
5. Rename the Button "btnAdd".
6. Change the Text property to "+".

You should have something that looks like the screen diagram below.



The Role of Objects and Variables



We have completed the interface. The diagram above illustrates the role that objects and variables have in programming. An object is used on the interface. It allows the user to interact with the code. The objects will assign the data to variables. The variables can be used to process the calculations. Once the data is processed it must then passed on to objects on the screen so that the data can be displayed for the user to see.

We can start coding our program.

A Visual Basic program requires FOUR sections:

1. Declare the variables.
2. Input the data.
3. Process the data.
4. Output the processed data.

We know we need three objects to handle the input and output of the data, so we will probably need three variables to handle the data for processing.

In the diagram above there are three variables identified:

- intNumber1
- intNumber2
- intAnswer

We are using the same approach to naming our variables as we did naming our objects. The “int” indicates an integer data type. The “Number1” identifies which value and it’s association with a corresponding object. All of our variables will be handling integers so we need to declare them as integers in our code.

To begin coding we need to identify which object will execute the code. We have added a button which is designed to execute code when clicked by the user.

Simply double click on your button and a new window will open so you can type your code in.

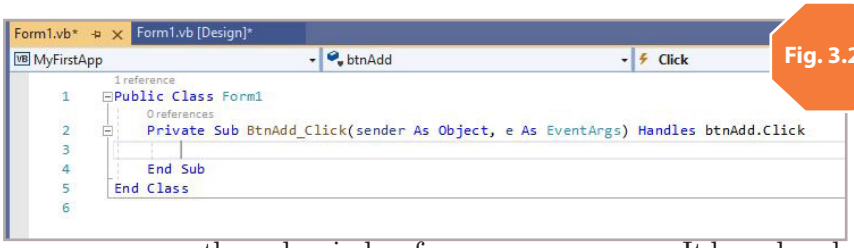
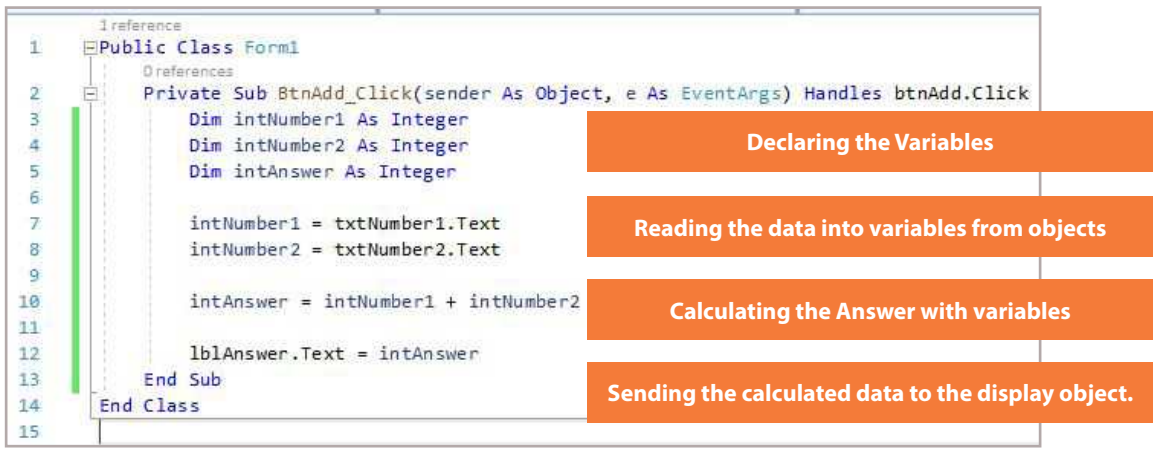


Fig. 3.27

In Fig. 3.27 above, you can see the code window for our new program. It has already written some lines of code for us. On Line 1 is Identifies the Public Class as Form 1. This is the name of our Form that we are currently using. Line 2 is a private sub-routine that will execute when BtnAdd is clicked. Line 4 ends the sub-routine and Line 5 ends the whole program. Programs can have many sub-routines.

We are going to write our code between the Private Sub BtnAdd_Click and End Sub.

First we need to declare the variables. We use Dim which is short for dimension. It will become clearer why, when you learn more about data structures later in the Specialist subjects.



In the code above, lines 3, 4 and 5 you can see how each variable is declared as an integer. Lines 7 and 8 send the data from the objects to the variables. Line 10 calculates the addition and outputs the answer into the variable intAnswer. Line 12 sends the answer to the label object on the screen. You will notice that the property ".Text" is identified when accessing data from an object.

Below in Fig. 3.28, you can see we have changed our interface a little and added more code. A heading is added using a label from the toolbox. The font is larger and this was done by accessing the Font property.

Three more buttons have been added to allow the user to multiply, minus and divide. You can see in the code that the buttons are named BtnMultiply, BtnMinus and BtnDivide (circled). Each button has its own subroutine, and you will notice that the data type has changed. Now that we have a "divide" process, we can no longer be working with integers for the Answer variable. Double is the VB.net version of decimal number data type.

```
Private Sub BtnMultiply_Click(sender As Object, e As EventArgs) Handles BtnMultiply.Click
    Dim dblNumber1 As Double
    Dim dblNumber2 As Double
    Dim dblAnswer As Double

    dblNumber1 = txtNumber1.Text
    dblNumber2 = txtNumber2.Text

    dblAnswer = dblNumber1 * dblNumber2

    lblAnswer.Text = dblAnswer
End Sub

Private Sub BtnMinus_Click(sender As Object, e As EventArgs) Handles BtnMinus.Click
    Dim dblNumber1 As Double
    Dim dblNumber2 As Double
    Dim dblAnswer As Double

    dblNumber1 = txtNumber1.Text
    dblNumber2 = txtNumber2.Text

    dblAnswer = dblNumber1 - dblNumber2

    lblAnswer.Text = dblAnswer
End Sub

Private Sub BtnDivide_Click(sender As Object, e As EventArgs) Handles BtnDivide.Click
    Dim dblNumber1 As Double
    Dim dblNumber2 As Double
    Dim dblAnswer As Double

    dblNumber1 = txtNumber1.Text
    dblNumber2 = txtNumber2.Text

    dblAnswer = dblNumber1 / dblNumber2

    lblAnswer.Text = dblAnswer
End Sub
End Class
```

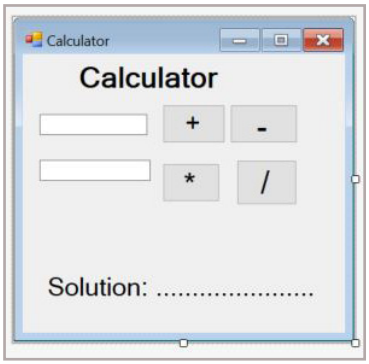


Fig. 3.28

Advanced

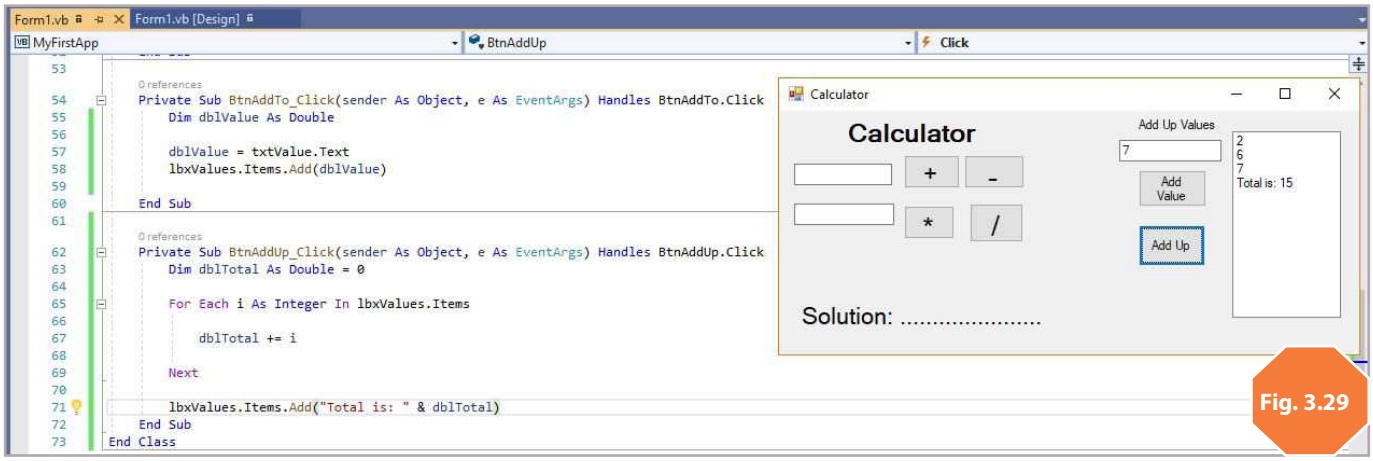


Fig. 3.29

Using Loops with ListBoxes

In Fig. 3.29 above, you can see the program interface has been extended on the right. It allows the user to enter values using the "Add Value" button. Each value is displayed in the ListBox object. The "Add Up" button adds up all the values in the ListBox. ListBoxes are really useful. They are simple objects that can hold and display many data items.

The code to add each value is on lines 55 - 58. We need to declare the value as a decimal in line 55, then we input the data on line 57 from the object txtValue to the variable dblValue. On line 58 we add the value to the ListBox named "lbxValues". We are using some properties here: "Items" and function "Add."

In lines 63 - 71 we use iteration, or a loop, to add up all the values stored and displayed in lbxValues. This time we have a new variable dblTotal declared in Line 63 as a double and set to zero. Our loop is called a FOR EACH loop. This means it will repeat for each item in the list box. Line 65 identifies a counter variable called "i" which identifies each item in the ListBox, lbxValues. Since this is a loop, we only need one line of code on 57: it adds "i" to the dblTotal. We have used a compound function (+=) to avoid writing the full code line: dblTotal = dblTotal + i.

On line 69, "Next" returns the loop instruction back to line 65. If there are no more items in lbxValues, it will move to Line 71. This final line of the sub-routine adds the text "Total is: " and the value calculated and stored in variable dblTotal. The outcome can be seen in the interface.

Conditions & IF Statements

We are going to start a new application. This one will be a pizza ordering app. In this application we will use what we learned in the Calculator App and add some new objects such as CheckBoxes, RadioButtons, PictureBoxes and introduce decision control structures using CASE and IF.

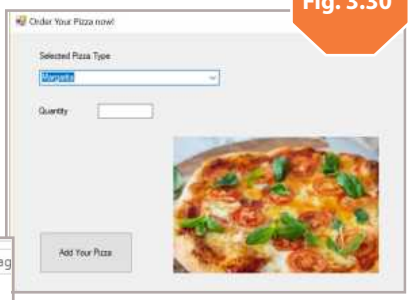
In Fig. 3.30 you can see the beginnings of our Pizza App. We are using an object called a ComboBox to allow the user to select a type of pizza. There is also an object called a PictureBox which will display an image that is associated with the selected pizza type.

The images are stored in a folder called "images" which is then stored in the "Debug" folder inside the "bin" folder which is inside the PizzaApp folder. This will make the images easy to access from your code.

Objects include: ComboBox1, txtQuantity, pbxPizza and btnAdd.

The ComboBox has a property called "Items". You can simply type in the list you want to appear in the CombBox in this property.

Fig. 3.30



Advanced

In Fig. 3.31, is code that controls what happens when a selection is made by the user in the ComboBox. Line 3 identifies the ComboBox name and SelectedIndex. All computer indexes begin at zero. We have four types of pizza (Margarita, Pepperoni, Hawaiian and Vegie) therefore we have four cases. The first case is Case 0, the second case is Case 1 etc. You can see our Case for each selection on lines 4, 13, 21 and 29.

Whatever code we place for each Case, will be executed if the user makes that case selection.

We have created a little mini program in each Case. You can see they are all the same except for the path to the images in the Debug folder.

```
1   Public Class PizzaOrderApp
2       Private Sub ComboBox1_SelectedIndexChanged(sender As Object, e As EventArgs) Handles ComboBox1.SelectedIndexChanged
3           Select Case ComboBox1.SelectedIndex
4               Case 0
5                   Dim ImagePath As String = "images/margarita.jpg"
6                   Dim img1 As Bitmap
7                   Dim newImage As Image = Image.FromFile("images/margarita.jpg")
8
9                   img1 = New Bitmap(ImagePath)
10                  pbxPizza.ImageLocation = ImagePath
11                  pbxPizza.Image = newImage
12
13              Case 1
14                  Dim ImagePath As String = "images/pepper.jpg"
15                  Dim img1 As Bitmap
16                  Dim newImage As Image = Image.FromFile("images/pepper.jpg")
17
18                  img1 = New Bitmap(ImagePath)
19                  pbxPizza.ImageLocation = ImagePath
20                  pbxPizza.Image = newImage
21              Case 2
22                  Dim ImagePath As String = "images/hawaiian.jpg"
23                  Dim img1 As Bitmap
24                  Dim newImage As Image = Image.FromFile("images/hawaiian.jpg")
25
26                  img1 = New Bitmap(ImagePath)
27                  pbxPizza.ImageLocation = ImagePath
28                  pbxPizza.Image = newImage
29              Case 3
30                  Dim ImagePath As String = "images/vegie.jpg"
31                  Dim img1 As Bitmap
32                  Dim newImage As Image = Image.FromFile("images/vegie.jpg")
33
34                  img1 = New Bitmap(ImagePath)
35                  pbxPizza.ImageLocation = ImagePath
36                  pbxPizza.Image = newImage
37          End Select
38      End Sub
```

Fig. 3.31

Each case will access the correct image and display it in the PictureBox; pbxPizza. We are using the same PictureBox object pbxPizza, so we need to identify the path to the image files as a variable "ImagePath". This means we can replace the image in pbxPizza each time a new selection is made.

We now need to think about all the variables we need to calculate the cost of the order. In Fig. 3.32, you can see four more variables are listed under the Public Class on line 1. We have dblPizzaPrice, the price of each individual pizza; intQuantity , the quantity of each pizza selected; dblCost is the total cost of the order of one type of pizza; while finally, dblTotalCost is the total amount for the full order.

For example if someone orders two Hawaiian pizzas and Vegie pizza:

dblCost = dblPizzaPrice * intQuantity

dblTotalCost += dblCost

These variables are declared outside of the Private sub-routines, which makes them accessible to all the routines and they do not need to be declared inside the subs. These are now Public Variables. In Fig. 3.32 you can also see some green code on lines 9 and 18. These are called comments. They are included to make the code easier to read. If you use a single inverted comma at the beginning of a line, it will not be executed. This is a good way of leaving code in your program, but 'turning it off' to test other aspects of the program.

Here you can see the comments are identifying the section of code as "Image Display Code". This will be handy when we are editing later. You can also see that each Case allocates a value to dblPizzaPrice. This allows for each pizza to be a different price.

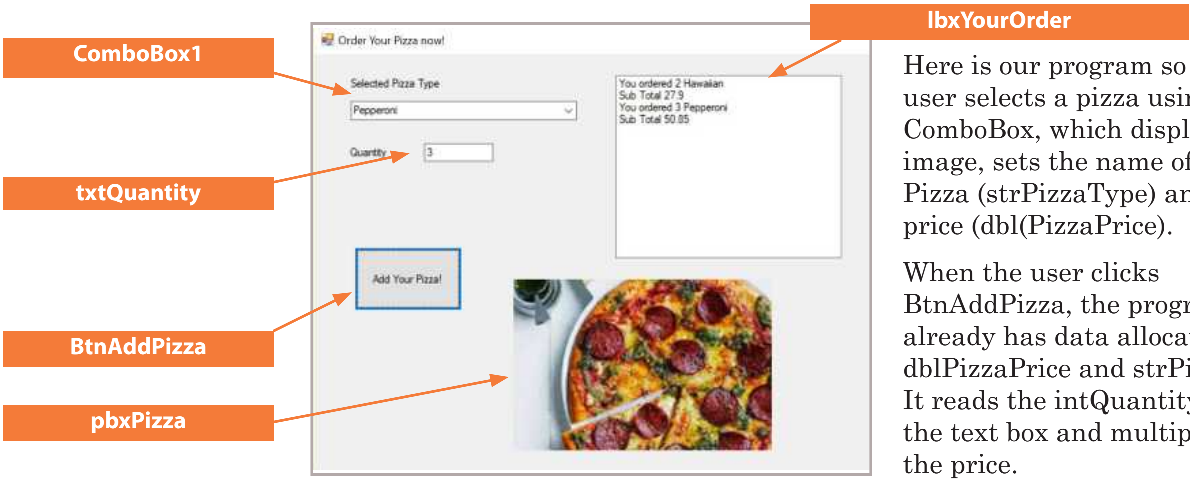
```
1   Public Class PizzaOrderApp
2       Dim dblPizzaPrice As Double
3       Dim strPizzaType As String
4       Dim intQuantity As Integer
5       Dim dblCost As Double
6       Dim dblTotalCost As Double
7       Private Sub ComboBox1_SelectedIndexChanged(sender As Object, e As EventArgs) Handles ComboBox1.SelectedIndexChanged
8           Select Case ComboBox1.SelectedIndex
9               Case 0
10                  ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Image Display Code Margarita
11                  Dim ImagePath As String = "images/margarita.jpg"
12                  Dim img1 As Bitmap
13                  Dim newImage As Image = Image.FromFile("images/margarita.jpg")
14                  img1 = New Bitmap(ImagePath)
15                  pbxPizza.ImageLocation = ImagePath
16                  pbxPizza.Image = newImage
17                  ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Sets the Price of the Margarita Pizza Type
18                  dblPizzaPrice = 15.95
19                  strPizzaType = "Margarita"
20                  ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
21              Case 1
22                  ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Image Display Code Pepperoni
23                  Dim ImagePath As String = "images/pepper.jpg"
24                  Dim img1 As Bitmap
25                  Dim newImage As Image = Image.FromFile("images/pepper.jpg")
26                  img1 = New Bitmap(ImagePath)
27                  pbxPizza.ImageLocation = ImagePath
28                  pbxPizza.Image = newImage
29                  ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Sets the Price of the Pepperoni Pizza Type
30                  dblPizzaPrice = 16.95
31                  strPizzaType = "Pepperoni"
32                  ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
33
34              Case 2
35                  ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Image Display Code Hawaiian
36                  Dim ImagePath As String = "images/hawaiian.jpg"
37                  Dim img1 As Bitmap
38                  Dim newImage As Image = Image.FromFile("images/hawaiian.jpg")
```

Fig. 3.32

Public variables

In each Case an image file is allocated for display, the price is set and the name of the pizza is set.

Green comments make the code easier to read.



Here is our program so far: the user selects a pizza using the ComboBox, which displays an image, sets the name of the Pizza (strPizzaType) and the price (dbl(PizzaPrice).

When the user clicks BtnAddPizza, the program already has data allocated to dblPizzaPrice and strPizzaType. It reads the intQuantity from the text box and multiplies it by the price.

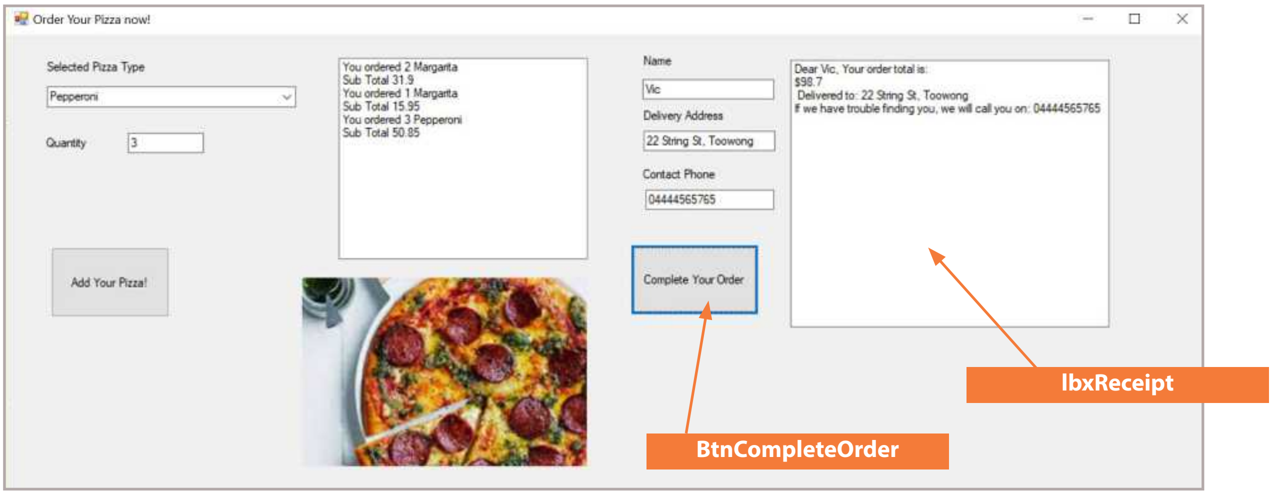
When we send the name of the pizza and the quantity to the lbxYourOrder, we need to write some text and add spaces between the data. We must always use "&" between text and a variable when sending to the screen for display. These are added line by line to the ListBox. Each time the button is clicked, it adds the latest selection and adds the costs for each pizza type. We now need to add up the total cost of the order. In our Add Your Pizza button we need to add: dblTotalCost += dblCost

```
ublic Class PizzaOrderApp
    Dim dblPizzaPrice As Double
    Dim strPizzaType As String
    Dim intQuantity As Integer
    Dim dblCost As Double
    Dim dblTotalCost As Double
    0 references
    Private Sub ComboBox1_SelectedIndexChanged(sender As Object, e As EventArgs) Handles ComboBox1.SelectedIndexChanged
        Select Case ComboBox1.SelectedIndex
            Case 0
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Image Display Code Margarita
                Dim ImagePath As String = "images/margarita.jpg"
                Dim img1 As Bitmap
                Dim newImage As Image = Image.FromFile("images/margarita.jpg")
                img1 = New Bitmap(ImagePath)
                pbxPizza.ImageLocation = ImagePath
                pbxPizza.Image = newImage
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Sets the Price of the Margarita Pizza Type
                dblPizzaPrice = 15.95
                strPizzaType = "Margarita"
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
            Case 1
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Image Display Code Pepperoni
                Dim ImagePath As String = "images/pepper.jpg"
                Dim img1 As Bitmap
                Dim newImage As Image = Image.FromFile("images/pepper.jpg")
                img1 = New Bitmap(ImagePath)
                pbxPizza.ImageLocation = ImagePath
                pbxPizza.Image = newImage
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Sets the Price of the Pepperoni Pizza Type
                dblPizzaPrice = 16.95
                strPizzaType = "Pepperoni"
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''

            Case 2
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Image Display Code Hawaiian
                Dim ImagePath As String = "images/hawaiian.jpg"
                Dim img1 As Bitmap
                Dim newImage As Image = Image.FromFile("images/hawaiian.jpg")
                img1 = New Bitmap(ImagePath)
                pbxPizza.ImageLocation = ImagePath
                pbxPizza.Image = newImage
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Sets the Price of the Hawaiian Pizza Type
                dblPizzaPrice = 13.95
                strPizzaType = "Hawaiian"
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
            Case 3
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Image Display Code Vegie
                Dim ImagePath As String = "images/vegie.jpg"
                Dim img1 As Bitmap
                Dim newImage As Image = Image.FromFile("images/vegie.jpg")
                img1 = New Bitmap(ImagePath)
                pbxPizza.ImageLocation = ImagePath
                pbxPizza.Image = newImage
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''Sets the Price of the Vegie Pizza Type
                dblPizzaPrice = 14.95
                strPizzaType = "Vegie"
                ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
        End Select
    End Sub

    0 references
    Private Sub BtnAddPizza_Click(sender As Object, e As EventArgs) Handles BtnAddPizza.Click
        intQuantity = txtQuantity.Text

        lbxYourOrder.Items.Add("You ordered " & intQuantity & " " & strPizzaType)
        dblCost = intQuantity * dblPizzaPrice
        lbxYourOrder.Items.Add("Sub Total " & dblCost)


    End Sub
nd Class
```

We also need the customer details so we can deliver the pizza to them. Let's use a new section of the Form to create a complete receipt for the order in a new ListBox.

When we double-click on the Add Your Pizza button we can enter the code to calculate the costs of the pizza order and display the information in the ListBox lbxYourOrder.

Advanced




```
0 references
Private Sub BtnAddPizza_Click(sender As Object, e As EventArgs) Handles BtnAddPizza.Click

    intQuantity = txtQuantity.Text '''''''''''''''''''''''''''''''''''''''''''''''''''''''''''' Declares the Quantity variable and reads data in from textbox

    lbxYourOrder.Items.Add("You ordered " & intQuantity & " " & strPizzaType) ''''''''''''''''' Writes a line to the listbox with quanitity and pizza type

    dblCost = intQuantity * dblPizzaPrice ''''''''''''''''''''''''''''''''''''''''''''''''''''' Calculates the subtotal

    lbxYourOrder.Items.Add("Sub Total " & dblCost) '''''''''''''''''''''''''''''''''''''''''''' Displays the subtotal

    dblTotalCost += dblCost '''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''' Add the subtotal to the Final Cost of the Order.

End Sub
0 references
Private Sub BtnCompleteOrder_Click(sender As Object, e As EventArgs) Handles BtnCompleteOrder.Click

    '''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''''' Reads in the Name, Address and Phone.
    Dim strName As String = txtName.Text
    Dim strAddress As String = txtAddress.Text
    Dim strPhone As String = txtPhone.Text

    lbxReceipt.Items.Add("Dear " & strName & ", Your order total is: ") '''''''''''''''''''''''' Displays the name of customer
    lbxReceipt.Items.Add("$" & dblTotalCost) '''''''''''''''''''''''''''''''''''''''''''''''''' Displays the Total Cost of the order
    lbxReceipt.Items.Add(" Delivered to: " & strAddress) '''''''''''''''''''''''''''''''''''''' Displays the address
    lbxReceipt.Items.Add("If we have trouble finding you, we will call you on: " & strPhone) '' Displays the phone contact

End Sub
End Class
```

We have nearly finished our Pizza App. So far it does everything we want it to do: reads in the data, calculates the data and displays the results on the screen. However! We have allowed for every contingency. What if the user has ordered three Margarita pizzas when they only wanted two? We need to provide the user with a button to clear their order and start again. See Fig. 3.33 where the subtotal and the total cost is re-set to zero. The lbxYourOrder is cleared of all items.

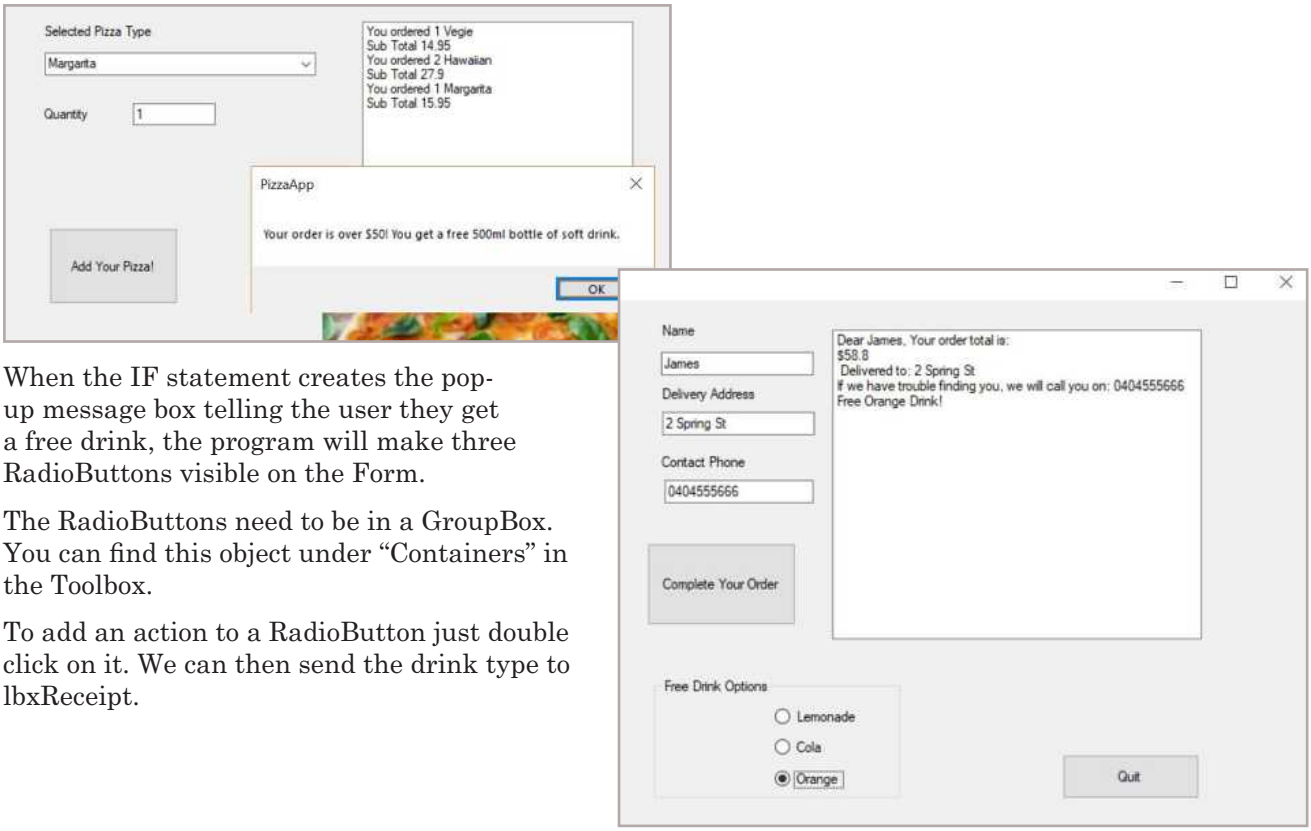
Fig. 3.33

```
0 references
Private Sub BtnClear_Click(sender As Object, e As Event
    dblCost = 0
    dblTotalCost = 0
    lbxYourOrder.Items.Clear()
End Sub
End Class
```

But wait, there's more! Your pizza store has a special offer. If the Total Cost of an order is over $50 they get a free bottle of soft drink. This means we need to test a condition in an IF Statement to decide if the customer gets the free drink. This needs to happen when the order is completed, so let's edit BtnCompleteOrder. Below you can see the condition is dblTotalCost >= 50. If it is true, the offer is made. If it is false, the customer will get a different pop-up message.

Now we need to add options for the customer to choose from. If you are offering the user a free bottle of drink, give them the option to choose which one. This is where we add new objects on the Form that are invisible until the customer qualifies for the drink.

```
If dblTotalCost >= 50 Then
    MsgBox("Your order is over $50! You get a free 500ml bottle of soft drink.") ''''''''''' The offer is made when the condition is TRUE
Else
    MsgBox("If you order is over $50 you could get a free 500ml bottle of soft drink!") ''''' Message when the condition is FALSE
End If
```



When the IF statement creates the pop-up message box telling the user they get a free drink, the program will make three RadioButtons visible on the Form.

The RadioButtons need to be in a GroupBox. You can find this object under "Containers" in the Toolbox.

To add an action to a RadioButton just double click on it. We can then send the drink type to lbxReceipt.

```
87          If dblTotalCost >= 50 Then
88              MsgBox("Your order is over $50! You get a free 500ml bottle of soft drink.") '''''''''' The offer is made when the condition is TRUE
89
90              gbxFreeDrinkOptions.Visible = True
91              rbnCola.Visible = True
92              rbnLemonade.Visible = True
93              rbnOrange.Visible = True
94          Else
95              MsgBox("If you order is over $50 you could get a free 500ml bottle of soft drink!") ''''' Message when the condition is FALSE
96          End If
97
```

```
102         Private Sub BtnClear_Click(sender As Object, e As EventArgs) Handles BtnClear.Click
103             dblCost = 0
104             dblTotalCost = 0
105             lbxYourOrder.Items.Clear()
106             lbxReceipt.Items.Clear()
107         End Sub
108
109         Private Sub RbnLemonade_CheckedChanged(sender As Object, e As EventArgs) Handles rbnLemonade.CheckedChanged
110             lbxReceipt.Items.Add("Free Lemonade Drink!")
111         End Sub
112
113         Private Sub RbnCola_CheckedChanged(sender As Object, e As EventArgs) Handles rbnCola.CheckedChanged
114             lbxReceipt.Items.Add("Free Cola Drink!")
115         End Sub
116
117         Private Sub RbnOrange_CheckedChanged(sender As Object, e As EventArgs) Handles rbnOrange.CheckedChanged
118             lbxReceipt.Items.Add("Free Orange Drink!")
119         End Sub
120     End Class
```

All we need is a Quit button and we are done. A very simple function - see below.

```
121         Private Sub BtnQuit_Click(sender As Object, e As EventArgs) Handles BtnQuit.Click
122             Close()
123         End Sub
124     End Class
```

Don't forget there are plenty of VB tutorial websites online.

A good starting place is: **https://www.vbtutor.net/vb2019/vb2019tutor.html**

Web Development III

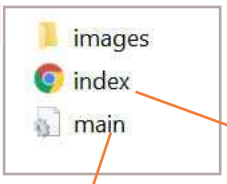
If you have completed the two chapters on web development, you will be familiar with the following:

- Basic HTML to organise content, make hyperlinks and use tables.
- Basic CSS to format text, colours and links.
- Saving and naming files so the HTML can create links

In this chapter we are going to be exploring the responsiveness of a web page. Most web sites are browsed using mobile phones and tablets, so pages need to be designed to respond to the size of the screen, allowing the end user to easily access all the content.

We will learn in this chapter some more advanced CSS and HTML using classes and a little JavaScript. It is important that you have access to a coding text editor such as Notepad++, Atom or Brackets. These are all free text editors designed for coding.

Fig. 3.34




```
<!DOCTYPE html>
<html>
<head>
<meta name="viewport" content="width=device-width, initial-scale=1">
<link rel="stylesheet" type="text/css" href="main.css" />

</head>
<body>
<div><h1>Hare Hair Here</h1>
</div>
<p>
<div class="topnav" id="myTopnav">
  <a href="index.html" class="active">Home</a>
  <a href="stylists.html">Stylists</a>
  <a href="booking.html">Make a Booking</a>

  <a href="javascript:void(0);" class="icon" onclick="myFunction()">
    <img src="images/menu.jpg" style="max-width:100%; height;auto;">
  </a>
</div>
</body>
</html>
```

```
.topnav {
  overflow: hidden;
  background-color: #333;
}

.topnav a {
  float: left;
  display: block;
  color: #f2f2f2;
  text-align: center;
  padding: 14px 16px;
  text-decoration: none;
  font-size: 17px;
}

.topnav a:hover {
  background-color: #fbd948;
  color: black;

  transition-duration: 0.4s;
}

.topnav a.active {
  background-color:#cc7a00;
  color: white;

}

.topnav .icon {
  display: none;
}

@media screen and (max-width: 600px) {
  .topnav a:not(:first-child) {display: none;}
  .topnav a.icon {
    float: right;
    display: block;
  }
}

@media screen and (max-width: 600px) {
  .topnav.responsive {position: relative;}
  .topnav.responsive .icon {
    position: absolute;
    right: 0;
    top: 0;
  }
  .topnav.responsive a {
    float: none;
    display: block;
    text-align: left;
  }
}
```

CSS properties to control the class "topnav"

```
.button {
  border: none;
  color: white;
  padding: 10px 20px;
  text-align: center;
  text-decoration: none;
  display: inline-block;
  font-size: 12px;
  margin: 4px 2px;
  cursor: pointer;
  width: 70px;
  height: 20px;
  border-radius: 12px;
  transition-duration: 0.4s;
}
.button:hover {
  background-color: #995c00;
  color: white;
}

.buttonM {
  background-color: #cc7a00;
  width: 100px;
  height: 45px;}
```

Fig. 3.34 is a web page index.html supported by a CSS file called main.css and there is an "images" folder containing a small icon called "menu.jpg"

This web page comes with a few additional features. The HTML (above) contains tags. These tags divide the web page into sections. The first section is the heading. The second section is identified as a class called "topnav". This will call up all the "topnav" properties in the CSS file (left).

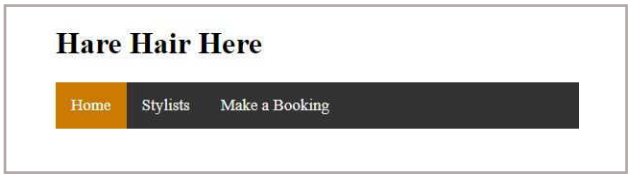
The .topnav property in the CSS file includes colour, link formatting and instructions on how to respond to the screen size. You can see line 33 and 41 in the CSS file "@media screen and (max width:600px)" This controls a menu icon's appearance when the screen is 600 pixels or less. The menu will display vertically. You can see the HTML link to the icon in line 18 above.

The icon is: ☰ You can find plenty of versions of this icon online.

Run the code and see what happens when you make the browser window very narrow.

Basic button controls are also included in the CSS file.

Experiment with the CSS code to see what each property controls, or visit w3schools.org for more information about menu properties.



Advanced

```
<!DOCTYPE html>
<html>
<head>
<meta name="viewport" content="width=device-width, initial-scale=1">
<link rel="stylesheet" type="text/css" href="main.css" />

</head>
<body>
<div><h1>Hare Hair Here</h1>
</div>
<p>
<div class="topnav" id="myTopnav">
  <a href="index.html" class="active">Home</a>
  <a href="stylists.html">Stylists</a>
  <a href="booking.html">Make a Booking</a>

  <a href="javascript:void(0);" class="icon" onclick="myFunction()">
    <img src="images/menu.jpg" style="max-width:100%; height;auto;">
  </a>
</div>


<script>
function myFunction() {
  var x = document.getElementById("myTopnav");
  if (x.className === "topnav") {
    x.className += " responsive";
  } else {
    x.className = "topnav";
  }
}
</script>


</body>
</html>
```

Fig. 3.35

javaScript

Fig. 3.36

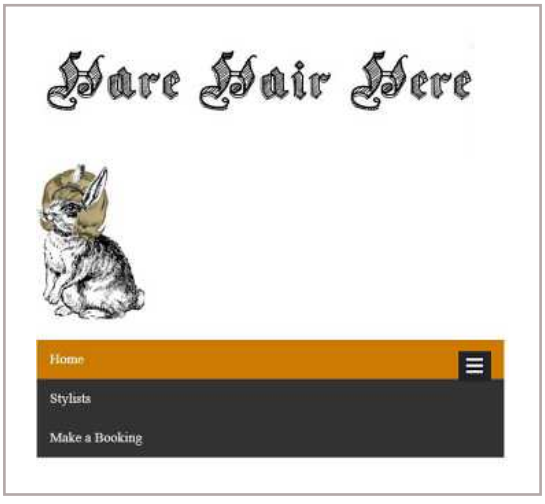


Fig. 3.35 has introduced some javaScript to the HTML document. It is housed in <script> tags and repositions the menu buttons from horizontal to vertical when the screen is less than 600 pixels wide. You can see that the menu icon appears on the right hand side as well.

The heading looked a bit boring, so it has been replaced with two images: “harehairhere.jpg” and “logo.jpg”. This provides a more professional appearance. In Fig.3.36 you can see the difference between a wider screen size and a narrower size.

You can see in the HTML below that has replaced the <H1> header, the image tags included. Inside the image tags are style instructions. These assist in allowing the images to changes size as the screen sizes are narrowed. If the maximum width (the size of the image) does not fit on the screen, it will automatically change the scale of the image.

The next stage is to design controls for the next that controls the content.

```
<div>
<img src="images/harehairhere.jpg" style="max-width:100%;height:auto;">
<img src="images/logo.jpg"style="max-width:100%;height:auto;">
</div>
```

Advanced

Now we can put in some content and a footer. You can see that the images and text are separated on the same lines. This can easily be done with a table. Here we need to use CSS controls on the table and the rows.

You can also see the highlight has moved from “Home” to “Stylist” on the active page. You can see how to identify the active page in the HTML menu below (circled).

In Fig. 3.37 you can see the index.html code from the bottom of the javaScript. Fig. 3.38 is the stylist. html file. Both pages have a footer controlled by a class called “footer”. You can also see that all the image tags include “class = a”. This refers to a CSS property that is on the next page in Fig. 3.39

```
<div class="topnav" id="myTopnav">
  <a href="index.html" >Home</a>
  <a href="stylists.html"class="active">Stylists</a>
  <a href="booking.html">Make a Booking</a>
  <a href="javascript:void(0);" class="icon" onclick="myFunction()">
    <img src="images/menu.jpg" style="max-width:100%; height;auto;">
  </a>
</div>
```

Fig. 3.37

```
</script>

<p>
<div>

<table>
<tr>
<td width=500px><img src="images/CoverImage.jpg" class="a" style="max-width:100%; height;auto;"> </td>
<td width=550px><p style="font-size:1vw;">We provide old fashioned service! Fancy a cup of tea and a chin-wag
with your friends while getting your mop up-do done? Well, Hare Hair Here is the place for you. Enjoy the relaxed
salon facilities and trust you will get your very best hair cut. Let's us give you the look you want. Give us a
call on <b> Ph: 0404555666</b> or use our online booking form.</p>

</tr>

</table>

</div>


<div class="footer">
  <p>Hare Hair Here &copy; 2020</p>
</div>

</body>
</html>
```

Fig. 3.38

```
<p>
<div>

<table>
<tr>
<td width=200px><img src="images/Face1.jpg" class="a" style="max-width:60%; height;auto;"> </td>
<td width=800px><p style="font-size:1vw;">Jessica is a fantastic stylist who has worked in Milan on some very
famous heads including Patricia Arquette and Gwyneth Paltrow. This salon has a lot of bookings for Jessica and
you may not get an appointment for at least one month, so plan ahead to avoid disappointment.</p>

</tr>
<tr>
<td width=200px><img src="images/Face2.jpg" class="a" style="max-width:60%; height;auto;"> </td>
<td width=800px><p style="font-size:1vw;">Trish is a colourist of mammoth proportions. (She's only 5'1" but her
talent is incredible). No matter the state of you hair, Trish can get the result you want. Want to go crazy, we
can provide a wide range of vibrant colours for your next unicorn phase. </p>

</tr>

</table>

</div>


<div class="footer">
  <p>Hare Hair Here &copy; 2020</p>
</div>

</body>
</html>
```

Advanced

Fig. 3.37

```
table{
        background-color: black;
        margin: 10px;
        padding: 10px;
        table-layout:fixed;
}

td{
    padding: 5px;
    margin: 10px;
}
```

```
p {
    font-family: Verdana,Arial, sans-serif;
    font-size: 100%;
    margin: 10px;
    padding: 0px;
    color: white;
```

```
img.a {
    opacity: 0.85;
    border-radius: 8px;
}
```

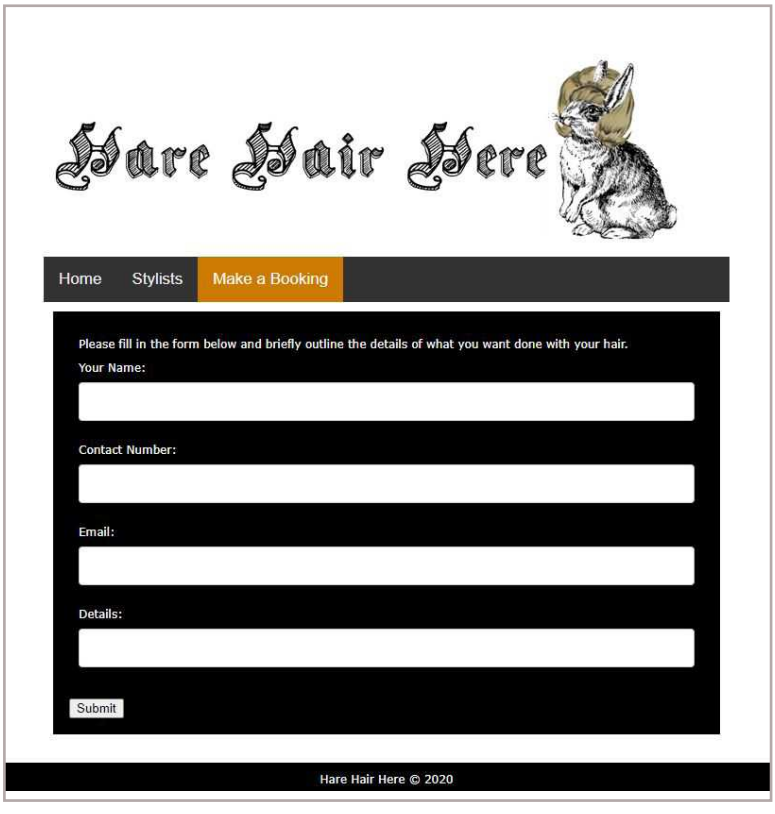
```
.footer {
    position: fixed;
    left: 0;
    bottom: 0;
    width: 100%;
    background-color: black;
    color: white;
    text-align: center;
}
```

In Fig 3.37, you can see the CSS controlling the table, the images, the footer and the paragraphs.

The final page we need to complete is the booking page. We will use HTML Forms and some javaScript to allow users of the website to make a booking.

```
<table>
<tr>
<td width=1000px>

<p>Please fill in the form below and briefly outline the details of what you want done with your hair.</p>

<form id="bookingForm" action="thanks.html">
 <p> Your Name: <input type="text" name="fname"><br><br>
  Contact Number: <input type="text" name="pnumber"><br><br>
  Email: <input type="text" name="email"><br><br>
  Details: <input type="text" name="details"><br><br></p>
  <input type="button" onclick="myFunction()" value="Submit">
</form>

<script>
function myFunction() {
  document.getElementById("bookingForm").submit();
}
</script>

 </td>
</tr>
</table>
```

```
input[type=text], select {
    width: 100%;
    padding: 12px 20px;
    margin: 8px 0;
    display: inline-block;
    border: 1px solid #ccc;
    border-radius: 4px;
    box-sizing: border-box;
}

input[type=submit] {
    width: 100%;
    background-color: #4CAF50;
    color: white;
    padding: 14px 20px;
    margin: 8px 0;
    border: none;
    border-radius: 4px;
    cursor: pointer;
}

input[type=submit]:hover {
    background-color: #45a049;
}
```



Our final page uses HTML Forms. You can see it contains an ID that can be referenced by our function script that will open a new page.

Each input box is declared a text box and given a name. We will not be able to store the data into these variables in this chapter, but in the Specialist chapter eCommerce, you can learn PHP to capture the data and store it.

For now, this form allows the user to input data and direct the browser to a page called thanks.html. Investigate the CSS options above and see how they work.

Advanced

3b. Digital Technology Knowledge

Data Analysis

Every digital system is collecting data on you, me, organisations, products and money. Data Analysis is the process of investigating the data collected and finding key information. There is data online that we can mine for information, or we can collect our own data. It is called primary source data if we collect data ourselves directly from the source. Otherwise, if we collect data from a dataset online, this is called secondary source data - because we did not collect the data directly from the source. In this Data Analysis chapter we are going to focus on collecting our own primary data.

Research Questions

If we are going to collect our own data, we need to decide on what we are researching. It is important that we develop a "Research Question". Writing a good research question means you have something specific that you are investigating. Let's say you're interested in the effects of social media on teenagers; we can design a research question that we can use. There are some steps to writing a good research question. We shall go through them one by one.

Step One: Be specific about what you want to know. Do you want to investigate whether teenagers have more social anxiety now with social media than teenagers in the 80s and 90s before the widespread use of the internet? Do you want to look into the number of hours a teenager spends of social media and whether there is an effect on school results.

Step Two: Decide what you want to know about the specific concern or issue. Let's say we want to know if increased hours per week on social media affects mathematics results in 14 year old students. You can see the general idea has now become very specific. Your primary sources will be students who are 14 years of age. You will look at the number of hours they spend per week on social media and their mathematics results.

Step Three: Now you need to write your investigation topic as a question. Does the number of hours spent using social media negatively affect mathematics results in 14 year old students?

Step Four: Make sure that the question is able to be investigated. There are a number of things we need to ask our primary sources for our research question, can they be answered?

"How many hours per week do you use social media?" This can be answered by looking at an app on your phone, or having a general guess.

"What results do you get in mathematics?" This is tricky! Do we ask them about their latest test result or what they usually get? We need to be more specific here! Maybe we need to ask them for their average results? What if they are generally good at mathematics without trying? These questions can all be answered, but we will need to investigate what questions will be most relevant.

Step Five: Check to make sure your investigation question is not too broad or too narrow. Should we look at middle school students as a group, or just 14 year old students? Should we investigate a particular social media or do we include watching online videos for long periods of time as well?

Activity 1

Tasks:

1. As a class, discuss some interesting social and ethical issues related to digital technology.
2. Create a list of social and ethical issues and relate them to different ages of people.
3. Choose one issue and write a Research Question.

Advanced

Data Collection

There are many ways of collecting data. We can interview people, survey people, observe them or test them doing something. We are going to focus on collecting data using online forms. There are many free online survey forms available online including: Google Forms, Survey Monkey and SoGoSurvey.

To collect data using a survey we need to design our data collection tool. To design a data collection tool is to write the questions and decide how they will be answered by the respondents.

There are two types of questions: open and closed. An open question is designed to elicit any number of answers. For example: "Tell me about your experiences with this product." This sort of question does not identify what sort of an answer is required. A closed question, which is easier to analyse, is designed to get a specific type of answer. For example: "Have you used this product?". This questions can only elicit a response of "yes", "no" or "I don't know". These kinds of answers are countable. We can easily add up how many people said they had used a product. We could then compare that number with the total number of people surveyed and then calculate a percentage. Open questions can provide more detailed information that could further inform you on the issue. It is not advised to ask more than one or two open questions in a survey because they tend to collect too much data and are hard to analyse.

For the most part you will be creating a survey of closed questions. The two main types of closed questions are multiple choice and Likert scale questions. Multiple Choice questions restrict the responses to a short list of options. For example:

Do you catch the train regularly?

- □ Yes, every day.
- □ Yes, every week.
- □ Sometimes, a few times a month.
- □ Rarely, a few times per year.
- □ Never.

The Likert scale is used when a question requires answers on a rating scale.

For example:

Q: I enjoy online shopping				
1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Let's go back to our research question: "Does the number of hours spent using social media negatively affect mathematics results in 14 year old students?" The first question that needs to asked is: "Are you 14 years old and at school?" If the answer is "no" then we do not want their data. This is called a boolean data point, where the answer is either true or false.

We need to know many hours a week they use social media. Here are examples of Multiple Choice and Likert Scale questions.

Q: Which of the following social media do you use?

- □ Instagram
- □ Facebook
- □ Tumblr.
- □ YouTube
- □ Twitter

Q: How do you feel about social media?				
1	2	3	4	5
Hate it!	Not a fan.	It's OK.	It's fun.	Love it!

Activity 1

Task:

Write 10 questions using the Multiple Choice style and the Likert Scale to investigate your research question from Activity 1.

Advanced

Permission

When we collect data from primary sources we are governed by legislation in Australia. The Privacy Act (1988) and the Australian code for the Responsible Conduct of Research (2018) both require that permission is sought when collecting data. If someone was to approach you and ask "Do you mind answering some questions?". You would probably respond with, "Why? & What's it about?"

When you collect data it is important that you get informed consent. The primary source must be informed about a few things before providing consent:

1. Who is collecting the data. This needs to include both the individual and the related organisation.
2. What the data will be used for, such as a school assignment.
3. How their privacy will be protected.
4. How their data will be kept secure.
5. That the data will not be used for any other purpose.

When we put this information together this is called a Participation Information Statement. The following is an example :

Participation Information Statement

The Streetbank High School Year 9 Class is investigating the effects of social media on mathematics results in 14 year old students. John Smith is a participant in this study and will be collecting data for analysis to produce a report. The purpose of this report is to create and submit an assessment task for the Year 9 subject Digital Technology. All data collected will be kept private, with no identifying information that an be traced to you. All data will be kept secure on the school network protected by individual password access. No data will be used for any other purpose and all data will be destroyed once the submitted report task has been assessed.

Consent Form

We are going to use our Participation Information Statement on a consent form before we begin collecting the data. This is where you get a record of the source's informed consent. The source must agree that they have been informed and understand the nature of the investigation. In Fig. 3.38 below, is an example of a consent form that can be used for collecting primary source data.

Fig. 3.38

CONSENT FORM

Name of Organisation: Streetbank High School **Investigator:** John Smith

Project Title: Does the number of hours spent using social media negatively affect mathematics results in 14 year old students?

Participation Information Statement: The Streetbank High School Year 9 Class is investigating the effects of social media on mathematics results in 14 year old students. John Smith is a participant in this study and will be collecting data for analysis to produce a report. The purpose of this report is to create and submit as an assessment for the Year 9 subject Digital Technology. All data collected will be kept private, with no identifying information that an be traced to you. All data will be kept secure on the school network protected by individual password access. No data will be used for any other purpose and will be destroyed once the submitted report task has been assessed.

I consent to participate in the project identified above.

I agree to be interviewed by John Smith.

I agree to provide information about my social media use and mathematics results.

I understand that any data I provide will be stored securely and will not be used for any other purpose.

I understand that the data will be destroyed after the report has been assessed.

I acknowledge that the purpose of this project is for educational purposes only.

By signing this consent form I agree to participate in the project.

Participant Name:.....

Signature and date: .....

Activity 3

Task:

Write a Consent Form for your investigation that contains a Participation Information Statement.

Advanced

Security of Data

When we collect data that is of a private nature we are legally bound to keep the data secure. There are two kinds of security controls: Physical and Logical.

Physical controls include:

- Locked doors to keep unauthorised access from devices where data is stored.
- Screen access limited to only authorised users of the data.
- Storing back-up data at another locked location in case a device is corrupted.

Logical controls include:

- Password access to devices storing data.
- Password access to networks where the data can be accessed from.
- Encryption when data is stored or transferred.
- Firewall to monitor traffic in and out of a network where data is stored.
- Anti-malware software to protect from viruses, bots and trojans.

Activity 4

Task:

Identify what you can do to keep the data you collect safe.

Data Types

Before we send out our online survey to collect data, we need to be aware of how our data will be formatted. We need to be aware of the data types we will be manipulating in the spreadsheet. In Fig. 3.39 this question will result in values. You will get a certain number of recipients selecting each one of the options. This means you get five values from this one question. How will you present this data? How will you integrate the data from this question with other questions? How will you know who selected "5: Love it" and also replied with low mathematics results?

Q: How would you describe your average maths results?		
Low	Average	High

Q: How do you feel about social media?				
1	2	3	4	5
Hate it!	Not a fan.	It's OK.	It's fun.	Love it!

Fig. 3.39

At the beginning of this chapter we explored some spreadsheet data manipulation techniques. Let's look at how conditional formatting could assist us in this. In Fig. 3.39, we can see some data for each of 19 primary sources on two questions. The data has been formatted red for loving social media and dark green for not liking social media. The math results show dark green for high results and red for low results. Then the data was sorted by the values in column B. Math results were not able to be sorted from High to Low because the data is text and it would have been sorted alphabetically. You can see that the 7 participants who most enjoy social media are lined up with the Average and Low math results, while the most people who responded with High math results have identified their fondness for social media to be between 1 and 3. This analysis shows us more than percentages on each question.

	A	B	C
1	Questions	Social Media	Math Results
2	1	5	Low
3	7	5	Low
4	9	5	Average
5	11	5	Average
6	16	5	Average
7	17	5	Low
8	18	5	Low
9	6	4	Low
10	8	4	Low
11	12	4	High
12	15	4	Average
13	3	3	High
14	4	3	Average
15	14	3	Average
16	19	3	High
17	5	2	Average
18	10	2	High
19	2	1	Average
20	13	1	High

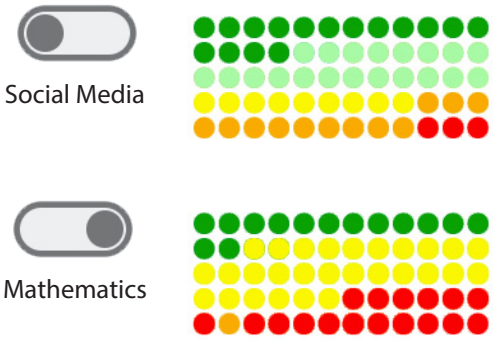
Advanced

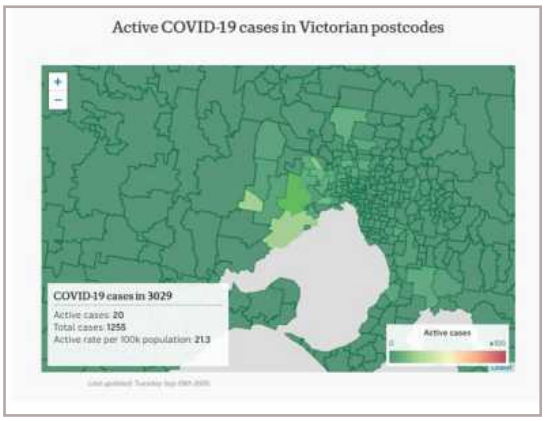
Visualisation

So far we have looked at infographics to present our data. Infographics are static designs that incorporate icons, shapes, line, text and data to inform the viewer. These are used to easily digest complex information.

A visualisation is a dynamic or interactive infographic. It allows the user to interact with the data to

Fig. 3.40

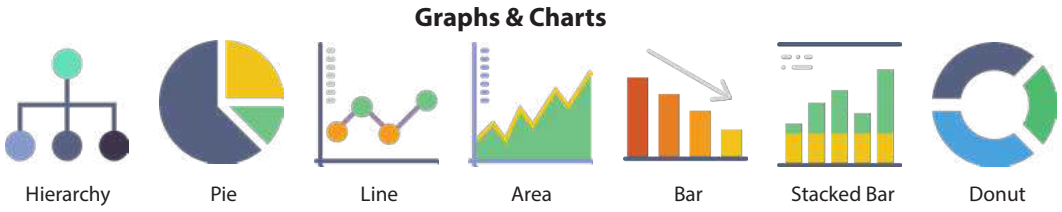


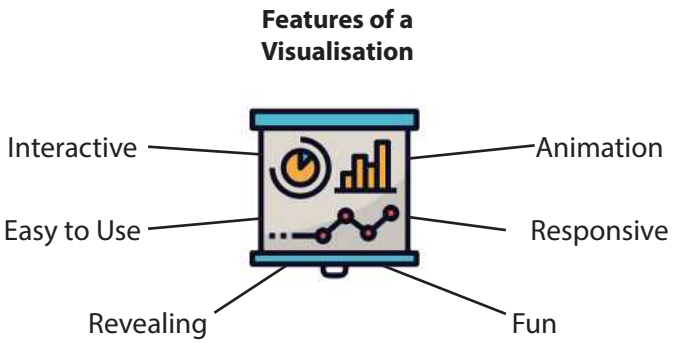


In Fig. 3.40 is an example of how interactivity could present the data from Fig. 3.39. Each dot represents a person surveyed and the matrix of dots can provide a visual representation of their results as a whole. Also to add interactivity, a toggle button allow the user to select which data is displayed. This interactive element provides a visceral experience for the user who can see the relationships between the social media results and the mathematics results.

On the right, you can see an interactive map from the ABC News website. The user can select a postcode area on the map and it displays the number of active COVID-19 cases in that area. This is an active visualisation. Source: https://www.abc.net.au/news/2020-03-17/coronavirus-cases-data-reveals-how-covid-19-spreads-in-australia/ (Accessed 1/10/2020)

Fig. 3.41





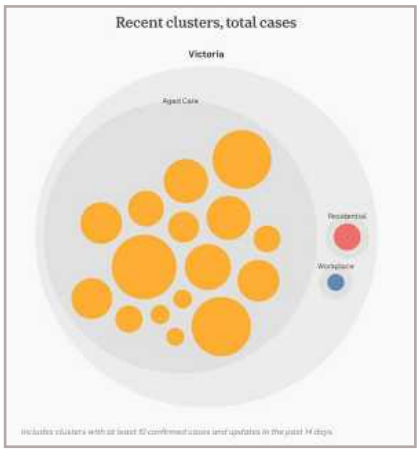


Fig. 3.41 outlines a wide range of graphs and charts that can appear in a visualisation. In an infographic they appear static and unchanging, while in a visualisation the graphs can become animated, interactive, and responsive to input form the user. With further use of the visualisation, it should reveal the information that is hidden within the data. Finally, if the visualisation is fun and engaging to use, then it is more likely to be successful. Graphs are not restricted to these examples, Fig. 3.41, also includes a bubble chart supplied by the ABC News COVID report website. Although not detailed, it clearly shows the outbreak situations relatively through bubble size.

Activity 5

Task:

Brainstorm how you could make the data for your investigation, more interactive.

Advanced

Transactional Processing Systems

The world revolves around databases. Everything we do, everything we use is touched by databases. Until we had computerised databases, companies had to employ dozens of people to process employee wages. An organisation would be limited by the number of staff they could employ. After a certain number, it would no longer be cost-effective because the company would have to pay even more wage clerks just to process the all wages. With the advent of computerised databases, companies grew into large multinational conglomerates. Commerce became more cost-effective and overheads were diminished.

Every bank, every store, every school, every employer uses complex databases. Every time you use social media, or buy a product online you are interacting with relational databases. These databases are designed to manage transactions or bookings. Let's use work through an example we are all familiar with; a school timetable system. We shall start very small and simply look at one aspect of the database. Timetable software is extraordinarily complex, which you will discover as we investigate the design of a database that can timetable teachers into rooms. Let's ignore different periods throughout the day for now. The transaction will be the allocation of a teacher to a room at any one time.

Entities and Transactions

An entity is a person or thing. In an online eCommerce database, the entities would be products and customers. In a library database, the entities would be library members and the books being borrowed. In our example where we allocate teachers to classrooms, the entities would be the teachers and the classrooms.

A transaction is a process that creates a record that links two entities, such as a customer buying a product, a library member borrowing a book, or the allocation of a teacher to a classroom.

Tables

A table is a flat-file database that holds data. The table is organised into fields and records.

Fig. 3.42

Field

Record

Name	Address	Email	Phone
Jue Cheng	195 Calypso Place	jCheng@centre.com	0444888333
Manpreet Singh	15 High St	MSbusiness@tps.com	0404232343
Marika Saarivirta	12/3 Pringle Ave	Saari@hotmail.com	0440444444
James Kanettie	2 Sprint St	James@gmail.com	0404555666

In Fig. 3.42, you can see a basic entity table. Each record describes a person. The entire table is designed around the fields. The fields define what data will be collected on each entity.

When designing a table you create a Data Dictionary. Below in Fig 3.43 you can see how the table in Fig. 3.42 is designed. The field names are identified, and then the data types. The size of each field is the maximum number of characters (or bytes) in each field. Finally we include a brief description of each field. This may seem superfluous, but when you are developing large complex systems, a description will come in very handy.

In Fig. 3.43, all the data types are "text". This is because each field is made up of all kinds of characters. If we were to include Date of Birth, the field's data type would be date/time and could be used to calculate the age of the person.

Fig. 3.43

Data Dictionary

Field Name	Data Type	Size	Description
Name	text	20	Customer Name
Address	text	100	Postal Address
Email	text	20	Contact Email
Phone	text	10	Contact Phone

Relationships

What makes a relational database more useful than a workbook of spreadsheets is the relationships we can create between the tables.

In Fig 4.44 below, you can see a table of data collected at a library. You can see on the 2nd of October James Smith borrowed "Harry Potter Combs his Hair" and returned it on the 3rd October. Each record in this table records data about the library member and the book they borrowed, when they borrowed it and when they returned it. The problem is, there is a lot of repetition. You can see each time a member borrows a book, all the details in their record are repeated. Similarly, if a book is taken out by different members, the details of the book are repeatedly recorded.

This repetition is called data redundancy. Relationships between tables in a relational database eliminate most of the data redundancies in a transaction. The table below attempts to collect all the data in a transaction - where members borrow books.

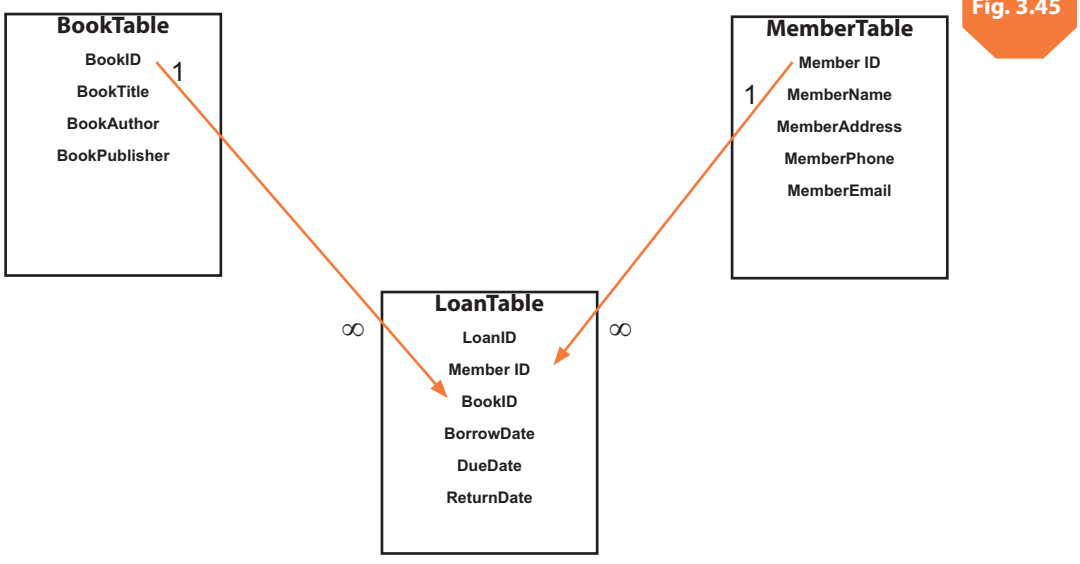
Fig. 3.44

BorrowDate	MemberName	MemberAddress	MemberPhone	BookTitle	BookAuthor	DueDate	ReturnDate
2 October	James Smith	Hawthorn	0404555666	Harry Potter Combs his Hair	J. G. Browsing	9 October	3 October
3 October	Jisha Singh	Woodburn	0444999888	The Peckish Games	S. Collins	10 October	5 October
4 October	James Smith	Hawthorn	0404555666	Afternoon	S. Meyer	11 October	15 October
5 October	Jisha Singh	Woodburn	0444999888	Harry Potter Combs his Hair	J.G. Browsing	12 October	10 October
5 October	James Smith	Hawthorn	0404555666	The Peckish Games	S. Collins		11 October

We organise our data into separate tables: entity tables and transaction tables. We keep all our data related to the entities in entity records and give each record a unique ID number. You would be familiar with this at school; you will have a student number for borrowing books at the library, and each book has an ID number printed on the spine.

To manage the transaction, we create a transaction table that only references the unique ID numbers of the entities involved in the transaction. In Fig. 3.45 below, you can see the Book Table and the Member Table are connected to the Loan Table. The Loan Table is the transaction table and it is connecting the two entity tables by including the BookID and the MemberID fields. These create the relationships. The relationship between the Book and the Loan Table is "one-to-many". This means any book can be borrowed many times by different Members. The relationship between the Member Table and the Loan table is also "one-to-many" allowing each member to borrow many books. You can see in the diagram that the line has a "one" at the entity end and a "∞" at the transaction end.

Fig. 3.45



Advanced

BookTable			
Book ID	BookTitle	BookAuthor	BookPublisher
200933	Harry Potter	J Browsing	McMillian
422095	The Peckish Games	S. Collins	Faber
100477	Afternoon	S. Meyer	Oxford Press
6020237	Wizard of Boz	A. List	Collins Pub.

Fig. 3.46

MemberTable				
MemberID	MemberName	MemberAddress	MemberPhone	MemberEmail
41601	James Smith	Hawthorn	0404555666	JamesS@school.com
90464	Jisha Singh	Woodburn	0444999888	JSingh@stBern.edu
80683	Sally Knight	Eltham	0433999888	SK@school.com

LoanTable					
LoanID	MemberID	BookID	BorrowDate	DueDate	ReturnDate
4479	41601	200933	2/10/2020	9/10/2020	3/10/2020
4480	90464	422095	3/10/2020	10/10/2020	5/10/2020
4481	41601	100477	4/10/2020	11/10/2020	15/10/2020
4482	90464	200933	5/10/2020	12/10/2020	10/10/2020

In Fig 3.46 above you can see the tables in data view; the two entity tables: BookTable and MemberTable and the transaction table: LoanTable. You can see how the LoanTable connects the entity tables through the use of ID numbers. The Harry Potter book record in the BookTable is orange and can be seen in the LoanTable twice. It has been borrowed on two occasions. You can see James Smith's record (blue) in the MemberTable and his ID appears in the LoanTable twice as well. He has borrowed two books. What books has Jisha borrowed?

Queries

The power of a relational database is in the way they can return data to complex questions. In our library database, we can use any field in a query to return the data we want, such as "Who returned a book late?" A query is written in a language called SQL (Structured Query Language). It is very simple to learn, it has only four sections:

1. SELECT: Select the fields you wish to use in your query.
2. FROM: Identify from which tables.
3. WHERE: The condition that will select the data, to answer the question.
4. ORDER: In what order do you want the data presented?

Let's write an SQL Query to find a library member who returned a book late. A librarian might like to know how to email the member to let them know they have a late fee. They might like to let the member know which book they returned late. We add all the fields we need, from their tables, and create a condition (ReturnDate>DueDate) where the date returned is after the due date. It's a good idea to have them in order of lateness, so we can order them by DueDate.

```
SELECT MemberName, MemberEmail, BookTitle, BorrowDate, DueDate, ReturnDate
FROM MemberTable, BookTable, LoanTable
WHERE ReturnDate > DueDate
ORDER DueDate Ascending
```

The Query above will return:

James Smith, JamesS@school.com, Harry Potter, 4/10/2020, 11/10/2020, 15/10/2020

Advanced

Reports

A report is a printable object. These are often created from a query. The librarian might want to print out a list of members who have late returns, or create letters directly from the database. It is possible to create a word document or a report in MS Access that pulls the data from the fields directly. This is more useful than merely displaying the data on the screen.

Forms

Once the tables have been designed, relationships formed, some data entered and some queries created, we build the interface of our library system. The interface is created using objects called Forms. On the form we add input objects such text boxes, pull-down menus and check boxes. We style it to look easy to read and follow as well as to look professional. We can create a menu of buttons on our system interface to allow the user to navigate all the forms. Buttons can also run queries and print reports.

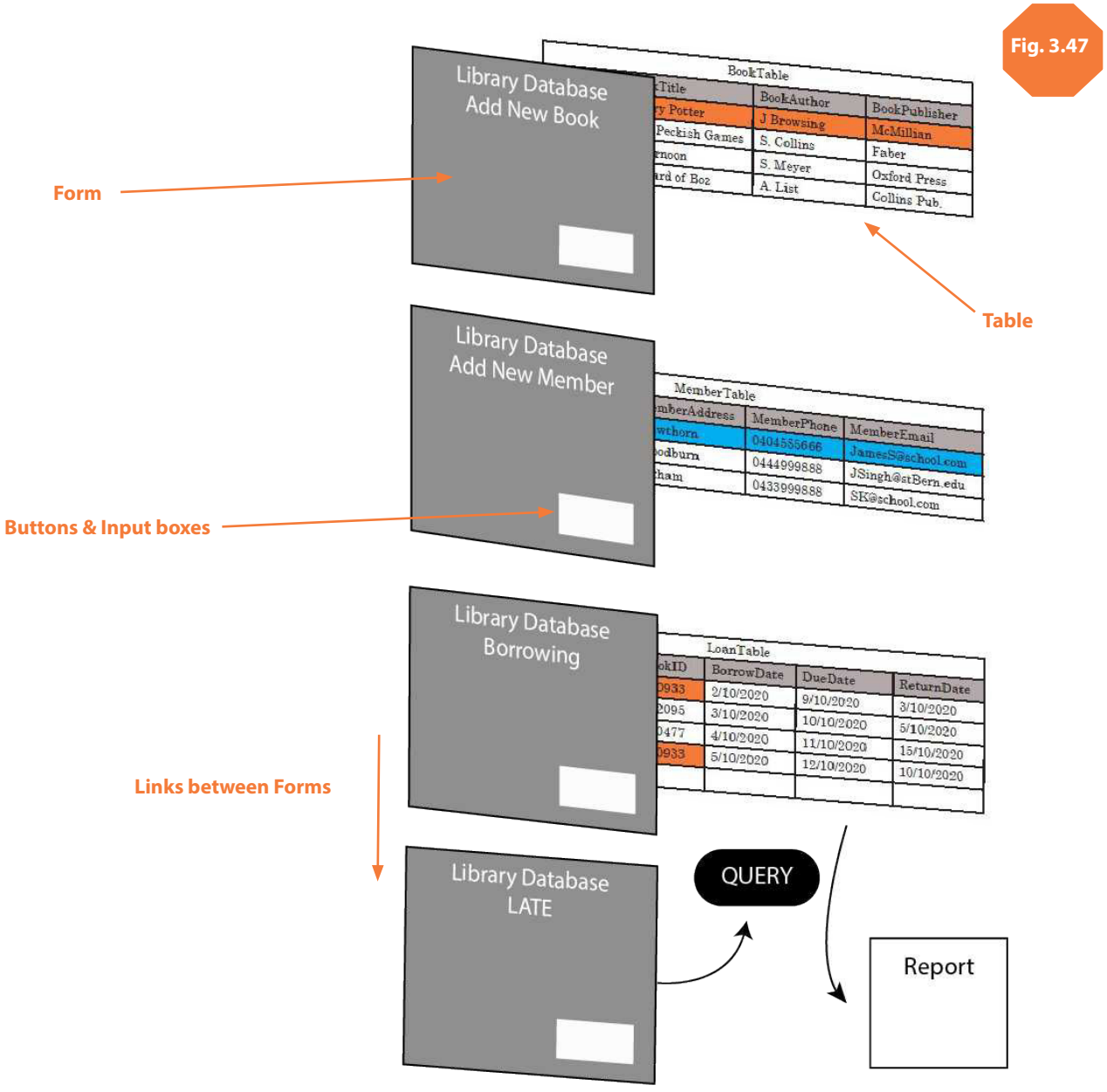
In Fig. 3.47 below you can see how the forms are related to the tables. The forms are built to allow the user to input data into the tables. This very basic library database allows the user to add new books to the BookTable, add new members to the MemberTable and check out books. The librarian can run a query to find the members with late returns and print out the list.

Activity 6

Task:

As a class identify other features this database could include to make it more useful.

Fig. 3.47



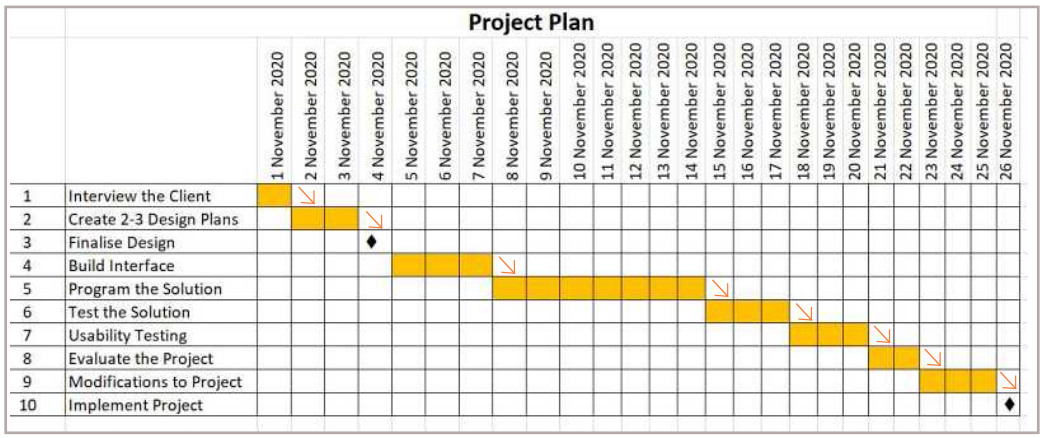
Advanced

Project Plan

If you have learned how to investigate data, develop software, websites and databases, you will now need to learn how to manage a project. When you are learning these skills, you may dismiss project management as unnecessary, but when you start creating more and more complex projects within teams of specialist technicians, you will find project plans essential.

A project plan requires a list of all the sub-tasks you need to complete so you can deliver the final product. It also identifies all the start and end dates of each task. Some tasks are dependent on other tasks to be finished. For example, the interface design needs to be complete and signed off by the client before starting to build the interface. In Fig 3.48 below you can see a basic project plan. It is also called a Gantt chart.

Fig. 3.48



Common Stages of Project Management

1. Collect Data

The chart above shows that the client will be interviewed on November 1st before anything else can be done. This is where the all the requirements are identified for the website or software. There are other ways to collect data too, such as surveys, observations and focus groups.

2. Design

Once the interview is over, the developer will have a better idea as to what is needed. The team can create a couple of designs for the client to choose from.

3. Milestones

The third task contains a diamond symbol called a "milestone". A milestone indicates an important completed section of the project. In the case of the plan above, you can see that the finalised design is the first milestone. This means one of the designs developed has been approved by the client, so they can go ahead and build the solution.

4. Development

Once the client has chosen their preferred design, the developer can start building the interface then the solution. This will take up most of the lifetime of the project.

5. Testing

Once the solution looks complete, the developers need to test the solution to see if it works. Testing involves the developers using test data to ensure it works correctly. This is not enough to declare the project complete.

6. Usability Testing

The solution needs to be tested by end users. These are the people who will use it in the end. This is called "usability testing". They investigate how easy it is to use and if it is efficient and effective. Developers already know how the project work; it needs to be tested by other people who will be using it.

7. Evaluating the Project

Once results from the usability testing are available, the developers need to look at how they managed their project. The need to evaluate the project as a whole to see if their product delivers what was required. The usability testing will indicate what modifications are required. Some other changes may need to be made to the project to ensure it is a more efficient and effective solution to a problem than the previous system.

8. Modifying the Project

Final changes to the project are required before the product can be implemented and used. These modifications come out of the usability testing and evaluation.

9. Implementation

This stage is the handover of the completed project to the client to use.

Collecting Data

When interviewing your client it is important to allow for them to explain exactly what they want. You may need to prompt discussion with questions if they are unsure about the details of what they want.

There are two types of questions: open and closed. Open questions allow for the client to expand on ideas and information that you, the interviewer, had not anticipated. Such as:

"Tell me what you want this website to do."

"What other website designs do like?"

Closed questions give the interviewer more control, and limit the amount of data collected. These questions have a limited range of answers. Such as:

"Do you want a downloadable mobile app, a website or both?"

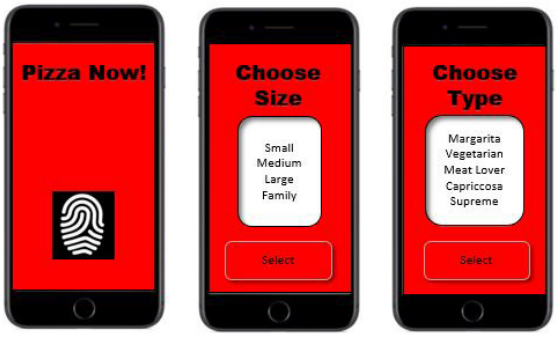
"Which of the following colour combinations do you prefer?"

There are only three possible answers to the first question (1. mobile app, 2. website, 3. both). The second question relies on the collection tools that the interviewer has prepared. If you give your client a few options to choose from, this will take less time than providing a lot of options or no guidance at all.

Designing Apps

Whether you are building software, a database or a website, the interface will guide how the solution will operate. At this stage you need to provide a range of possible interface designs based on your interview with the client. You can easily create 'mock-ups' of each screen in PowerPoint or other graphic software you have skills and access in. Fig 3.49 is an example of an interface design for a mobile app.

Fig. 3.49



It is ideal that you provide a professional looking design to assist your client in making a choice. In the example on the left you can see the app interface has been illustrated in a mobile phone frame. This also assists the developer in making choices when considering what can be included on the screen at one time.

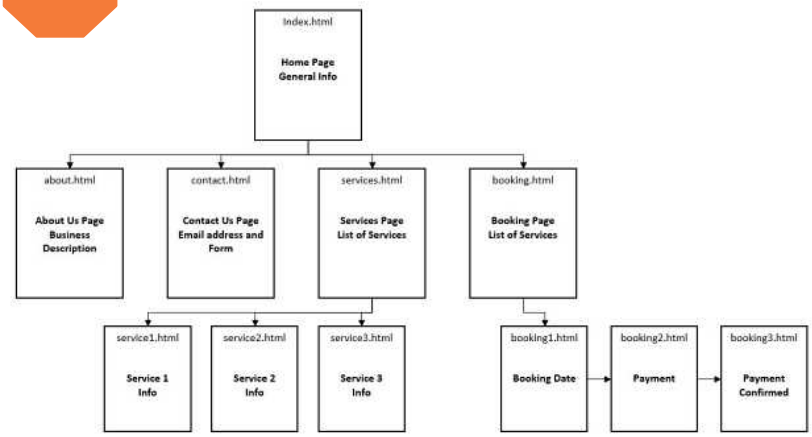
Advanced

Designing Websites

Designing websites, you need to be aware of how the site will look on a computer screen, a tablet and a mobile phone. We learned how to ensure our design is flexible between screen sizes. Ideally you should illustrate all three designs when presenting your proposed ideas to your client. The hierarchy of the site also needs to be illustrated. Websites often have many pages because they house more data than mobile apps. A hierarchy structure or tree structure needs to be included when designing web solutions. Fig 3.48 shows possible web designs for different screen sizes.

Fig. 3.48

Fig. 3.49



In Figure 3.49 you can see an example of a hierarchy diagram. It shows the structure of the website proposed.

The home page is at the top and links down to four other pages - About Us, Contact, Services and Bookings.

The Services page links to more information about three different services they provide. The Bookings page is linked to a series of other pages that manage the booking and payment processes.

Usability Testing

When you are happy with your product and you think you are finished, it is time to hand it over to the end users to test. There are a few things we want to find out in usability testing.

1. Is it easy to learn to use?

2. Do the end users find it an improvement on the previous system?

3. Is the design easy to understand?

4. What improvements are required?

When you provide end users with the recently completed product, it is important that the users are given some tasks to do. Developers can design the tasks in consultation with the client so the project is thoroughly tested. Ideally, developers should observe the end users while they test the solution. This will allow developers to see where users stumble or struggle. After the testing, the developers can survey or interview the users that tested the product to get more information. This will inform the development team on what needs to be modified.

To report on usability testing requires the following:

1. List of tasks given to the end users.
2. Observation notes.
3. List of questions.
4. Answers to the questions.

Fig. 3.50 is a brief example of how a usability report could be written. It is better to provide more detail.

Fig. 3.50

USABILITY TESTING

1. Users were asked to process a new library member, add a new book to the library, process a loan and a book return.

2. We found that the users took some time to find the navigation button to add new book. One user asked for assistance in this. Most were happy to work it out themselves.

3. Questions included: Did you find it easy to use?

What would you improve?

Is it better or worse than the old system?

4. Most of the users found it easy to use, but they all said the buttons were too small to read clearly. Most said it was an improvement, but one said it was not. When questioned further, it became clear this person struggled to understand the navigation.

Advanced

Project Evaluation

Once you get feedback from the end users, it is important that the project is evaluated. There are a few things that need to be addressed at this stage:

1. How well did the team do in delivering what was required?
2. Did the project stay on schedule?
3. Are there many modifications required?
4. Could the project be better managed?

Usually a project evaluation is written as a report, and submitted to the team manager for reflection on how to avoid errors, delays and shortcomings in the future. Some issues that commonly arise are:

- underestimating the amount of time required to complete a task,
- poor communication within the team or with the client,
- lack of skills or resources to produce the required outcomes.

A good method to easily investigate a project is for all team members to keep records of what was discussed, completed and any issues that arose. A useful tool is a blog. Online blogs automatically date each post and can provide links to resources. The project evaluation can refer directly to team member daily posts to reflect on issues within the team or the project.

Fig. 3.51 provides a brief example of a Project Evaluation.

Fig. 3.51

PROJECT EVALUATION

It appears that our product had shortcoming in the navigation design. Although the client was satisfied with the efficiency of processing of data, we found that many of the end users struggled with elements in the interface.

We managed to stay on schedule but due to many interface modifications, this may take us beyond the deadline of 26th November. The modifications are mostly with the button size, and how the menus are displayed on the screens. Some of the text may need to be enlarged for readability.

Since we delivered a working product, the project appears to have been managed well. However, the fact that the interface design was not ideal for the users means the team did not meet all the requirements. All the information about the requirements came from the client. It appears, in retrospect, that we should have surveyed the other end users to get their feedback when the design folio was being approved.

In future, it would be best to communicate with all end users to ensure the product we deliver is ideal for everyone. This would also allow us to avoid lengthy delays due to modifications, to implementation of the final product.

Advanced

Summary of Required Project Management Documentation

1. Project Plan: A schedule of all tasks
2. Design Folio: 2-3 Designs of the final product
3. Usability Testing: Results of end user testing
4. Project Evaluation: Reflection on the project as a whole.

3c. Advanced Assessment Tasks

Students are asked to respond to the Digital Technology knowledge by using the Information Technology Skills they have developed.

In Advanced Level students learned skills in:

- Microsoft Excel
- Relational Databases using Microsoft Access
- Visual Basic Programming
- Web Development III

Students developed knowledge and understanding of:

- Data Collection
- Data Security
- Visualisations
- Transaction Processing Systems
- Project Management

Project One Research Task

Students will be provided with some downloaded databases from Australian or International sources. Students may also find their own databases and have them approved by the teacher.

Students will conduct Data Analysis on the database using Excel spreadsheets. This will include data manipulation in order to investigate relationships in the data. Students will report on the relationships in the data using an interactive visualisation.

Research Task Marking Criteria

Students will produce a report on their findings including the following:

Introduction:

Overview of the topic investigated

Data:

Raw data in the spreadsheet

Manipulated data in a spreadsheet

Sources:

Name of the organisation and web address that published the database used in the report.

Name of the organisation and web address from where extra research has been included.

Data Manipulation:

Description of how the data was manipulated

All formulas used in the manipulated spreadsheet

Graphs and Charts:

All the separate graphs and charts produced from the spreadsheet

Summary of findings from these

Icons and Layout:

The icons used in the visualisation are appropriate to the topic.

The layout is well balanced and attractive.

Conclusion:

The visualisation includes all findings

The visualisation is interactive.

A target audience should be clearly identified

Project Two Web Development

Students create a multi-page website designed for a general audience.

The students must produce a website for a business where customers can book services or buy products.

Web Development Marking Criteria

Students must include and effectively use the following HTML:

- A table or div.
- Links to all HTML pages.
- A logo, header and a footer.
- Paragraphs and Headings

Students must include and effectively use the following CSS in a separate file:

- Background colours for body and table elements.
- Font controls, borders.
- Link display controls.
- Flexible design for different screen sizes.

Students use appropriate design elements to ensure the website looks attractive and professional.

Students should employ correct file management.

Project Three Programming

Students must create a software app for a cafe. The application must allow the customers of the cafe to order any kind of take-away coffee, with any kind of milk and with an option for sugar.

Programming Marking Criteria

Student submissions must include:

- Images of the coffee and icons for the different kinds of milk available should be included.
- It must calculate the total cost of the coffee.
- It must display the full order (eg: Latte with soy milk and one sugar).
- All variables and objects must be named for clarity.
- Comments in the code must also be included to make it easy to read.
- Interface should be attractive and professional looking.
- Different coffees and milk types must have different prices.

Project Four Transaction Processing

Students must create a database that allows for products to be hired such as: vehicles, costumes, technical equipment or library books.

Transaction Processing Marking Criteria

Students must include:

- Two entity tables; one for the customer, one for the items being hired out.
- Relationships created between the entity tables and transaction table.
- Forms that allow the user to easily hire out equipment.
- Forms that easily allow the user to add new equipment or customers.
- Forms that easily allow the user to delete or edit equipment or customer details.
- At least 10 records in each table.
- At least one query using SQL.
- At least one report.

Project Five Team Project

Students must work in teams to develop a digital system of any kind. They must identify:

- Who will use the system/who is the client.
- What is the purpose of the system.
- What data is required by the system.
- What does the system output.

Team Project Marking Criteria

Students must produce:

- A digital system.
- A project plan.
- A blog of all decisions, contributions, and discussions throughout the project.
- A design folio for approval of the client/end user.
- A report on usability testing.
- An evaluation report.

The team project's four stages:

1. Presenting a proposal to the class for their digital system.
2. Developing the digital system.
3. Usability testing of the system in class
4. Presenting the usability testing results and evaluation to the class.

Specialised Level

ACARA CURRICULUM

Digital Technology Knowledge and Understanding

ACTDIK034 Investigate the role of hardware and software in managing, controlling and securing the movement of and access to data in networked digital systems.

ACTDIK035 Analyse simple compression of data and how content data are separated from presentation

Digital Technologies Processes and Production Skills

ACTDIP036 Develop techniques for acquiring, storing and validating quantitative and qualitative data from a range of sources, considering privacy and security requirements

ACTDIP037 Analyse and visualise data to create information and address complex problems, and model processes, entities and their relationships using structured data

ACTDIP038 Define and decompose real-world problems precisely, taking into account functional and nonfunctional requirements and including interviewing stakeholders to identify needs

ACTDIP039 Design the user experience of a digital system by evaluating alternative designs against criteria including functionality, accessibility, usability, and aesthetics

ACTDIP040 Design algorithms represented diagrammatically and in structured English and validate algorithms and programs through tracing and test cases

ACTDIP041 Implement modular programs, applying selected algorithms and data structures including using an object oriented programming language

ACTDIP042 Evaluate critically how student solutions and existing information systems and policies, take account of future risks and sustainability and provide opportunities for innovation and enterprise

ACTDIP043 Create interactive solutions for sharing ideas and information online, taking into account safety, social contexts and legal responsibilities

ACTDIP044 Plan and manage projects using an iterative and collaborative approach, identifying risks and considering safety and sustainability

Suitable for all year levels

4a. Software Development

Analysis

By now you will have learned the basics of programming. Once students learn how to code, they are keen to start solving their programming problems directly in code. This is a bad habit. We are going to explore the correct approach to solving a programming problem. In Programming skills III, it is demonstrated how to create a Pizza Ordering App in Visual Basic. The instructions show you how to build the application, however, if you were approached by a pizza restaurant to create an app, you would need to analyse the problem before designing a solution. Analysis is a process that looks at what the end user needs, how it will be used and what data is collected and created by the solution. Let's analyse and design a solution for a more complex application.

Context Diagram

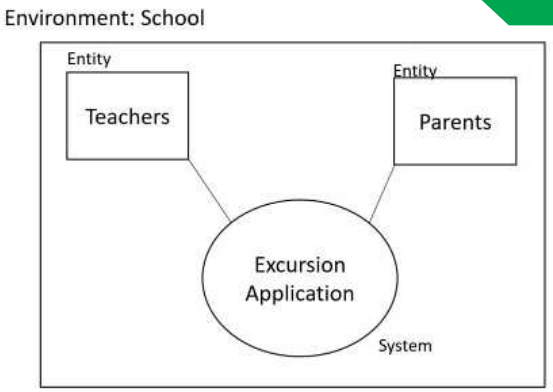
Let's look at solving a problem teachers often have. Each time a teacher wants to take their class on an excursion, they need to collect permission slips from all the students after they have been signed by parents. They need to keep records of all the students attending. The teacher needs to take the role once everyone gets on the bus and when they return on the bus. It is important to keep records of any health issues the students may have, and if there is an injury during the excursion. A teacher has approached you to develop a web app to solve this problem.

The first tool we will use is a Context Diagram. There are three components to this: The Environment, Entities and the System. The environment is where and how the application will be used. In the case of the Excursion App the environment would be "school". The entities that interact with the application are the parents and the teachers. The system is the application it's self.

In Fig. 4.1 (right), you can see the Context Diagram for the Excursion Application. The system is always depicted as a circle. The entities must be in rectangles and the whole diagram in a border labelled with the environment. This gives you perspective and makes you think about who will be using the system.

Context Diagram

Fig. 4.1

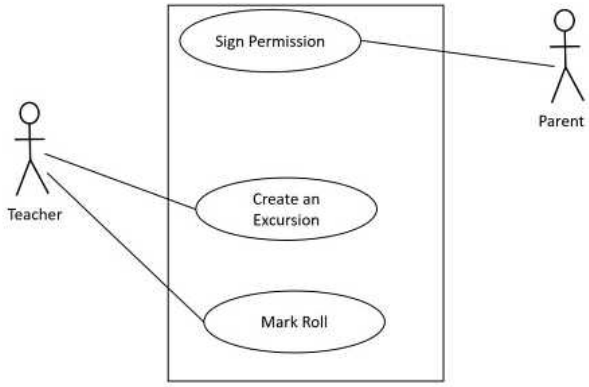


Use Case Diagram

The next stage is to investigate how the application will be used. The Use Case Diagram identifies the system centrally in a box and illustrates the entities as stick people. See Fig. 4.2 below.

Use Case Diagram

Fig. 4.2



You can see the parent uses the application to sign permission forms, while the teacher creates an excursion event and uses it to mark the roll while on the trip.

You can be as detailed as you like in terms of how each person uses the system. Creating a Use Case Diagram focuses your attention on all the ways people need to use the app. This then allows you to design a plan for an interface.

Developing very large complex systems, a Use Case Diagram is essential.

Specialist

Data Flow Diagram

Finally we need to analyse how the data will move through the system. The data flow diagram will assist you in identifying what your program will need to do. It will also force you to think about the data that is entered into the system and how it will transform into the data that is displayed by the system.

First we look at our context diagram and break it up into separate processes that the system must perform. You can see five processes in the system circle from our context diagram in Fig 4.3.

You can see both entities 'teachers' and 'parents' are interacting with the system. The system is made up of the following processes:

1. Signing permission & adding health records
2. Collecting all excursion attendances
3. Roll taking when bus leaves
4. Noting any injuries
5. Roll taking when the bus returns

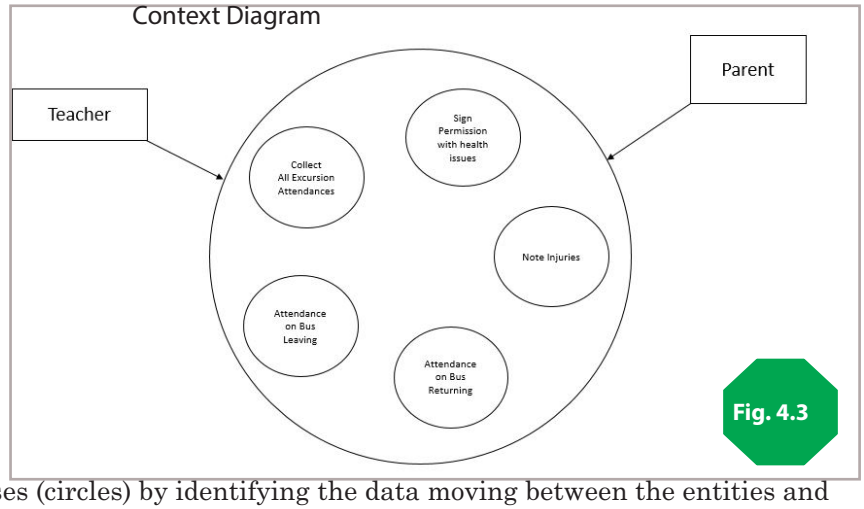


Fig. 4.3

Now we need to connect our processes (circles) by identifying the data moving between the entities and the processes. We also need to add a new element, the database, where all the data will be stored. In Fig 4.4 you can see each arrow illustrates the data flow. The data is labelled on each arrow. You can see the direction of each data flow from the entity to the process. Then the process changes the data to move it to the database.

Fig. 4.4

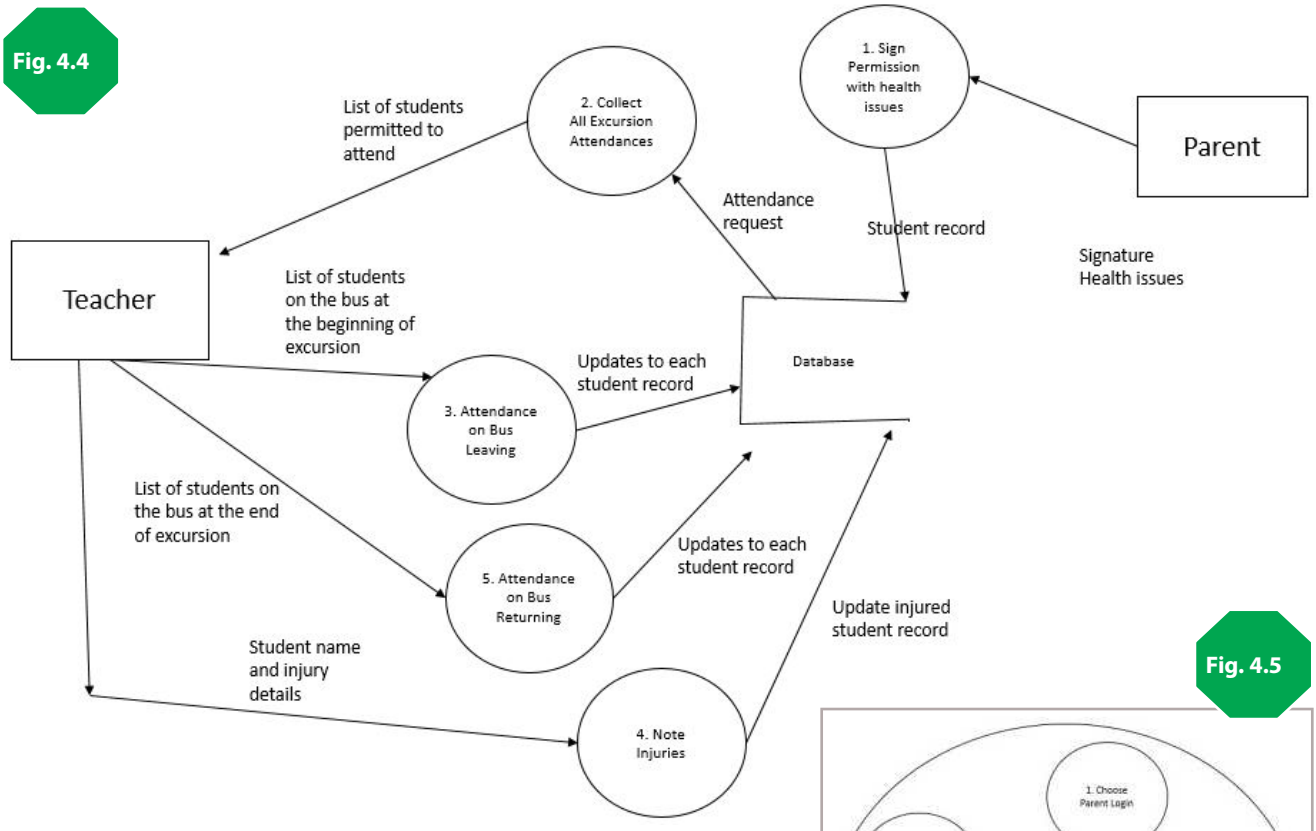
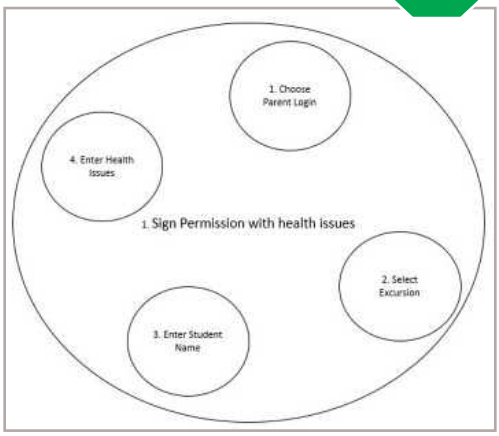


Fig. 4.5



The DFD shows the five main processes and the importance of the database where the data will be stored. We can look at each process and break each of them in more processes so we can identify more requirements of the system.

In Fig 4.5, we have blown up process number one - parent signs permission. This process can be broken into even more detailed processes. This will help up design the solution.

Specialist

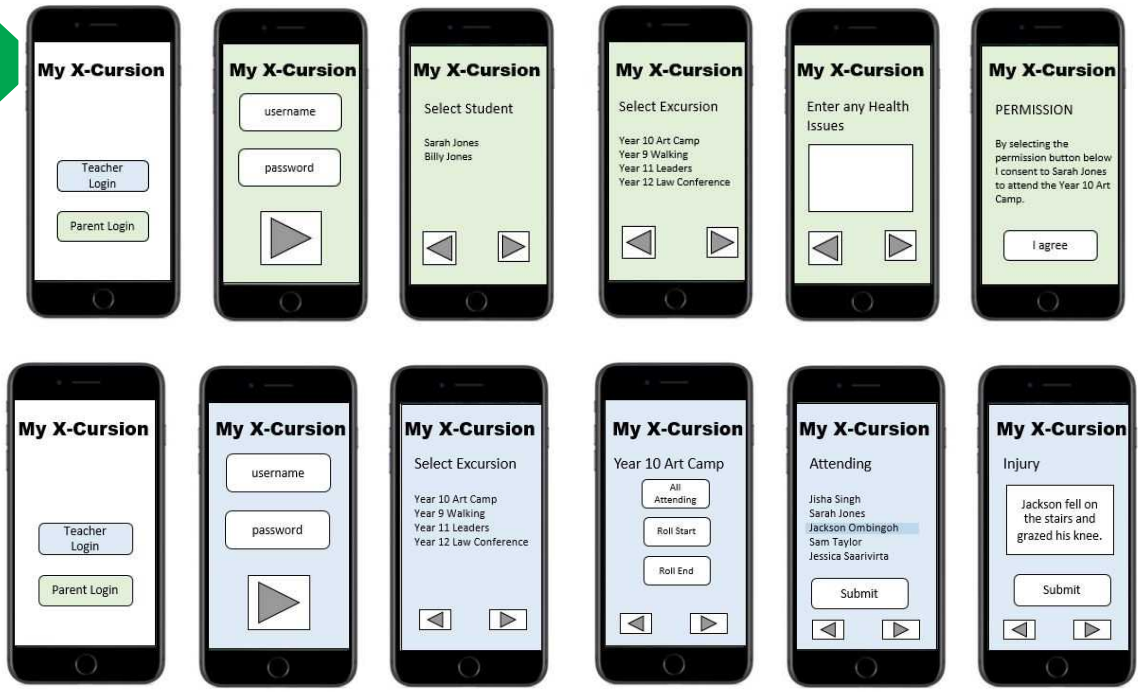
Design

Now we are going to start designing our software by creating the interface design. The interface is what the end user sees on the screen. Sometimes the layout design is called a 'mock-up'. Sometimes it is called a "storyboard' but the most common name for interface design is 'Design Layout'. All interface designs need to include the following:

1. The layout of all the objects on the screen.
2. How each object is labelled.
3. How each screen is connected to other screens.
4. The design elements such as colour, icons and font type.

Below in Fig 4.6 you can see that each screen has been designed to allow for data to be entered and displayed for each process. The use of colour assists with navigation. Consistency of navigation is important and you can see that forward and back buttons remain consistent on each page in terms of their location and design. These design layouts have been created by finding an image online of a mobile phone and using the Shapes tools in PowerPoint. It is a very good way to create simple design layouts with plenty of detail.

Fig. 4.6



Now we know what the program will look like, we can now plan for how we will develop the application. We can use the interface to identify the objects used to collect and display data. We can also identify eleven different screens that need to be identified. Let's focus on the teacher interface and identify all the objects. In Fig 4.7 below, you can see each button has been labelled with the prefix 'btn'. You can see that each button is clearly labelled in relation to its purpose. Listboxes allow for data to be displayed and selected by the user: lbxExcursions allows the user to select which excursion they are taking. The listbox lbxAttendanceList allows the user to select a student to identify them as 'not present' or 'injured'.

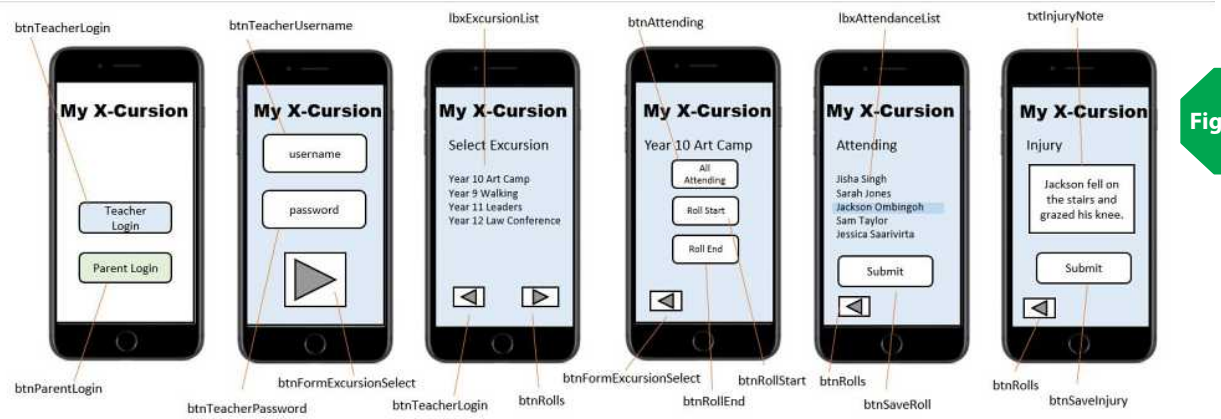


Fig. 4.7

Specialist

Algorithms

Let's use our interface object information to design a solution. We are going to investigate how we can use simple language to solve the problem before getting started coding. We know the names of the objects in our interface, so let's use them to help us find out what our variables will be. We are going to solve the problem using the object and variable names in pseudocode. Pseudocode is a type of writing that makes solving a software problem easy to read.

Here are the rules for writing an algorithm in pseudocode:

1. Write one statement per line.
2. Use all capitals for keywords.
3. Indent to show hierarchy, loop controls and decision structures.
4. Always end multi-line control structures.
5. Do not use a programming language syntax - pseudocode should be independent of coding languages.
6. Assignment statements identifies the destination of the data first.

Let's look at each of these rules with different examples. The first three rules limit how much can be done on one line of the pseudocode. We should use all capitals for key words and indent to show hierarchy. If we have to design a program that reads in the username and password and return an error message or allow access to the next screen, here is the algorithm below.

```
1. START
2.      READ in the username
3.      READ in the password
4.      QUERY username and password in database
5.      IF (username = TRUE) AND (password = TRUE) THEN
6.              Open Welcome Screen
7.      ELSE
8.              Message "You have entered incorrect login details"
9.      ENDIF
10. END
```

You can see that the algorithm is easy to read. It uses single lines to execute a single statement. Keywords that are used in pseudocode include:

START, END, READ, PRINT, DISPLAY, IF, THEM, ELSE, ELSEIF ENDIF, SELECT CASE, WHILE, END WHILE, REPEAT, UNTIL, FOR, FOR EACH, NEXT, QUERY.

You can also see how indenting makes the IF Control Structure easier to read. If both the username and password are both found to be true then it will allow access to the welcome stream, otherwise, it will display an error message.

Control Structures

There are three types of control structures in coding:

1. Sequence: one executable line of code after the other.
2. Decision: where a condition is tested and a decision is made (IF or SELECT CASE).
3. Iteration: repeated loops where a sequence repeats when or until a condition is met.

Control Structures Examples

Sequence: The code reads from start to end, line by line.

```
1. START
2.      READ in NumberOne
3.      READ in NumberTwo
4.      Answer = NumberOne + NumberTwo
5.      DISPLAY Answer
6. END
```

Decision: The code must test a condition before deciding on which line to execute first. Below is a simple guessing game where the code generates a random number and tests the user's guess. If it is the same as the answer the program displays "Correct". If Guess is higher than Answer it displays "Lower", otherwise it will display "Higher".

```
1. START
2.      Answer = RandomNumber
3.      READ in Guess
4.      IF (Guess = Answer) THEN
5.              Message"Correct"
6.      ELSEIF (Guess > Answer) THEN
7.              Message "Lower"
8.      ELSE
9.              Message "Higher"
10. END
```

If we use a pull-down menu or listbox we can use another kind of decision control system called SELECT CASE. Below is an algorithm that set the prices for each pizza when they are selected in a listbox.

```
1. START
2.      SELECT CASE listbox
3.      CASE 0
4.              Price = 12.99
5.              Set HawaiianPizza.jpg Visibility = TRUE
6.      CASE 1
7.              Price = 15.99
8.              Set MargaritaPizza.jpg Visibility = TRUE
9.      CASE 2
10.             Price = 17.99
11.             Set MeatLoversPizza.jpg Visibility = TRUE
12.     CASE 3
13.             Price = 12.99
14.             Set VegetarianPizza.jpg Visibility = TRUE
15.     END SELECT
16. END.
```

Iteration: Control structures can repeat sequences until a condition is met (Post-Test Loops), or while a condition is met (Pre-Test Loops). Some iteration works when the number of repeat times is known (FOR and FOR EACH). In the example below you can see the guessing game is now repeated three times.

```
1. START
2.      FOR Counter = 1 to 3
3.              READ in Guess
4.              IF (Guess = Answer) THEN
5.                      Message"Correct"
6.              ELSEIF (Guess > Answer) THEN
7.                      Message "Lower"
8.              ELSE
9.                      Message "Higher"
10.     NEXT Counter
11. END
```

The loop below is a Pre-Test loop. It checks the condition before entering the loop. In the algorithm below it tests to see if the user has completed their order. If they have not, it will continue to read in more pizza order details.

```
1. START
2.      WHILE (Complete = FALSE)
3.              READ in Pizza Type
4.              READ in Pizza Size
5.              READ in Quantity
6.      END WHILE
7. END
```

The Post-Test loop checks the condition after entering the loop. In the algorithm below it tests to see if the user has ordered enough for free home delivery. It keeps adding pizza prices to the total cost and tests the total cost at the end of the loop. Once $25 is reached, a message appears to tell the user they qualify for free delivery.

```
1. START
2.      REPEAT
3.              READ in Pizza Type
4.              READ in Pizza Size
5.              READ in Quantity
6.              TotalCost = TotalCost + Price
6.      UNTIL (TotalCost >= 25)
7.      Message "You qualify for free home delivery"
8. END
```

Data Structures: Array

So far we have only used variables to handle data. In the database chapters we used a data structure called a record. A data structure holds more than one data item. A record has many fields that can contain different data types.

We are going to learn about another very useful data structure called an Array. Arrays are used to store data so they can be sorted or searched. Arrays have a very useful feature - they have index numbers that identify where the data is in the array. Below is an array. Let's call it NamesArray(4). We call it NamesArray(4) because it is an array, it contains names and the highest index is 4. This does not mean that there are four items. In fact there are five. Arrays always start at zero.

Let's say we need to search this array for a person the user inputs. We can use a loop to test each item via the index number.

0	1	2	3	4
Stanley	Marika	Lance	James	Rosemary

```
1. START
2.      READ in Name
3.      Found = FALSE
4.      FOR Index = 0 to 4
5.              IF (Name = NamesArray(Index)) THEN
6.                      Found = TRUE
7.                      END FOR
8.              END IF
9.      NEXT Index
10.     IF (Found = FALSE) THEN
11.             Message: Name "is not in this array"
12.     END IF
13. END
```

We are going to use an array in our Teacher Excursion application to manage the students in our excursions. An array stores the data in memory while the app is operating, but we will also need to store the data into a file. It is easy to store data into a text file using VB code.

We will need a text file to hold the whole class list. The maximum number of a class can be set to 30. We can pull the data from the file using a FOR loop and place it into ClassArray(29).

```
1. START
2.      OPEN Class.txt
3.      FOR (Index = 0 to 29)
4.              ClassArray(Index) = (Class.txt) READline
5.      NEXT Index
6. END
```

All student names are now in the ClassArray(29). Now we need to allow the parents to provide permission for their child to attend the excursion and to add the health issues. A single array like ClassArray(29) will not be able to hold that data.

We now need a new array that can store the student names with permission as well as the health information. We will need an associative array to store more than one list. In the table below you can see our index values above each name, as well as index values on the far left. We have added another row with health information.

	0	1	2	3	4
0	Stanley	Marika	Anne	Rosemary	Steve
1	none	asthma	none	none	peanut allergy

Each item is allocated a location based on the index values. Stanley is at (0,0) his health note "none" is at (0,1). Marika is at (1,0) and her health note "asthma" is at (1,1).

So now we can identify the data by (x,y) in the array, where the x identifies which student and the y identifies either the name or the health note for that student.

Let's assume all the permissions are complete and create an algorithm for the teacher to find all the students with health issues. We need the names and the health note displayed in a list on the screen. Let's assume all 30 students have permission and the array ExcursionArray(29,1) is full.

```
1. START
2.      FOR (x = 0 to 29)
3.          IF (ExcursionArray(x,1) <> none) THEN
4.              Display Excursion Array(x,0)
5.              Display ExcursionArray(x,1)
6.          END IF
7.      NEXT x
8. END
```

Above we have a FOR loop that checks each of the 30 students. If the (x,1) does not equal "none" then it will display the name and the health note.

Now we need to write the algorithm for parents to search for their child's name, add a health note and give permission. The ClassArray(29) will be searched and the name added to the ExcursionArray(29,1) along with the health note.

The algorithm above searches for the name in the ClassArray(29). When the name is found, the Index number for the name in the ClassArray will be assigned to the variable "StudentNumber". This will then be used to place the name into the ExcursionArray(29,1). This will mean each student will keep their place in the roll. If a student is not provided permission, their name will be missing in the roll.

```
1. START
2.      READ in Name
3.      FOR Index = 0 to 29
4.          IF (Name = ClassArray(Index)) THEN
5.              StudentNumber = Index
6.              END FOR
7.          END IF
8.      NEXT Index
9.      ExcursionArray(StudentNumber,0) = ClassArray(StudentNumber)
10.     ExcursionArray(StudentNumber,1) = HealthNote
11.     IF HealthNote = "" THEN
12.         ExcursionArray(StudentNumber,1) = none
13.     END IF
14. END
```

Now we need to allow the teacher to mark the roll twice on the bus and to list any injuries. We want to keep the amount of data stored on our mobile device to a minimum. So let's use our ExcursionArray.

Let's extend the ExcursionArray by adding rows for each of the two bus rolls (one for the start of the excursion and one at the end.) We also need a row for injuries. In the table below, you can see that row 2 and 3 contain the letter "p" for present. Rosemary is absent in row 3 due to an injury added in row 4.

	0	1	2	3	4
0	Stanley	Marika	Anne	Rosemary	Steve
1	none	asthma	none	none	peanut allergy
2	p	p	p	p	p
3	p	p	p	a	p
4				broke arm falling off the stairs - parents came to pick her up.	

Now let's do the algorithm for the button "Bus Roll Start"

```
1. START
2.      FOR (x = 0 to 29)
3.              Display ExcursionArray(x,0)
4.              IF (ExcursionArray(x,0) = SelectedStudent) THEN
5.                      (ExcursionArray(x,2) = a
6.              ELSE
7.                      (ExcursionArray(x,2) = p
8.      NEXT x
9. END
```

For button "Bus Roll End" the algorithm is the same, only we are adding the p and a to row 3:

ExcursionArray(x,3)

Data Structures: Records

Databases are made up of records that hold all the data to describe a person, object or transaction. Records are really useful managing data sets regarding entities such as people and products. Below is a table of data that could be used for parent login purposes. You can see there are three records made up of six fields. The data is required to stay together in rows. The record keeps the association of the data intact, but each field can be searched independently. Ideally when storing and searching passwords, you should use a secure connection to the location of the file containing the login details. A hash table or a secure database can provide more security, but for the purposes of investigating records and XML files, we are going to store the data below in an XML file. We are going to search it using Visual Basic.

Parent Given Name	Parent Family Name	Student Given Name	Student Family Name	Username	Password
Maria	Smith	Michael	Smith	SmithM	6skk38
James	Lee	Suzie	Lee	LeeJ	abc123
Jisha	Singh	Rajesh	Singh	SinghJ	12w390a

```xml
<?xml version="1.0" encoding="UTF-8"?>
<FamilyDetails>
  <ParentLogin>
    <parentGName>Maria</parentGName>
    <parentFName>Smith</parentFName>
    <studentGName>Michael</studentGName>
    <studentFName>Smith</studentFName>
    <userName>SmithM</userName>
    <securityCode>6skk38</securityCode>
  </ParentLogin>
  <ParentLogin>
    <parentGName>James</parentGName>
    <parentFName>Lee</parentFName>
    <studentGName>Suzie</studentGName>
    <studentFName>Lee</studentFName>
    <userName>LeeJ</userName>
    <securityCode>Yes!</securityCode>
  </ParentLogin>
  <ParentLogin>
    <parentGName>Jisha</parentGName>
    <parentFName>Singh</parentFName>
    <studentGName>Rajesh</studentGName>
    <studentFName>Singh</studentFName>
    <userName>SinghJ</userName>
    <securityCode>12w390a</securityCode>
  </ParentLogin>
</FamilyDetails>
```

Parent Login Solution

You can see the code on the left with the same data as the table on the previous page. It is the same data, but expressed as an XML file.

Line 1 is a declaration that identifies the code type.

Each record is identified as <ParentLogin>. Within each record are the six fields:

- <parentGName>
- <parentFName>
- <studentGName>
- <studentFName>
- <userName>
- <securityCode>

It is easy for users to read, and can be edited with any label in the tags. You can see each record is between the record tags and there is a database tag <FamilyDetails>.

We are going to use a FOR EACH loop to check each of the fields in our XML file. Once the table is expressed as XML, they are no longer called records. They are called “nodes”. Visual Basic has special syntax for Nodes and for NodeLists. See the pseudocode below. It loads the XML file and loads the NodeList. It then checks each Node in the NodeList. For each Node it checks to see if the username and password fields are identical to the input. If both are true it will load the first names of both the parent and the student into variables and open the next form that allows access to the parent permission input form. If both the username and password are found, the loop needs to be exited because no other Nodes are required. Once the loop is completed for each Node a warning message will display “Incorrect Login”.

```
1. START
2.      Load XML file = ParentDB.xml
3.      NodeList = Get Tag Names
4.      FOR EACH Node in NodeList
5.          IF <username> = Username AND <securityCode> = Password THEN
6.              Read <ParentGName>
7.              Read<StudentGName>
8.              Open InputForm
9.               Exit FOR
10.         END IF
11.     NEXT
12.     Display “Incorrect Login”
13. END
```

On the next page is a screen-shot of the Visual Basic that can handle the data in ParentsDB.xml.

```vb
Imports System.Xml
Imports System.IO
4 references
Public Class Form2
    Public ParentN As String
    Public StudentN1 As String
    Public StudentN2 As String
    0 references
    Private Sub BtnLogin_Click(sender As Object, e As EventArgs) Handles btnLogin.Click
        Dim xmlDocument As New XmlDocument
        Dim xmlNodeList As XmlNodeList
        Dim xmlNode As XmlNode

        xmlDocument.Load("ParentDB.xml")
        xmlNodeList = xmlDocument.GetElementsByTagName("ParentLogin")

        For Each xmlNode In xmlNodeList
            If (txtUserName.Text = xmlNode.Item("userName").InnerText) And (txtSecurityCode.Text = xmlNode.Item("securityCode").InnerText)
                ParentN = xmlNode.Item("parentGName").InnerText
                StudentN1 = xmlNode.Item("studentGName").InnerText
                StudentN2 = xmlNode.Item("studentFName").InnerText
                Form3.Show()
                Me.Hide()
                Exit For
            End If
        Next
        lblWarning.Text = "You have entered incorrect login details."
    End Sub
End Class
```

VB.net code to check Parent Login and return student name. If the login is correct, Form 3 will open.

Roll Call Solution

We do not need to always store data in XML files. Sometimes a simple text file will suffice. On the right you can see a simple text file called "ClassList.txt". The file holds 30 names of students.

Using Streamreader ,it is possible to load the data from the text file line by line. Each line is allocated to the first row in the array and to a Listbox on the interface form. Listboxes are really useful because they can store data and allow the user to select data displayed. Let's look at the algorithm for this. When the VB form loads, it will load the text file. We know there are 30 students so for each of the 30 lines in the file, we will allocate the line of text to the first row of the array. We will also allocate the names to the Listbox so the teacher can select them.

ParentDB.xml | ClassList.txt

```
1  Phillip Jamison
2  Michael Smith
3  Shareen Scarlet
4  Rajesh Singh
5  Zhang Wei
6  Ramesh Kumar
7  Amin Dana
8  Oliver Browning
9  Ali Khaled
10 Tran Nguyen
11 Annisa Sri
12 Charlotte Williams
13 Janet Tayor
14 Marika Saarivirta
15 Anita Brock
16 Aung Kaung
17 Youssef Choudra
18 Ted Danish
19 Gerta Schmidt
20 Kiara Singh
21 Prisha Patel
22 Martin Durant
23 Corina Green
24 Samantha Swedes
25 Suzie Lee
26 Prudence Ng
27 Kelly Thomas
28 Jack Wilson
29 Wei Lu
30 Leo Perera
```

1. START
2. Load the Form
3. Load the text file ClassList.txt
4. FOR i = 0 to 29
5. Excursion Array(i,0) = Readline
6. Listbox Item = Readline
7. NEXT
8. END

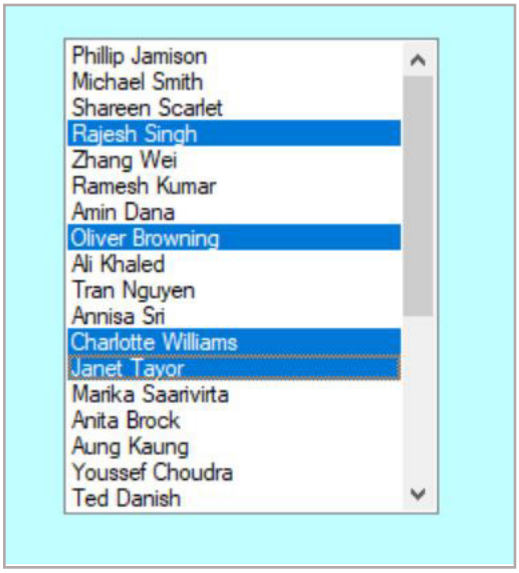
```vb
Imports System.IO

2 references
Public Class Form4
    0 references
    Private Sub Form4_Load(sender As Object, e As EventArgs) Handles MyBase.Load
        Dim ExcursionArray(29, 4) As String
        Dim LoadNames As StreamReader = File.OpenText("ClassList.txt")
        For i = 0 To 29
            ExcursionArray(i, 0) = (LoadNames.ReadLine())
            lbxRollCall.Items.Add(ExcursionArray(i, 0))
        Next

    End Sub
End Class
```

VB.net code to ead data from ClassList.txt into an array and a Listbox.

Specialist

Loading the Array

We have loaded the array with the names, now we need the Teacher to be able to run a roll call and store the absences. You can see below that the interface displays a ListBox that contains all the students. The teacher can select the students who are absent. The algorithm is below.



1. START
2. FOR EACH SelectedIndex in Listbox
3. Excursion Array(SelectedIndex,0) = “absent”
4. Listbox Item = Readline
5. NEXT
6. END

```
For Each selectedIndex In lbxRollCall.SelectedIndices
    ExcursionArray(selectedIndex, 1) = "a"
Next
```

There is more than one way to collect selected items from a listbox: ListBox.GetSelected(i) can also work. We now have an array that holds the data as per the table below. You can see that:

Excursion Array(3,1) , Excursion Array(7,1) , Excursion Array(11,1) and Excursion Array(12,1) all hold the data “a”.

In this array we will store the absences in the column “1” for the start of the excursion. We can store absences in column “2” for the end of the excursion.

Any injuries that occur can be stored in column “3” while health issues are stored in column “4”.

If students have been added to this list it is because parents have given permission. You can see for the students listed, some health issues have been included.

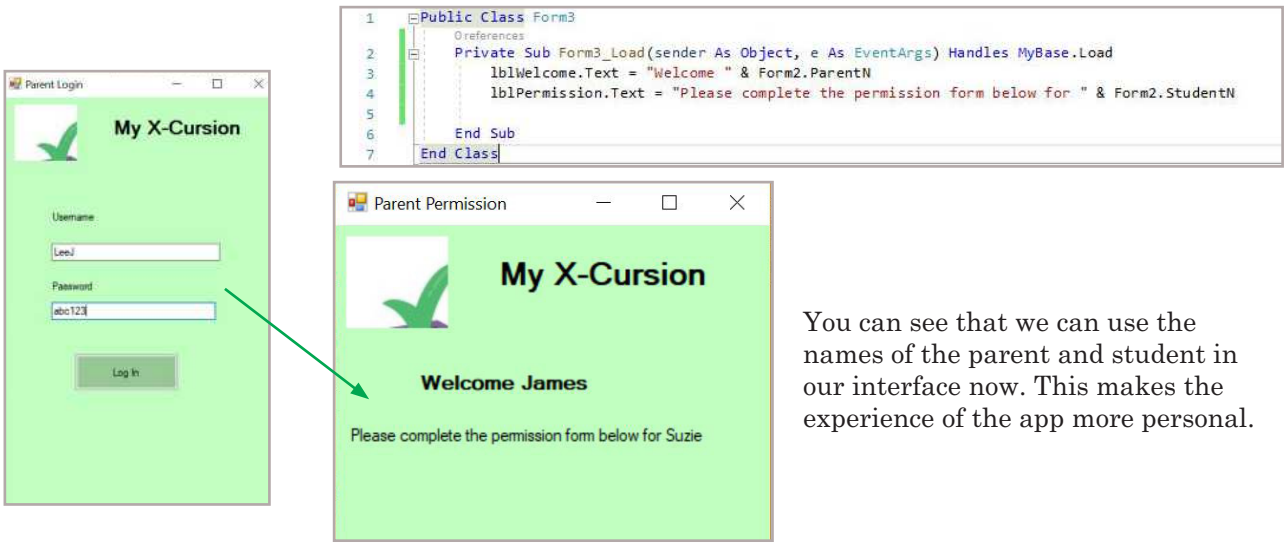
A possible function could check the absences in column “1” against column “2” to identify students lost on the excursion.

	0	1	2	3	4
0	Phillip Jamison				
1	Michael Smith				
2	Shareen Scarlet				
3	Rajesh Singh	a			
4	Zhang Wei				
5	Ramesh Kumar				asthma
6	Amin Dana				
7	Oliver Browning	a			
8	Ali Khaled				
9	Tran Nguyen				
10	Annisa Sri				
11	Charlotte Williams	a			
12	Janet Tayor	a			
13	Marika Saarivirta				allergies
14	Anita Brock				
15	Aung Kaung				
16	Youssef Choudra				
17	Ted Danish				
18	Gerta Schmidt				
19	Kiara Singh				
20	Prisha Patel				
21	Martin Durant				
22	Corina Green				
23	Sam Swedes				allergies
24	Suzie Lee				
25	Prudence Ng				

Specialist

Parent Permission Form

Now that the parent has access to the next form, lets ensure they know, that we know who they are and who their child is. You will notice in the VB code above that the variables ParentN and StudentN1 and StudentN2 are declared Public variables. This will allow us to access them from other forms.



You can see that we can use the names of the parent and student in our interface now. This makes the experience of the app more personal.

Now we need to obtain some important information from the parent. We need their permission for Suzie to go on the excursion and we need to know any health issues. Let's transfer Suzie's name into the Array and collect the information from the parent, James.

```
1   Imports System.IO
    2 references
2   Public Class Form3
3       Public ExcursionArray(29, 4) As String
        0 references
4       Private Sub Form3_Load(sender As Object, e As EventArgs) Handles MyBase.Load
5           lblWelcome.Text = "Welcome " & Form2.ParentN
6           lblPermission.Text = "Please complete the permission form below for " & Form2.StudentN1
7           lblAgree.Text = "By clicking the check box below you agree that" & vbNewLine & Form2.StudentN1 & " is permitted to attend the excursion."
8           lblHealth.Text = "If " & Form2.StudentN1 & " has any health issues please check the box."
9       End Sub
10
        0 references
11      Private Sub BtnPermitSubmit_Click(sender As Object, e As EventArgs) Handles btnPermitSubmit.Click
12          Dim Location As Integer
13          Dim search As Integer
14          Dim LoadNames As StreamReader = File.OpenText("ClassList.txt")
15          For i = 0 To 29
16              ExcursionArray(i, 0) = (LoadNames.ReadLine())
17          Next
18          If cbxAgree.Checked = True Then
19              Dim PermissionFile As System.IO.StreamWriter
20              PermissionFile = My.Computer.FileSystem.OpenTextFileWriter("PermittedList.txt", True)
21              PermissionFile.WriteLine(Form2.StudentN1 & " " & Form2.StudentN2)
22              PermissionFile.Close()
23          End If
24
25          If cbxHealth.Checked = True Then
26
27              For search = 0 To 29
28                  If ExcursionArray(search, 0) = Form2.StudentN1 & " " & Form2.StudentN2 Then
29                      ExcursionArray(search, 4) = txtHealthNote.Text
30                      Location = search
31                  End If
32              Next
33          End If
34          MsgBox("You have submitted your permision for " & Form2.StudentN1 & " to attend the excursion.")
35          If Location = True Then
36              MsgBox("You have notified us that " & Form2.StudentN1 & " has a health issue: " & ExcursionArray(Location, 4))
37          End If
38
39      End Sub
40  End Class
```

VB.net code to enter parent permissions, store the student into an array and any health issues.

We are using two sub routines in the code above. The first routine runs as soon as the form loads. This displays the instructions to the parent using their name and their child's name. The second routine reads in the ClassList.txt file to load all the names into the array. If the parent checks the "I Agree" checkbox, their child's name will be stored in a new text file called PermittedList.txt. You can see in Line 21, we did a little tricky thing with adding both the variables StudentN1 and StudentN2 from Form 2 with a space to make it easy to read in the file.

Then if the Health checkbox is selected, the code searches the array for the child's first name and family name and stores the text from the textbox (where the parent enters health issue data) into the fourth column. We created a variable called Location to grab the location of the x index (0 - 29) so that we can find which student the health note is for.

Updating an XML File

Another technique we need to learn is to update the data stored in an XML file. The trick here is to save the file once the data is stored. Below is the algorithm and the VB code that will allow the Parent to change their password stored in the XML file.

1. START
2. Name the XML document
3. Name the NodeList (These are the tags in the record)
4. Name the Node
5. Load the XML document
6. Load the NodeList
7. IF userName and securityCode are correct
8. Get the ParentName from the XML
9. OldPassword = Get the Security Code from XML
10. NewPassword = Get from InputBox
11. Store the NewPassword into the <securityCode> tag
12. Save the XML document
13. END IF
14. END

```
0 references
Private Sub BtnChange_Click(sender As Object, e As EventArgs) Handles btnChange.Click
    Dim xmlDocument As New XmlDocument
    Dim xmlNodeList As XmlNodeList
    Dim xmlNode As XmlNode
    Dim oldPassword As String
    Dim newPassword As String

    xmlDocument.Load("ParentDB.xml")
    xmlNodeList = xmlDocument.GetElementsByTagName("ParentLogin")
    For Each xmlNode In xmlNodeList
        If (txtUserName.Text = xmlNode.Item("userName").InnerText) And (txtSecurityCode.Text = xmlNode.Item("securityCode").InnerText) Then
            ParentN = xmlNode.Item("parentGName").InnerText
            oldPassword = xmlNode.Item("securityCode").InnerText
            newPassword = InputBox("Enter your new Password")
            xmlNode.Item("securityCode").InnerText = newPassword
            xmlDocument.Save("ParentDB.xml")
            MsgBox("You have updated your password " & newPassword)
            Me.Hide()
            Exit For
        End If
    Next
```

VB.net code to change stored data in an XML file.

You now have all the techniques to complete the program.

1. Store data into an array
2. Access data in an array
3. Access data in a text file
4. Store data in a text file
5. Read data from an XML file
6. Edit data in an XML file
7. Search an Array

Now comes the trickiest part of all. Putting it all together.

Activity 1

As a class, or in groups, put together an algorithm that organises all the tasks into a full program. Using the pseudocode techniques used here, structure he solution in separate sub routines.

Specialist

Validation

Validation is an important programming technique that stops bad data entering the system you have built. You do not want your program to crash when a user mistakenly enters the wrong type of data or forgets to complete a form. There are three types of data validation: Existence, Data Type and Range Checking.

Existence Checking

Existence checking checks if there is any data to input. Sometimes the user will forget to enter something vital to run correctly, so an existence check returns a prompt to the user to fill in the missing data.

Here is a VB example where the text property of the textbox txtAmount is checked to NOT be nothing.

```
If (txtAmount.Text) <> “” then
        intAmount = txtAmount.Text
Else
        MsgBox(“Please enter an Amount”)
End IF
```

Data Type Checking

Sometimes a mistake can be made or data mistyped. Checking the data type is crucial. You can not multiply a value with the letter Q, nor can you store a decimal number in a variable declared an integer.

Here is a VB example where NumericCheck is either True or False. Our intAmount is declared an integer.
We use a VB function called IsNumeric() to test if the textbox is holding a value. If the check is true we can read in the data in the object into the variable. This is a nice save way of checking the data before reading it in.

```
Dim NumericCheck as Boolean
Dim intAmount as Integer
NumericCheck = IsNumeric(txtAmount.Text)
If (NumericCheck = True) then
        intAmount = txtAmount.Text
Else
        MsgBox(“Please enter a value for Amount”)
End IF
```

Range Checking

Sometimes the data has been added and the data type is correct but it is outside of the allowable range. If you were to enter a very large number, your program would crash and report an ‘overflow’. An overflow occurs when the variable has not been defined to hold a number that large.

```
If (txtAge.Text > 18) And (txtAge.Text < 120) Then
                intAge = txtGross.Text
ELSE
                MsgBox(“You have not entered an appropriate age”)
END IF
```

Activity 2

Class discussion: In our My X-Cursion App, where could we use each type of validation?

4a. Specialist Assessment Tasks

Students are asked to respond to the Digital Technology knowledge by using the Information Technology Skills they have developed.

In Specialist Level students learned skills in:

- Analysing problems
- Designing Solutions
- Solving problems with algorithms
- Using XML code to store and retrieve data
- Using text files to store and retrieve data
- Code using Visual Basic

Students developed knowledge and understanding of:

- Context Diagrams
- Use Case Diagrams
- Data Flow Diagrams
- Pseudocode
- Validation

Project One Programming Folio

Students develop a folio of five programs that demonstrate the techniques covered in this chapter.

1. Create an app that reads in a student name, their result for an exam and the total number of marks for the exam. It needs to calculate their result as a percentage and provide a grade.

    A is between 100% and 85%

    B is between 84% and 75%

    C is between 74% and 50%

    F is below 50%

2. Create a Pizza Ordering App (similar to the tasks in the Advanced Chapter) but read the data from a text file into a listbox. Allow the user to select more than one pizza type and display their selections on the screen.

3. Create an address book in XML and an app to search the address book for a name, returning their phone number, address and email.

4. Create a list of products in XML with different sizes and prices. Create an app that reads the data in and displays it. Allow the user to change the prices in the XML file.

5. Complete the Teacher Roll Marking App outlined in the chapter.

Programming Folio Marking Criteria

Programming Skills:

- Naming variables and objects
- Using provided examples and adapting them effectively
- Looking up alternative solutions online
- External storage of data used effectively

Problem Solving Skills:

- Data management
- Validation
- Use of control structures & sequencing
- Conditions
- Functions

Usability:

- Interface design
- Output format

Project Two Project Proposal

Students write a project proposal that outlines their own programming project. It should include a brief introduction that outlines who will use the program and what it does. The proposal should be in two parts:

1. Analysis, where the students create a context diagram, a use case diagram and a data flow diagram.

2. Design, where the students create an interface design that shows what the program will look like on the screen. Finally, they must create an algorithm in pseudocode.

Project Proposal Marking Criteria

- Context Diagram - three components
- Use Case Diagram - Actors, Use Cases and their connections.
- Data Flow Diagram - Entities, Data Flow, Data Stores and Processes.
- Interface design should be easy to understand
- Interface should be easy to use.
- Algorithm should use the conventions of pseudocode
- Algorithm should be a logical solution

Project Three Programming Project

Students create a program of their own design from their proposal. The marking criteria remain the same as per the Folio task.

4b. eCommerce

Market Research

To start and run a successful business you need to know all about your potential and existing customers and the marketplace you operate in. Market research is a valuable tool for all businesses. Statistics and other market research data help you make informed decisions about the marketing of your business.

Obtaining statistics and conducting market research can give you a better understanding of your market, your customers and their needs, as well as giving you a better insight into your competitors. This greater understanding of your market can help you better focus your marketing efforts, make informed decisions about your business and make the most of available opportunities.

It's important to regularly assess who your competitors are, their strengths and weaknesses, who your customers are and what they want, and whether there are any gaps in the market. This can be crucial during all stages, including starting, running or growing your business. It's also helpful to understand market trends so you can make the most of your business opportunities. Look for information in market reports, government statistics, trade publications and industry association publications to find out new developments and possibilities both in your industry and in the commercial environment.

Customer Characteristics

When you are identifying your product or service, it is important to know who exactly are your customers and what problem are you solving for them, and how will your product or service succeed in the marketplace where others may have failed?

A buyer persona is a semi-fictional representation of your ideal customer based on market research and real data about your existing customers.

This is the person you are creating your content, products or service for. They can't wait for you to launch because you solve a problem they have!

Instead of focusing on "target market" or something abstract, you humanise your marketing and make it real. Developing a buyer persona results in stronger and more cost effective marketing. It allows you to convey a more tailored message, minimise advertising waste and discover objections holding back customers. When you can put a name to your customers, you can hopefully meet their needs better.

There are plenty of online methods to gather your Buyer Persona Data:

- Quora.com – see the most common questions for your niche.
- Facebook Groups – review profiles of group members.
- Online Marketplaces & Review Sites – Amazon, Yelp, Udemy, AppStore etc.
- Typeform – ask what is your biggest fear / frustration with topic x.
- Google Analytics – review demographic & interest reports.
- Facebook Analytics – review demographic reports.
- YouTube Analytics – review demographic reports.

Finally, remember your buyer persona is only a theory. You will test this theory with the feedback and data you'll collect about your audience as your business grows.

Defining your product

In the process of researching your market and validating your product, you might find you will need to refine your product. Sometimes you have one idea in your mind about what would be an ideal product, but your market research tells you it will not be as popular as you had hoped. You may need to re-define your product to make it more marketable. You should attempt to answer the following questions to make a clear definition of your product:

- What is your product?
- What is unique about your product?
- What other products are on the market that are similar or the same?
- Is there a GAP in the market that your product can fill?
- Provide examples of other products that failed.
- Provide examples of other products that succeeded.
- What market trends does your product tap into?
- Who are your customers?
- Where can you access your customers online?
- What online phenomenon can your product's marketing tap into?

Activity 1

Students will design their own product and answer the questions.

Class discussion can allow for idea enhancement and feedback.

CASE STUDY

The Product

Averil developed a cat themed board game because she loved playing board games and loved cats. It's always good to go with your passions. Her board game has gone through many iterations since its first draft two years ago. There has been a lot of product testing with friends and with people she does not know. It is crucial to get accurate and honest feedback on the viability of your product.

During the development of the game, it was crucial to identify that it was a viable product that would fill a gap in the already crowded board game market. Averil's logic behind developing this product is that despite there being hundreds of board games on the market, she could not find any cute cat ones.

Who are the customers?

Averil decided that the two key customers would be:

1. Board Gamers
2. Cat Lovers

1. Board Gamer Market Research

Averil continued to get ongoing feedback from players throughout the development of the product. Monthly gaming meet-ups has resulted in 64 board game players to test the product. These players were surveyed. Another 27 players were surveyed without having played the game.

Board gamers who HAVE played the game (64 surveyed):

- When asked " Would you play again?" YES 92% NO 8%

Board Gamers who have NOT played the game (27 surveyed):

- Question 1: Would you choose a game about cats in a store? YES 46% NO 54%
- Question 2: What is your impression of the type of game it is based on the design?

  Children's Game 65% Family Game 32% Adult Game 3%

Specialist

2. Cat Lovers

The internet is full of cat websites, social media cat groups, cat videos and cat memes. Averil decided to make a long list of Cat groups on social media to distribute a survey.

She managed to obtain responses from 301 people from the surveys circulated on the cat groups on Facebook, Instagram and others. She asked them whether they liked board games, whether they would buy the cat game and about their style preferences. She used =COUNTIF() in Excel on the data she collected, and calculated the percentages of respondents that answered yes to each question. (See the spreadsheet below).

Unfortunately, this did not give her enough information.
She wanted to know how many people liked both cats and boardgames and would buy the game. These people represent her buyer persona. She wanted to know their preferences in styles from Disney to cat cartoons like Pusheen.

B304 =COUNTIF(B2:B302,"y")

	A	B	C	D	E	F	G	H
1	Cat Lovers SURVEY	Likes board games	Would buy Cat Game	Pusheen	Disney	Hanna Barbera	Cat T-Shirt	
296		n	y	n	y	n	n	
297		y	n	y	n	n	n	
298		n	y	y	n	y	n	
299		y	n	y	n	n	n	
300		y	n	y	n	n	n	
301		y	n	y	y	n	y	
302		n	y	n	y	n	y	
303								
304		183	169	219	154	89	122	
305		61%	56%	73%	51%	29%	40%	
306								

This required some extra formulas. In the spreadsheet below you can see in column I the results of the formula:

=IF(AND(B2="y", C2="y"), "BP", " ")

This formula will display "BP" in this column if both B2 and C2 contain "y". Otherwise it will leave the cell blank.

Then Averil can use COUNTIF to get the number of respondents who both like the board game and would buy the board game. The fact that the respondents are on a cat group online means she does not have to ask them if they like cats. A total of 104 people are identified as Buyer Personas.

Then Averil wanted to know which graphic style of cat her buyer persona's preferred. Again, she used the =IF(AND()) function and was able to display "Pusheen" where recipients had both "BP" in the I column and "y" in the Pusheen column. At the bottom, she counted the number of "Pusheen" cells using =COUNTIF().

Clearly Pusheen was the most popular graphic design amongst the people who would buy the board game. This is important information for Averil. She can adjust her designs and her marketing of the product accordingly.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Cat Lovers SURVEY	Likes board games	Would buy Cat Game	Pusheen	Disney	Hanna Barbera	Cat T-Shirt		Buyer Persona	Pusheen	Disney	Hanna Barbera
291		y	y	y	n	y	n		BP	Pusheen	Disney	
292		y	n	y	y	y	y					
293		n	n	n	y	n	n					
294		y	y	y	y	n	y		BP	Pusheen		Hanna Barbara
295		y	n	y	y	y	y					
296		y	y	y	n	y	n		BP	Pusheen	Disney	
297		y	y	n	y	n	n		BP			
298		y	n	y	n	n	n					
299		y	y	y	n	y	n		BP	Pusheen	Disney	
300		y	y	y	y	n	y		BP	Pusheen		Hanna Barbara
301		y	n	y	y	n	y					
302		n	y	n	y	n	y					
303												
304		213	174	229	161	103	123		104	90	46	38
305		71%	58%	76%	53%	34%	41%		34%	30%	15%	13%

Specialist

Collecting Data

To conduct market research you need to ask questions of your potential customers. You need to collect enough data to give you a clear picture of your buyer persona. The more data you collect, the more accurately you can draw conclusions. Two key ways of collecting data are Online Surveys and Focus Groups. We have all done online surveys. Not all survey questions are informative, or relevant to what you need to know. In the Case Study, Averil gets people to play her board game to get feedback. This is a form of focus group where they discuss and experience the product to provide information. It is important that you collect data using collection tools that allow you to easily analyse the data. If you want people to give you all the information they know about their board game experiences you might ask a questions like:

"Tell me about a board game you played and didn't enjoy."

This is an OPEN question where you are asking for a lot of information, a story, a description that you might have to investigate further. Open questions provide information that you had not anticipated. They take a lot longer to read and organise into data that can be analysed.

It is far easier to write CLOSED questions. These are questions where there is a limited range of answers. These can be questions with a "yes" or "no" answer A multi-choice question allows the recipient to choose one of the small range of possible answers. A Likert Scale closes down the range of responses to complex questions like:

"How did it make you feel?

Instead of allowing the user to write a long sentence, you can offer the following options:

1) I really loved it

2) It was fun

3) It was OK

4) I was bored

5) I hated it.

You may be familiar with questions such as:

"This board game is the best game I have ever played"

1. Strongly Agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly Disagree.

This is called a Likert Scale. It makes it easier to analyse the data than if you ask OPEN questions. Open questions yield too much data. They are also difficult to graph! These kinds of questions can be very valuable because they are often anecdotal and may give you an insight into the desires of your potential customers.

It is important that you take care with your examination of the data collected. You are looking for feedback about your product. In the case of getting negative feedback, make sure you have questions that will collect data on why. Try to minimise the number of OPEN questions you need to read. Remember if you have over 50 respondents with several sentences, you are going to have trouble analysing all that information.

There are plenty of online forms that can collect data for free. Google Forms, Facebook Surveys, Survey Monkey and TypeForm. Students can use these tools to circulate their questions on social media to collect data. It is important that students know where their buyer persona would be online and target them using appropriate social media. Take care to read the rules of any online social media group you target to ensure you are allowed to collect commercial data.

Activity 2

Students conduct market research to validate the product. Design a product and write 10 market research questions. In the class, discuss the product ideas and the questions.

Analysis

If you used Google Forms or TypeForm, they both connect to your Google Sheets so you can download your data. These collection tools offer analysis, often displaying your results in graphs. This can be helpful, but not always useful. In the case study, you could see that it was combinations of question results were more informative. You can use Excel to analyse your data using the following formulas.

=AVERAGE( )	to find the mean or average of a set of values
=MAX( )	to find the maximum value in an unsorted set of values
=MIN( )	to find the minimum value in an unsorted set of values
=MODE( )	to find the most repeated data point in a set of values
=COUNTIF( ) and =IF(AND( ))	to check a condition

Other techniques include:

SORT & FILTER	allows for the data to be reorganised from A-Z or vice versa.
VLOOKUP	allows a formula to find a data point in a look up table to return another data point in association.
GRAPHS	a visual display of a data set to make the data easier to read and present.

Now it's time to tell the story of the data. What does the data say about your product? What have potential customers told you about what they want?

It may take about a week to collect data from online. Keep checking your numbers everyday. If you are getting no responses, rethink where you are posting the survey and how you are describing its purpose.

Activity 3

Students use Excel to analyse their data and create some key graphs to validate their product.

Infographics are now an important method of displaying data. Infographics combine icons, graphics, diagrams and data display to tell the story of the data collected.

Characteristics of infographics include:

- Use of icons that minimizes reading text. Icons are a shortcut to meaning and bring the purpose of the infographic in sharp relief for the viewer quickly and easily
- Use of a limited colour palette or use of colours that are linked to the purpose or subject of the infographic
- Use of line to organise the layout to separate, divide or connect ideas
- Use of whitespace to keep the infographic from looking crowded
- Charts and Graphs depicting data
- Secondary data to support collected data
- Use of repetition - repeated font types, image sizes, colours, formats etc.
- Headings and labels are provocative or interesting to draw the reader in
- Incorporating balance in the overall layout makes the infographic more appealing
- Use of a metaphor in how the data is displayed.

When displaying data in a graphical form, it is important to choose the right chart:

- Bar graphs make comparisons such as number of students enrolled in different subjects.
- Pie charts display proportions or percentages of a whole such as numbers of students in this class who play rugby.
- Time lines show events in chronological order.
- Scatter plots show widely variant data placed between two variables to investigate a relationship between those variables
- Line graphs show a relationship between an independent variable (often it is time) and a dependent variable.
- Bubble charts provide three or more variables to be displayed in the chart.

Infographics can be developed in Office software such as Microsft Word or PowerPoint, but most are developed using online tools. These tools provide easy access to icons and diagrams that use a set colour theme to ensure they look professional. You can even put raw data into them and use their graph making features. Free online infographic tools include: Canva, Piktochart, Venngage, Visme, Easely and many others.

Activity 4

Students use their analysed data to create an Infographic.

The Business Plan

Every book on 'how to do well in business' will tell you to create a business plan. It is an essential first step in starting a business. It defines your goals and objectives for the business. You can use this document to communicate with investors, banks and business partners to ensure that everyone knows what your business is about.

A Business Plan contains:

1. A summary page (completed last)
2. An outline of the business details
3. Product/service description
4. The operations of the business
5. Market research analysis
6. Overview of competitors
7. Projected finances

For the purposes of this course, we will only look at the first 6 sections.

- Section 2 contains all the contact details of who owns the business, where it is located and how it will operate.
- Section 3 describes in detail, the product or service the business intends to profit from.
- Section 4 outlines how the business will operate - in our case, we will be operating our business online using an eCommerce website.
- Section 5 should include a summary of your research, including the Excel sheets and the infographic.
- Section 6 outlines who your competitors are, and why your product or service is filling a gap in the market.
- Section 1 summarises all the main points of the business plan.
- Use the templates available on **www.business.gov.au**

The Internet

The internet is a network of computers that are available for access by anyone with a browser. A browser is software that interprets HTML code and displays it on the user's screen. HTML = HyperText Markup Language. The internet is generally defined as a global network connecting millions of computers. More than 190 countries are linked into exchanges of data, news and opinions.

The internet is not the World Wide Web (WWW). The internet is a massive network of networks, a networking infrastructure. It connects millions of computers together globally, forming a network in which any computer can communicate with any other computer as long as they are both connected to the Internet. The World Wide Web, or simply web, is a way of accessing information over the medium of the Internet. It is an information-sharing model that is built on top of the internet.

The WWW has a set of rules called protocols that allows computers to share information. Commonly used protocols are HTTP, TCP/IP and DNS.

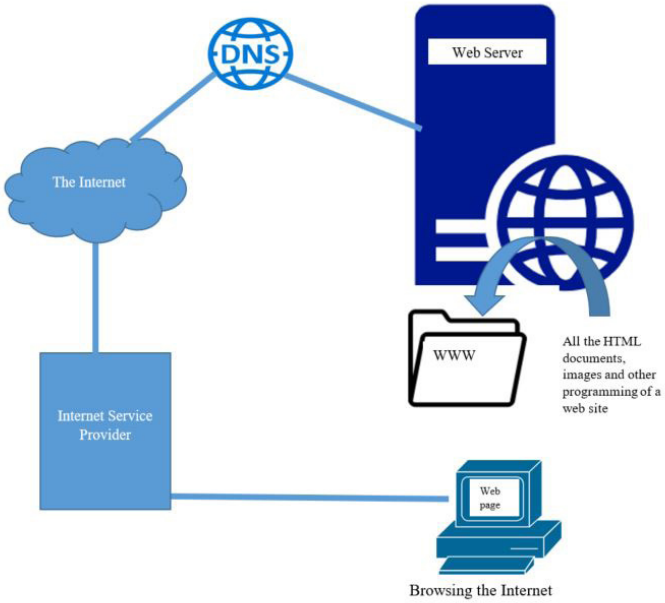
You may be familiar with HTTP. This stands for HyperText Transfer Protocol which establishes the rules for how information passes through the internet to allow the user to see HTML pages through their browser. The TCP/IP (Transmission Control Protocol/Internet Protocol) automatically provides each computer accessing the internet with an identification number so data can find it's destination location and source location - it also provides a method that allows one machine to find another through the massive network of machines that make up the internet.

When you want to send a message or retrieve information from another computer, the TCP/IP protocols are what make the transmission possible. Your request goes out over the network, hitting Domain Name Servers (DNS) along the way to find the target server. The DNS points the request in the right direction. Once the target server receives the request, it can send a response back to your computer. The data might travel a completely different path to get back to you. This flexible approach to data transfer is part of what makes the internet such a powerful tool.

A website is stored on a web server (which is a device that stores HTML and allows browsers access to it's WWW folder). When a person is browsing the internet, they enter a URL (Universal Resource Locator). A URL is the address of the web server that hosts the website.

For example: www.cats.gov.au is the URL for a government website in Australia about cats. (of course). The owner of the website will have registered the domain name "cats.gov.au" with a Domain Name Server (DNS). The Domain Name Server directs any browser to the correct web server that owns the domain name.

Below is a diagram that illustrates the journey of a website to be accessed by someone browsing the internet.



The user may type in the www.cats.gov.au URL or they may access that URL through a link. The URL directs them to where the URL is registered at the DNS. The DNS points the request to the web server which allows the index page of the WWW folder to be downloaded to the computer of the user and displayed in the browser.

In previous chapters we have covered HTML and CSS. These scripting languages organise the content of the website and format the text and other features. In this chapter we are going to investigate a server-side scripting language called PHP. PHP stands for PHP Hypertext Pre-Processor and it is executed on a web server. When testing your web pages in HTML and CSS, you used to open the files in a browser, but with PHP, you need to run web server software to see your page in a browser. There are two ways to run a web server:

1. Download and install a web server such as XAMPP: **www.apachefriends.org**
2. Use a web hosting service online such as this free service: **www.awardspace.com**

Not all schools will allow access to an online web server cPanel, the interface for the web developer to control the online web server - or be able to afford the service. Below, we have provided the instructions on how to use XAMPP on both Mac and PC computers. XAMPP is a free, open source server.

SETTING UP THE WEBSERVER ON A MAC

- **Open XAMPP**
- **Click "Start" and wait till the Status light turns green**
- **Click "Volumes"**
- **Click "Mount"**
- **Open Finder - you should see 192.168.64.2 (The IP address of your web server) under "Locations" Click on it.**
- **Open "lampp"**
- **Open "htdocs" - this is the file directory where you will be storing your web site so it can be served to your browser via the XAMPP web server.**
- **Open Atom to create your first php file (File - New)**
- **File - Save As allows you to save to "htdocs"**
- **You should now be able to see your file in the "Project" section of Atom including the folders it is stored in.**
- **When you load your php file into Chrome - you can click and drag - then you need to replace the address string with the IP address.**
- **Example: /Users/YourName/.bitnami/stackman/machines/xampp/volumes/root/htdocs/MyfirstWebsite/index.php**
- **Replace: /Users/YourName/.bitnami/stackman/machines/xampp/volumes/root/htdocs with 192.168.64.2**
- **Correct Address: 192.168.64.2/MyFirstWebsite/index.php**

SETTING UP THE WEBSERVER ON A PC

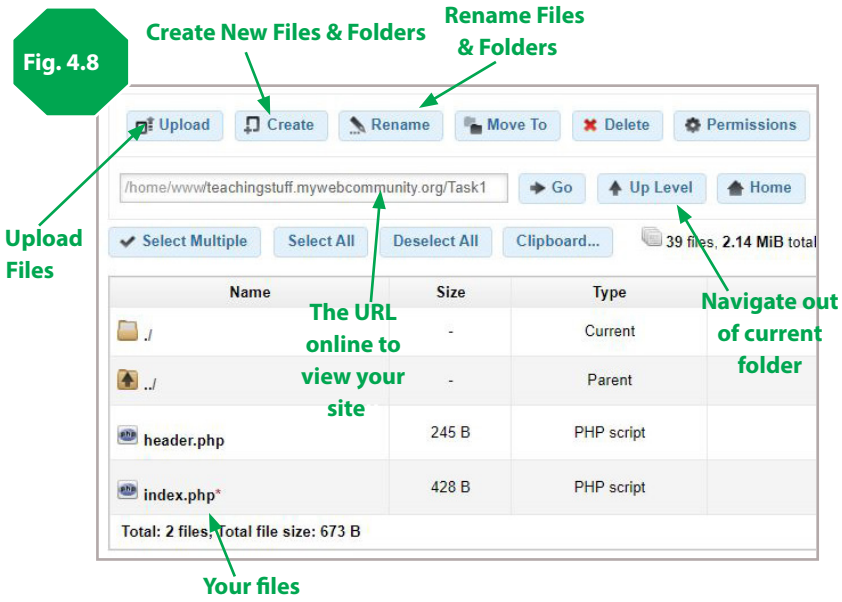
- **Open XAMPP**
- **Click the "Start" button next to "Apache"**
- **Open Notepad++ or Atom to create a php file (File - New)**
- **To save your php file so XAMP can load it (File - Save As) and navigate to:**
- **Windows (C:) - xampp - htdocs**
- **When you load your php file into Chrome you need to replace the address with "localhost"**
- **Example: C:/xampp/htdocs/MyFirstWebsite/index.php**
- **Replace: C:/xampp/htdocs/ with "localhost"**
- **Correct Address: localhost/MyFirstWebsite/index.php**

You do need to take care running a web server on your computer. Ensure you are offline when you are installing XAMPP or running it for long periods of time. By default, XAMPP has no passwords set and it is not recommended to run XAMPP with this configuration as it is accessible to others. Simply type the following command (as root) to start a simple security check: "**sudo /opt/lampp/lampp security"**

This will allow you to change the password to the MySQL/phpMyAdmin. Setting a password will protect the XAMPP demo pages (http://localhost/xampp/) using this password. The user name is 'lampp'. After running this command, your XAMPP installation should be more secure.

There are plenty of web hosting services online, but most of them charge fees. Awardspace.com is a free web hosting service. You can create your files and folders online in their File Manager. This will give you a real experience of dealing with cPanel, the graphical user interface for web hosting, used the world over. You can see in the window on the right, access to the File Manager. In Fig 4.8 below you can see the file manager, all the features you can use and the two files that we will be creating in our first task: index.php and header.php.

Fig. 4.8



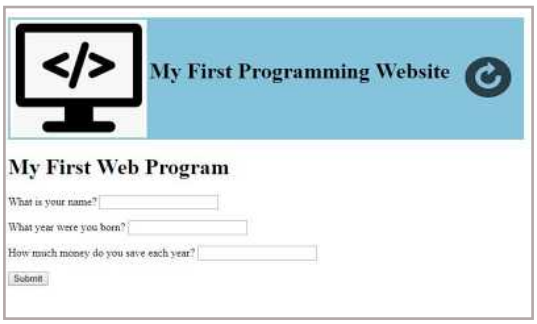
We are going to create a header document that will be used on each page. In PHP we can create separate documents for a header or a footer for our website and call them up to display using the code:

<?php include (“header.php”); ?>

To declare the code is PHP, we need to use the open tag **<?php** and the close tag **?>**. The function is ‘**nclude** which displays the contents of the PHP page identified in the brackets. You can see the code creates the header illustrated below, one row with three columns containing icon.jpg, “My First Programming Website and refreshicon.jpg. The refreshicon.jpg is a button to reload index.php. In this webpage we have only included HTML.

HEADER.PHP

```
<html>
<body>
<table bgcolor=#7cbed8>
<tr>
<td> <img src=”images/icon.jpg”></td>
<td><h1> My First Programming Website </h1></td>
<td> <a href=”input.php”><img src=”images/refreshicon.jpg”></a></td>
</tr>
</table>
</body>
</html>
```



Specialist

Now we are going to code the input page. You can see in the code below where the header.php is included. We then have a header “My First Web Program” and then a form. A form is HTML and it can collect data from the visitor to the website. The first thing the form tag does is identify what it will do with the data collected. This form will “post” the data to a page called output.php.

To create the input boxes you can see we use an input tag and identify the data type, and then name the variable the data will be stored in. **<input type=”number” name=”savings” />** Will only read in a value and store the value into a variable called “savings”. Input type “submit” creates a button that will post the data to output.php.

INPUT.PHP

```
<html>
<body>
<?php include (“header.php”); ?>
<h1>My First Web Program</h1>
<form action=”output.php” method=”post” />
<p> What is your name? <input type=”text” name=”username” /></p>
<p> What year were you born? <input type=”number” name=”dob” /></p>
<p> How much money do you save each year? <input type=”number” name=”savings” /></p>
<input type=”submit” value=”Submit” />
</form>
</body>
</html>
```

Now let’s write the output page and collect the data posted from input.php.

OUTPUT.PHP

```
<?php
include(“header.php”);
$username = $_POST[“username”];
$dob = $_POST[“dob”];
$savings = $_POST[“savings”];
$age = 2021 - $dob;
$total = (67-$age) * $savings;
echo “<br><br>”;
echo “Hello $username. You are $age years old.”;
echo “If you save $savings each year you will have $ $total when you retire”;
?>
```

You can see the whole page is written in PHP. The first and last lines are our PHP tags. Each line ends in a semi-colon (**;**) to execute the PHP code line. You can see the **include** function for the header on the second line. The next five lines start with PHP variables. All variables in PHP start with a dollar sign (**$**). **$username**, **$dob** and **$savings** are retrieved from the posting on the previous page. You can see we have used the same variable names from the form on input.php. Finally **$age** and **$total** are calculated. **$total** is calculated by multiplying how much you save per year by the number of years till retirement. The current age of retirement in Australia is 67.

‘**echo**’ is a PHP instruction to display data to the screen. You can see the first echo includes two HTML **
** tags to create line breaks. Remember, if you are coding for a browser, the data needs to be formatted with HTML, so we use **echo** to pass the HTML to the screen.

Decision Control Structure

Now we want our program to be more accurate. If you have not had your birthday yet, it may not have calculated your age correctly. So, we are going to add a new input box on the input page:

"Have you had your birthday this year yet? (y/n)"

```
<input type="text" name="adjust" />
```

We can call this variable "adjust" and set it to text in our "input.php". Read it into your output page as a PHP variable: $adjust. Below is the code for the updated output.php page. We have included an IF Statement to test if $adjust contains the letter n (upper or lower case).

OUTPUT.PHP

```
<?php
include("header.php");
$username = $_POST["username"];
$dob = $_POST["dob"];
$savings = $_POST["savings"];
$adjust = $_POST["adjust"];
If ($adjust == "n" || $adjust == "N") {
$age = (2021 – $dob) – 1;
} else {
$age = 2021 - $dob;
}
$total = (67-$age) * $savings;
echo "<br><br>";
echo "Hello $username. You are $age years old.";
echo "If you save $savings each year you will have
$ $total when you retire";
?>
```

PHP Syntax

Curly Braces { }

We use curly brackets called "Braces" { } to group code together. For example when we say,

IF (Age >18) then we group the code that executes when the condition is True, and then group the code to run when the condition is False.

Semicolon ;

Each line of PHP needs to end with a semicolon, unless there is a brace required after a condition is tested.

Equals

To assign data to a variable we use a single equals sign **($age = 2021 = $dob)**. When we are testing a variable with a condition we use a double equals **($adjust == "n")**.

PHP Tags

<?php to open and **?>** to close.

PHP Variables

All PHP variables must start with **$**.

Iteration Control Structure

Computers are really good at repeating lots of boring jobs quickly. That is why being able to write loops in your program can be enormously useful.

The first type of loop we are going to use is the COUNTED loop. This is when we know how many times we want to repeat code.

In our little programming website we are going to use a loop to display how many separate savings the user will have accumulated for each year until they are ready to retire.

```
<?php
include("header.inc.php");
$username = $_POST["username"];
$dob = $_POST["dob"];
$savings = $_POST["savings"];
$adjust = $_POST["adjust"];
if ($adjust == "n" || $adjust == "N") {
$age = (2021 - $dob)-1;
} else {
$age = 2021 - $dob;
}
$total = (67-$age) * $savings;
echo "<br><br>";
echo "Hello $username. You are $age years old. ";
echo " If you save $savings each year you will have $ $total when you retire <br><br>";
$year = 2021;
$retirement = 67 - $age;
for ($count =0; $count <= $retirement; $count++){
    $year = $year + 1;
    $saved = $savings * $count;
    echo "In $year you will have $ $saved <br>";
}
?>
```

Fig. 4.9

In the loop highlighted above, you can see we have set **$year** to 2021 and then added 1 to the year for each loop. **$retirement** is the number of years until the user is 67. The "FOR" loop identifies **$count** will start at 0 and repeat until **$count = $retirement** by adding 1 to **$count** each time it repeats. **$count++** is the same as **$count = $count + 1**.

Each time it repeats, it prints to the screen the year and the amount of money accumulated. **$count** is used to multiply the **$savings** per year to see the accumulated amount. The output is illustrated in Fig 4.9. You can see each loop prints the new total for the savings until the number of repeats is complete. It adds one to the year and savings to a running total.

An uncounted loop repeats a sequence of instructions until a condition is met. We use uncounted loops when we don't know how many times we need to repeat the code.

For example: The government tells us, if we are to retire comfortably, we should retire with $500,000. Let's create a calculator to find out how much money you would need to save to accumulate the $500,000 given your age in 2021.

Specialist

Activity 5

As a class, brainstorm how you could use the IF statement and the Loop in a website. Design the input page and the output page. Code the solution.

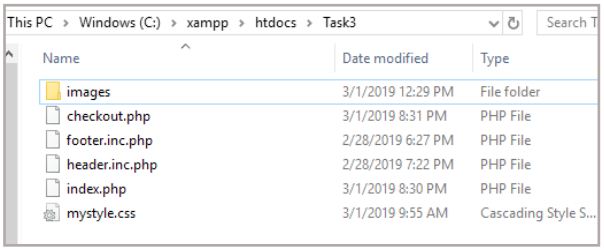
eCommerce Basic Model Website

We are going to set up a basic eCommerce website. It reads in the user selections, places the total number of items into the cart, calculates the total cost of the order, and displays it on the checkout.php page.

Obviously, most eCommerce pages offer more features, so refer to **w3schools/php** for more coding tips to add extra features. Don't forget CSS is able to provide a lot of functionality too, to create interactive menus and slideshows of product photos. w3schools contains all the resources you need.

INDEX.PHP

Fig. 4.10



You can see in Fig 4.10 that we are going to make a home page called "index.php" and a "checkout.php" page for our calculated order details. We have a "header.php" and "footer.php" to be included in both of the pages. Finally we have a "mystyle.css" cascading style sheet to control how the HTML displays the data. Let's start with the footer and the header.

FOOTER.PHP

```
<!DOCTYPE html>
<body>
<table width=100% bgcolor=#000000> <tr>
<td width= 80%><H2> Games on Tees is owned by Product Inc</H2></td>
<td width= 20%><H2> Copyright 2021</H3></td> </tr>
</table>
</body>
</html>
```

HEADER.PHP

```
<!DOCTYPE html>
<body>
<table width=100% bgcolor=#000000> <tr>
<td width= 80%><a href="index.php"><img src="images/header.JPG"></a></td>
<td width= 20%><a href="checkout.php"><img src="images/cart.JPG"></a>
<?php
$TotalAmt = $_SESSION("TotalAmt");
echo"<br> $TotalAmt Items <br>";
?>
</td></tr></table>
</body>
</html>
```

The footer.php is fairly straight forward, but you can see in header.php, we are collecting data posted from a SESSION. The session will start on the checkout.php page and deliver the total number of items into the header under the cart. You can see this in Fig 4.10.

Now let's collect the data on the index.php page. We are going to use two kinds of input; checkboxes that will allocate which product is selected, and a textbox to read in the amount of each item.

INDEX.PHP

```
<?php session_start(); ?>
<!DOCTYPE html>
<head> <link rel="stylesheet" type="text/css" href="mystyle.css" ?> </head>
<body>
<?php include("header.php");  ?>
<center><H1> Welcome to Games on Tees. Have a look around</H1><br><p>
<form action="checkout.php" method="post" />
<input type="submit" value="Submit" /><br><br>
<table width = 70% bgcolor = "green" border = 1>
<tr><td 10%><p>GTA Tee Shirt</p></td>
<td><center><img src="images/gta.jpg"></center></td>
<td 10%> <p><input type="checkbox" name="gtaPrice" method = "post"> Price: $16.95</p></td>
<td 10%><p> Amount</p><center><input type="text" name="gtaAmt" value = "0"></center></td></tr>
<tr><td 10%><p>Minecraft Tee Shirt</p></td>
<td><center><img src="images/Minecraft .jpg"></center></td>
<td 10%> <p><input type="checkbox" name="minecraftPrice" method = "post"> Price: $15.95</p></td>
<td 10%><p> Amount</p><center><input type="text" name="minecraftAmt" value = "0"></center></td></tr>
<tr><td 10%><p>Fortnite Tee Shirt</p></td>
<td><center><img src="images/fortnite.jpg"></center></td>
<td 10%> <p><input type="checkbox" name="fortnitePrice" method = "post"> Price: $17.95</p></td>
<td 10%><p> Amount</p><center><input type="text" name="fortniteAmt" value = "0"></center></td></tr>
</table></form>
<?php include("footer.php">; ?>
</center></body>
</html>
```

CHECKOUT.PHP

```
<!DOCTYPE html>
<head> <link rel="stylesheet" type="text/css" href="mystyle.css" ?> </head>
<body>
<?php session_start() ;
$gtaPrice = 16.95;
$minecraftPrice = 15.95;
$fortnitePrice = 17.95
if(isset ($_POST["gtaPrice"])) {
        $gtaAmt = $_POST["gtaAmt"];
        $gtaCost = $gtaPrice * $gtaAmt;
} else {
        $gtaAmt = 0;
        $gtaCost = 0;
}
if(isset ($_POST["minecraftPrice"])) {
        $minecraftAmt = $_POST["minecraftAmt"];
        $minecraftCost = $minecraftPrice * $minecraftAmt;
} else {
        $minecraftAmt = 0;
        $minecraftCost = 0;
}
if(isset ($_POST["fortnitePrice"])) {
        $fortniteAmt = $_POST["fortniteAmt"];
        $fortniteCost = $fortnitePrice * $fortniteAmt;
} else {
        $fortniteAmt = 0;
        $fortniteCost = 0;
}
$TotalAmt = $gtaAmt + minecraftAmt + fortniteAmt;
$TotalCost = $gtaCost+ minecraftCost + fortniteCost;
include ("header.php");
?>
<form action="index.php" method="post" />
<table width = 70% bgcolor = "green" border = 1> <tr>
<td 10%<p> Your Selections</p></td>
<td 10%> <p>
<?php
$TotalAmt = $_session["TotalAmt"];
$TotalCost= $_session["TotalCost"];
echo "Number of items selected: $TotalAmt <br>";
echo "Total Cost: $ $TotalCost";
?>
</td></tr></table>
<?php include ("footer.php"); ?>
</body></html>
```

Once the PHP session is started on the checkout.php page, we assign the values for each of the prices.

Then we run an IF statement. IF **gtaPrice** (which was a checkbox on index.php) isset (this means it contains input or is set to True) then it will place the value that was posted into **gtaAmt** textbox to indicate how many shirts the user wants.

Then we can calculate the cost of all the GTA tee shirts ordered.

Otherwise, both the amount (**$gtaAmt**) and cost (**$gtaCost**) will be assigned zero.

We check each of the tee shirt types to see if any checkbox are selected.

Here we can add up the total amounts and the total costs.

We display the header.

Then we display the total number of items chosen and the total cost of their order. We post the variables $TotalCost and $TotalAmt in a form so that they can be posted up to the header, if we want to keep adding more to our cart.

Finally we display the footer.

MYSTYLES.CSS

```
body{
        font-family: Arial, sans-serif;
        font-size: 90%
        color: #222222
        margin: 50px;
        padding: 0px;
}
td{
        font-family: Verdana, sans-serif;
        font-size: 100%
        color: #ffffff
        margin: 10px;
        padding: 0px;
}
p{
        font-family: Arial, sans-serif;
        font-size: 100%
        color: #ffffff
        margin: 10px;
        padding: 0px;
}
H1{
        font-family: Verdana, sans-serif;
        font-size: 200%
        color: #22ff22
        margin: 0px;
        padding: 0px;
}
H2{
        font-family: Verdana, sans-serif;
        font-size: 70%
        color: #53bb4c
        margin: 10px;
        padding: 0px;
}
```

Our last file is our CSS file. This is how you can control you design by allocating colour and size to different fonts and other objects used in the HTML.

Activity 6

Students should get this code working for the Games on Tees website. Once they get it working they can use some of the code and adapt it for their own eCommerce websites.

Online Marketing

There are three main approaches to online marketing:

1. Search Engine Optimisation (SEO)
2. Social Media Marketing
3. Content Marketing

Search Engine Optimisation

SEO or Search Engine Optimisation is the technique of using keywords in your website to assist your customers in finding your website with a Google Search. Using keywords on your site is about matching the language on your site to the language that your customers use when they search for you. We do this to an extent in everyday life, but don't realise it because it's normal and natural. For example, a plumber doesn't take out a billboard announcing that they will "fix all your sillcocks!" Instead, the plumber announces that they can "fix all your outdoor taps!" Same service – different language. Keywords are simply how people search for your product or service. Your end goal is to help your customer find what they are looking for. Google is just the intermediary between you and your customer.

The goal of SEO and the effective use of keywords is to help Google understand your site. However, you have to keep in mind that Google is not stupid. Google is going to catch any attempt to deceive or manipulate. Remember, Google is not a human, and it's not your customer. Google loves SEO when it is done well. Your goal with understanding how to use keywords on your site is to help Google understand what your website, and each page on your site is about, so that customers searching through Google can find what they are looking for. Again: your goal is to help the person searching by helping the search engines – not trying to trick, spam or manipulate the person searching by spamming the search engines.

Choosing target keywords may require some brainstorming, online searching and the use of some online tools to suggests keywords. Once you have a list of possible keywords & phrases, start by reviewing the first page of Google for each keyword. Look to see if there are well established sites with high quality content. Eliminate overly competitive keywords and focus on keywords you actually have a chance to rank in. Your chosen keywords will be the centrepieces of your content.

Choose one keyword per page. You'll generally want to start with lower-volume keywords. Write title tags in your HTML. Every page of your website should have unique title tag, preferably starting with a relevant keyword. Include modifiers like "best", "2016" etc. to stand out and to pick up long tail searches. Keep title tags 55 characters or less or they'll appear truncated in search results.

When adding keywords to your website, it is important to include your keyword in 6 places on each page of your website. Including your keyword in these 6 areas will help search engines identify the subject of your page and rank your page in search results.

- Page title
- Meta description
- Header
- Sub header
- Body paragraphs
- Image alt tags

Page titles and meta descriptions are a more technical part of keywording your website. However, it is important to recognize how valuable they can be for your internet marketing efforts. Page titles and meta descriptions are parts of your website page that actually show up in search results, they are the first impression a searcher gets of your website page. You can read this information directly on the Google search result page.

Social Media Marketing

People love to hang out on social media, which is why we see so many adverts. If we search for a sea kayak on Google one day, you might see ads for sea kayaks on Facebook or Pinterest the next day. Businesses know that investigating social media groups is the best way to find out where their customers are online. The use of Instagram Stories is a highly productive method of advertising new products to follower. Hashtags are great to catch the attention of people on Twitter. Facebook Ads allow the business to identify their users when creating a campaign. If you don't have a lot of money to spend on advertising, social media is a cost-effective solution. Just as an example, when researching the market for this textbook, I placed posts on various educational Facebook groups to see if there was any interest. I was bowled over by the number of teachers keen to get a copy. This marketing cost me nothing but time.

Social media marketing may not be the get-rich-quick scheme you may have been promised, but there is significant potential in building and nurturing a social media audience. Again, content will come into play heavily here, as it will likely be the factor that attracts your audience to begin with. Here, you stand to gain greater brand visibility, a greater reputation and far more inbound traffic with your social media links.

Content Marketing

Content marketing is creating content that people want to see or read, for example a video on how to make a website can contain advertising or your product. Content Marketing takes a variety of forms, and depending on how you form your strategy, you could accomplish a number of different goals. You could use instruction manuals, ebooks and other long-form content to attract downloads, signups and sales, or you could use an on-site blog to attract more inbound traffic to your site. One very popular form of content marketing we are all familiar with, is the entertaining YouTube video with product placements.

You could even use content as a form of help and troubleshooting, or some combination of these applications. Content marketing is incredibly versatile and useful. If the content is highly sought after, like solution to a commonly experienced problem, your brand and your marketing will become very visible to possible customers. Do the viewers of the content convert into customers? That may depend on the relationship between the content and your product or service.

Think about how you can use these online marketing strategies to promote your product, and present your ideas in a Marketing Plan. A Marketing Plan Report should contain:

- Introduction: outline the purpose of the marketing - more subscriptions, sales, re-tweets.
- Social Media initiative and strategies: how will you harness social media to market your product?
- SEO: list your keywords and how you will use them as tags.
- Content initiative and strategies: What content will you create in order to market your product? How will you use that content? Competition: What is the competition doing with their marketing in social media and in content publishing?

A brief example Marketing Report:

Introduction

In order to increase traffic to our website for customers to see our new range of sea kayaks, we will run a range of online marketing campaigns. With more traffic, we can collect feedback on the products and sales.

Social Media Marketing

We already have a following on Instagram, so we will post some interesting Instagram Stories including people using about new kayak products to encourage followers to visit our website for more information. Facebook Video advertising can be cost effective if we develop some cool videos of our new products being used.

SEO

Keywords: kayak, sea, sea kayak, ocean, canoe, rowing, paddling, equipment, paddle, surf.

Content Marketing

Our content marketing includes providing kayaking interest groups online with articles on safety, how to care for your kayak an information about great spots to kayaking when travelling.

4b. Specialist Assessment Tasks

Students are asked to respond to the Digital Technology knowledge by using the Information Technology Skills they have developed.

In Specialist Level students learned skills in:

- Collecting data
- Analysing data
- Spreadsheet formulas
- Designing infographics
- HTML and CSS
- PHP

Students developed knowledge and understanding of:

- Market Research
- Business Plans
- Internet Technology

Project One Market Research

Students will develop a product or service idea and conduct market research on social media. Students will need to produce a data collection tool to collect the data. Students must then analyse the data collected using a range of spreadsheet formula.

Market Research Marking Criteria

- Clear description of product or service
- Data Collection Tool contains relevant questions
- Raw data manipulated effectively
- Appropriate spreadsheet formula applied to data.
- Graphs produced from data analysis
- Key values to be used in report.

Project Two Business Plan

Students produce a business plan that outlines the goals and objectives of the business. A full report is made of the market research. A final inforgraphic should be included.

Business Plan Marking Criteria

- Summary Page: outline of the nature of the business.
- Outline of the Business Details: who what where is this business.
- Product/Service Description: a full description of the product or service.
- Market Research Analysis: a brief overview and an infographic.
- Overview of competitors: a brief comparison of competitors and how this business is filling a gap in the market.

Project Three eCommerce Website

Students produce a website for their product. The minimum features must include:

- an option for the customer to make a selection
- a cart in the header managed by PHP that shows how many items are in the cart
- a checkout page that presents the customer's order details
- images of the product.

eCommerce Website Marking Criteria

- CSS manages the design elements for the site.
- Header and footer are managed by PHP.
- All links function (including images).
- Tables, Divs and other HTML sections are used optimally.
- PHP sessions transfer data from one page to another.
- PHP correctly processes the order.
- PHP correctly displays the order details.
-

Project Four Marketing Report

Students will produce a marketing report that includes:

- What the marketing campaign is attempting to achieve
- Methods of using Social Media
- A list of Keywords for SEO and where to put them in the website
- Ideas for Content Marketing.

Marketing Report Marking Criteria

- The report clearly states the purpose of the marketing campaign.
- More than two social media companies are identified, a clear description of how their features will be used to promote the product or service.
- A comprehensive list of keywords is provided and are related to the product or service.
- Innovative content ideas are presented that would be popular and interesting for a target audience.

4c. Data Analytics

What is Data Analytics?

We are living in a time of data. Online, websites collect data from their visitors, banks collect data from their customers, schools collect data on their students. Researchers can use this data to improve services, customise products and reflect on the human condition through analysis. During the 2020 presidential election, Google presented all the data that came to hand to present the most up to date graphical depictions of the ongoing results. This is data analytics. Large amounts of data, investigated and presented in such a way that it is easy to understand in a visual presentation. We are all used to analysing the numbers of our sports teams. Now we can use the same processes to investigate data on almost anything through the use of digital technology. Before you can begin an investigation and start collecting your own data, an hypothesis must be created.

Writing a Hypothesis

A hypothesis is a suggested solution for an unexplained occurrence that does not fit into current accepted scientific theory. When you write a hypothesis you are creating a prediction made on some evidence or observation as a starting point for further investigation. It can be tested in a scientific method and it can only be accepted or rejected.

Hypotheses can be written in the form of:

- an 'If Statement' such as "If rainfall decreases in spring, eastern Australia can expect bush fires."
- a question such as "Does El Niño (changing ocean temperatures) affect the bush fire seasons?"
- a conditional statement such as "With the occurrence of El Niño, eastern Australia will experience bush fires. "

Features of a Hypothesis

All hypotheses need to be developed in a particular process. A researcher might make an observation, or a guess based on published data and ask a question. Once some research has been conducted, the researcher can state a hypothesis that can be tested by gathering data to analyse.

A hypothesis must:

- be able to be tested
- identify clear variables, both independent and dependent.
- be supported or refuted
- make testable predictions
- be based on a specific observation
- be objective
- be specific, not general.

When formulating a hypothesis, you must choose a topic and devise a statement that may be true. Once you have an idea, you need to conduct preliminary research to find sources of data to support your hypothesis. Finally, rewrite the statement as a testable hypothesis. Below is an example:

"El Niño affects the weather around the world. In Australia we experience higher temperatures when the El Niño makes ocean temperatures increase. Rain decreases especially when El Niño is at it's peak around Christmas time. (Source: Bureau of Meteorology, Australian Government)

Hypothesis: Did El Niño cause the 2019-2020 Victorian bushfires?

Data Sources

Data refers to raw and unorganised facts, figures and symbols, which are input to a digital device. Once the data is digitally processed it is turned into information. You can collect and analyse primary or secondary source data. Primary sourced data is collected directly by the researcher, while secondary is already published by other researchers.

Primary sources

- This type of data is recent and up-to-date. The researcher has obtained the data directly from the sources, observer, or by direct observation.
- These original documents can be different first hand documents such as letters, autobiographies, diaries, letters, interviews and others.
- Newspapers can be included only if the articles are about a recent event.

Secondary sources

- These are documents that hold the interpretation of primary sources. They are already published by other researchers.
- These source materials draw conclusions about what was found in primary sources.
- These are usually in the form of published works such as books, documentaries, magazines, articles, conferences and so on.

Variables

A variable is like a container that holds a value. This value will change depending on the conditions. Variables can be independent or dependent. An independent variable is the cause of the change while the dependent variable is the factor that is affected. The findings should not be affected by other factors. To avoid this, a researcher should conduct a fair test by making sure that only one factor is changed at a time while keeping all other variables the same.

Example: Investigating the amount of rainfall before and after an El Niño peak compared to rainfall in a year where normal ocean temperatures are recorded, we would identify the ocean temperatures as the independent variable and the rainfall as the dependent.

Research can use quantitative and qualitative data.

Quantitative data is measurable and specific and therefore it can be represented in charts and tables. It uses numbers and statistics and they are easy to collect and analyse because:

- participant are more willing to take part as it is less time consuming
- it can capture a large sample size
- answers are not in detail and participants cannot provide further detail.

Qualitative data gives a more detailed understanding by collecting words and opinions. This data can be analysed but it can be time consuming depending on the instrument used for gathering data. Usually qualitative data is captured from a small sample size so analysis is possible. Data gathering tools include interviews and focus groups.

Data Types

Data types specify the kind of data that will be stored in a field. It is important that data types are considered when writing questions or formulating data collection tools. These data types may include:

- Text (string): holds a combination of characters to a limit of 255.
- Numeric (integer, decimal) values that can be used in calculations.
- Date is a variation of numeric data type and can be used in calculations.
- Character: a single alphanumeric character saves storage space (Example: sizes S, M and L).
- Boolean: used when there are only two options: True or False.

Activity 1

Students should write a hypothesis based on data sets provided by the teacher. Identify the variables. Discuss your answers with the class.

Primary Source Data Collection Techniques

Observation:

- Gathers information from the natural environment
- Uses a specific collection technology
- The researcher looks for specific information
- The researcher goes to the participants' own environment.

Interviews:

- Gathers opinions, preferences and beliefs
- It is generally on a one-to-one basis
- The environment should be a quiet and relaxed
- The collation and analysis is time consuming and difficult.

Focus groups:

- It is a small group of individuals that discuss some provided questions
- The focus group must be selected carefully
- This group is made up of five to twelve people
- Discussion is guided by the researcher.

Surveys and questionnaires:

- These are common tools for gathering data
- They collect data about preferences
- They have to be designed carefully
- A quick method of gathering large amounts of data
- Questions used in a survey must be carefully worded to gather meaningful and useful data.

Types of Questions

Open questions collect a lot of data that is unforeseen by the interviewer. There is a wider range of options for responses. You are often able to collect qualitative data with open questions. For example:

- "Tell me about the problems you have had with train travel"
- "What kinds of success have you had with these kinds of products?"

Closed questions only allow for a limited range of responses. These questions produce data that is easier to analyse because they are quantifiable. For example:

- Have you ever use this product? (Yes/ No/ Don't know)
- How much rain do you usually get in December? (0 – 200mm)
- What is your postcode?

Secondary Source Data Mining

Data mining is the process of accessing data collected by secondary sources and investigating patterns within the data. We have access to many huge databases on a wide variety of topics such as weather data, social science data, populations, finance, natural systems - they are endless. It is important to choose data from reputable database sources such as governments, research organisations and educational sources. Here are a selection of online data stores that could provide a data mining opportunity:

- http://www.bom.gov.au/climate/
- https://www.abs.gov.au/statistics
- https://data.csiro.au/collections/
- http://data.un.org/
- https://data.nasa.gov/browse

Database Organisation

When identifying tables and fields, it is necessary to understand the requirements of the system so that it works effectively and efficiently. Following on from the Transaction Processing topic in the Advanced chapter you should be familiar with:

Tables

- Should contain data on a specific area of the organisation.
- Should reduce duplication of data from table to table.

Fields

- Should be specific to the table.
- Should contain only one piece of data each (e.g. address should be broken up into street number, street name, suburb and postcode)
- Should allow for easy searching and sorting (e.g. separate fields for first name and surname)

Data types

- Should be the most relevant to the field.
- Should consider what the field will be used for (e.g. phone number will not be used for calculations

  therefore it should be a text data type so that it can be formatted with parentheses and spaces).

Field sizes

- Some data types have automatic field lengths but others provide an option of varying lengths.
- When a field size is selected, that amount of space is reserved in the database, even if it is not all used.

Each table of data is designed by a data dictionary where the fields, data types and field sizes are set. In Fig 4.11 we have a data dictionary for sea temperatures. (Source: https://www.ncdc.noaa.gov/)

Fig. 4.11

Field	Data Type	Size	Description
Month	Text	14	Month name and year example (September 2019)
NiñoRegion1&2 Temp	Decimal	4	Average sea surface temperature in Celcius. (21.36) for Region 1&2
NiñoRegion1&2 Anom	Decimal	4	The extent of difference from the average temperature in Celcius. Region 1&2.
NiñoRegion3 Temp	Decimal	4	Average sea surface temperature in Celcius. (21.36) for Region 3
NiñoRegion3 Anom	Decimal	4	The extent of difference from the average temperature in Celcius. Region 3.
NiñoRegion4 Temp	Decimal	4	Average sea surface temperature in Celcius. (21.36) for Region 4
NiñoRegion4 Anom	Decimal	4	The extent of difference from the average temperature in Celcius. Region 4.

Activity 2

As a class, students should write a small survey to collect data from the class about a teacher approved topic. Create a data dictionary of the data that can be collected from the survey questions.

Niño Regions Sea Surface Temperatures

MONTH	NIÑO 1+2		NIÑO 3		NIÑO 4		NIÑO 3.4	
	TEMP	ANOM	TEMP	ANOM	TEMP	ANOM	TEMP	ANOM
November 2019	21.32°C 70.38°F	-0.27°C -0.49°F	25.46°C 77.83°F	0.48°C 0.86°F	29.47°C 85.05°F	0.84°C 1.51°F	27.26°C 81.07°F	0.61°C 1.10°F
December 2019	23.16°C 73.69°F	0.34°C 0.61°F	25.47°C 77.85°F	0.33°C 0.59°F	29.50°C 85.10°F	1.01°C 1.82°F	27.07°C 80.73°F	0.50°C 0.90°F
January 2020	24.55°C 76.19°F	0.03°C 0.05°F	25.81°C 78.46°F	0.18°C 0.32°F	29.28°C 84.70°F	0.98°C 1.76°F	27.09°C 80.76°F	0.53°C 0.95°F
February 2020	26.56°C 79.81°F	0.42°C 0.76°F	26.61°C 79.90°F	0.24°C 0.43°F	29.17°C 84.51°F	1.08°C 1.94°F	27.14°C 80.85°F	0.42°C 0.76°F

Specialist

Validation

Validating data is a check that is done to ensure that the data is reasonable. It does not test to make sure the data is accurate. For example, if you were to enter an Australian postcode, validation would ensure that it is four characters long and it begins with a valid state number. Validation would not check that the postcode actually exists or whether it matches the suburb that was entered. Validation can be set up to be done electronically or manually.

Electronic validation is done automatically by the system. Examples of electronic validation include:

- Existence checking
- Range checking
- Data type checking
- Spell checking.

Manual validation is completed by people. Examples of manual validation include:

- Proofreading
- Reasonableness
- Common sense
- Spelling of names.

Validation is used to check the reasonableness of the data entered. Although validation can be done manually, Relational Data Base Management Systems (RDBMS) allow electronic validation which will be done automatically while the database is being used. Electronic validation that can be used include:

- existence check: checks if there is any data in the field. (Example checks if postcode field is empty)
- range check: checks if the data is between specified values. (Example: Age check 18 - 65)
- type check: checks if the data is the correct data type. (Examples: checks phone number is limited to 0123456789+() characters.)

These are also a form of validating the data entered:

- input mask: forces the correct format to be used (eg. dd/mm/yy).
- limited list: allows data to be selected from a restricted list of choices.

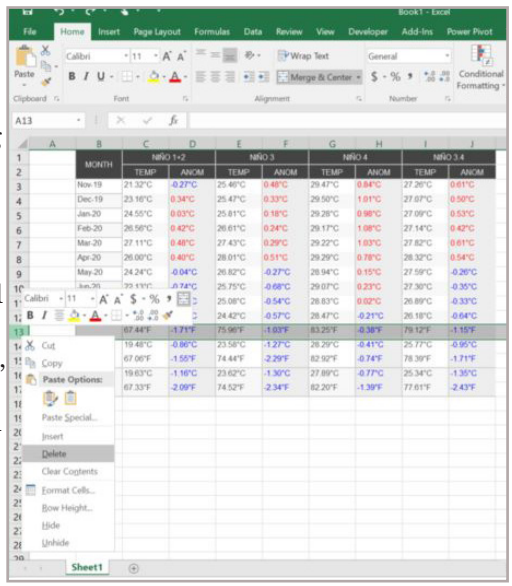
Data Manipulation

Once you have decided what data you wish to use, you need to find the data sets online and download them. There are a number of common file types to be aware of:

1. CSV (Comma Separated Values) can easily be opened in Microsoft Excel. It is a basic text file where the data is separated by commas.

2. XML (Extensible Markup Language) organises data between tags that identify the fields and records.

3. GZ (G Zip) are compressed data files that can be opened using WinZip.



You may need to remove data that you will not be using in the spreadsheet. On the right you can see Row 13 is highlighted and "Delete" is selected. Here all the Fahrenheit temperatures are being removed by row. A right click (RC) on the name of the row, and you can delete it. This is also the case with columns. If you wish to add a row or column you can RC then select "Insert" and it will add a new row or column where you need it.

Specialist

You may end up with data containing characters you can not use in a formula or calculation. In the Sea temperatures spreadsheet below you can see each data item has '°C' included in the data. We can not use this data, so we need to trim the '°C' off each cell. You can see we have used the "substitute" formula to remove these characters.

You should already be familiar with functions from the Intermediate and Advanced chapters. Here they are again with a few extra you might find useful. For a full list of 50 Excel formulas visit this online resource: **https://exceljet.net/formulas**.

Functions

Addition: =SUM(D1:D5)

Maximum: = MAX(D1:D5)

Minimum: =MIN(D1:D5)

Average: =AVERAGE(D1:D5)

Today's Date: =TODAY()

Time: = NOW()

Count: = COUNT(D1:D5)

Count IF: =COUNTIF(D5:D12,>100")

IF: =IF(C6>=50,"Pass","Fail")

Cell Referencing

Each cell in a spreadsheet is named after the Column Name (D) and the Row Name (12): D12 is a the cell name. When we use these cell names in a formula, the spreadsheet knows exactly which cells to include in the calculation. When we use Fill Down or Fill Across to duplicate the formula, the spreadsheet knows that the cell names identified in the formula need to be changes in relation to where the formula is. stored. You can see in the table, right, that the AVERAGE formula has been applied to 6 rows. It has automatically changed the row references for each formula. This is because the cell names used are "relative". When we refer to a cell by the column and row names it is a relative reference. It allows any formula we use to update the referencing in relation to the location of the formula.

	A	B	C
1	67	87	=AVERAGE(A1:B1)
2	26	72	=AVERAGE(A2:B2)
3	45	45	=AVERAGE(A3:B3)
4	26	26	=AVERAGE(A4:B4)
5	72	66	=AVERAGE(A5:B5)
6	48	29	=AVERAGE(A6:B6)

Sometimes we do not want our cell references to change. We need to give our cell references an absolute reference. We can do this in two ways:

1. Identify C6 as $C$6. If we use $C$6 in a formula that is filled down or across, it will always copy as $C$6 and refer only to that one cell. This can be useful if you have a single value you wish to apply to a lot of data.

2. We can rename the cell from C6 to any text you like, such as "TaxRate" or "TotalMarks". We can rename a cell permanently in the Cell Name box on the left of the formula bar.

When we refer to all the cells between two cell names such as A5:E5 this is called a range. We used a range in our AVERAGE formula in the table above.

Activity 3

Add the collected data to a spreadsheet and discuss data manipulation techniques appropriate to the data collected. Complete activities that include the functions listed above. Revisit the VLOOKUP process from the Advanced Chapter.

Data Analysis

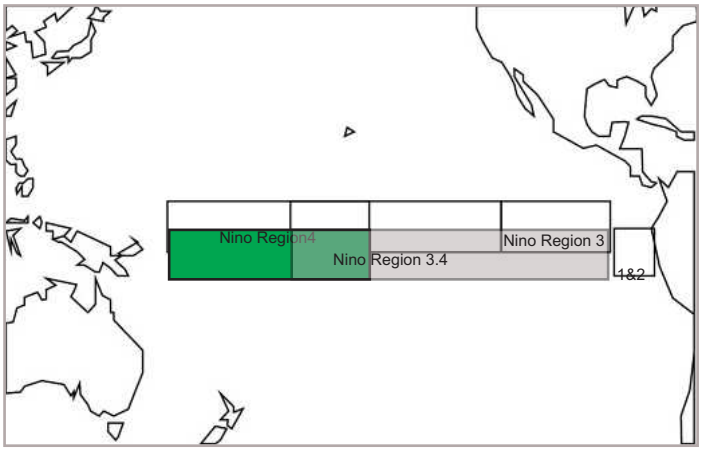
Fig. 4.12

	A	B	C	D	E	F	G	H	I	J
1	YR	MON	NINO1+2	ANOM	NINO3	ANOM	NINO4	ANOM	NINO3.4	ANOM
2	1982	1	24.29	-0.17	25.87	0.24	28.3	0	26.72	0.15
3	1982	2	25.49	-0.58	26.38	0.01	28.21	0.11	26.7	-0.02
4	1982	3	25.21	-1.31	26.98	-0.16	28.41	0.22	27.2	-0.02
5	1982	4	24.5	-0.97	27.68	0.18	28.92	0.42	28.02	0.24
6	1982	5	23.97	-0.23	27.79	0.71	29.49	0.7	28.54	0.69
7	1982	6	22.89	0.07	27.46	1.03	29.76	0.92	28.75	1.1
8	1982	7	22.47	0.87	26.44	0.82	29.38	0.58	28.1	0.88
9	1982	8	21.75	1.1	26.15	1.16	29.04	0.36	27.93	1.11
10	1982	9	21.8	1.44	26.52	1.67	29.16	0.47	28.11	1.39
11	1982	10	22.94	2.12	27.11	2.19	29.38	0.72	28.64	1.95
12	1982	11	24.59	3	27.62	2.64	29.23	0.6	28.81	2.16
13	1982	12	26.13	3.34	28.39	3.25	29.15	0.66	29.21	2.64
14	1983	1	27.42	2.96	28.92	3.29	29	0.7	29.36	2.79
15	1983	2	28.09	2.02	28.92	2.55	28.79	0.69	29.13	2.41
16	1983	3	28.68	2.16	29.1	1.96	28.76	0.57	29.03	1.81

The table in Fig 4.12, you can see the raw data collected from the National Climatic Data Center (NCDC) on sea temperatures in the El Niño Zones. This was published by the National Oceanic and Atmospheric Administration in the US.

(Source: https://www.ncdc.noaa.gov/)

To further understand the data, it was important to identify the El Niño regions in the pacific ocean On the map you can see the regions 1 & 2 are on the coast of Peru, where the El Niño phenomenon was first observed. Region 3 overlaps with region 4. to create a sub-region 3.4.



Normally trade winds from the east move warm water to the west of the Pacific. El Niño is when that warm water spreads across the surface of the Pacific affecting the global climate. (Source CSIRO and NCDC)

	A	B	C	D	E	F	G	H	I	J
1	YEAR	MONTH	NINO1+2	ANOM	NINO3	ANOM	NINO4	ANOM	NINO3.4	ANOM
2	1982	1	24.29	-0.17	25.87	0.24	28.3	0	26.72	0.15
3	1982	2	25.49	-0.58	26.38	0.01	28.21	0.11	26.7	-0.02
4	1982	3	25.21	-1.31	26.98	-0.16	28.41	0.22	27.2	-0.02
5	1982	4	24.5	-0.97	27.68	0.18	28.92	0.42	28.02	0.24
6	1982	5	23.97	-0.23	27.79	0.71	29.49	0.7	28.54	0.69
7	1982	6	22.89	0.07	27.46	1.03	29.76	0.92	28.75	1.1
8	1982	7	22.47	0.87	26.44	0.82	29.38	0.58	28.1	0.88
9	1982	8	21.75	1.1	26.15	1.16	29.04	0.36	27.93	1.11
10	1982	9	21.8	1.44	26.52	1.67	29.16	0.47	28.11	1.39
11	1982	10	22.94	2.12	27.11	2.19	29.38	0.72	28.64	1.95
12	1982	11	24.59	3	27.62	2.64	29.23	0.6	28.81	2.16
13	1982	12	26.13	3.34	28.39	3.25	29.15	0.66	29.21	2.64
14	1983	1	27.42	2.96	28.92	3.29	29	0.7	29.36	2.79
15	1983	2	28.09	2.02	28.92	2.55	28.79	0.69	29.13	2.41
16	1983	3	28.68	2.16	29.1	1.96	28.76	0.57	29.03	1.81
17	1983	4	28.56	3.09	29.12	1.62	28.85	0.35	28.91	1.13
18	1983	5	28.19	3.99	28.97	1.89	29.08	0.29	28.89	1.04
19	1983	6	27.44	4.62	28.15	1.72	28.88	0.04	28.24	0.59
20	1983	7	25.95	4.35	26.62	1	28.65	-0.15	27.07	-0.15
21	1983	8	23.78	3.13	25.87	0.88	28.38	-0.3	26.53	-0.29
22	1983	9	22.24	1.88	25.24	0.39	28.23	-0.46	26.44	-0.28
23	1983	10	21.86	1.04	24.61	-0.31	27.75	-0.91	25.87	-0.82
24	1983	11	21.9	0.31	24.17	-0.81	27.76	-0.87	25.58	-1.07
25	1983	12	23.01	0.22	24.44	-0.7	27.82	-0.67	25.59	-0.98
26	1984	1	24.18	-0.28	24.82	-0.81	27.64	-0.66	25.64	-0.93
27	1984	2	25.18	-0.89	26.22	-0.15	27.25	-0.85	26.39	-0.33
28	1984	3	26	-0.52	27.12	-0.02	27.21	-0.98	26.86	-0.36
29	1984	4	25.16	-0.31	27.34	-0.16	27.7	-0.8	27.39	-0.39
30	1984	5	23.23	-0.97	26.46	-0.62	27.95	-0.84	27.39	-0.46
31	1984	6	21.96	-0.86	25.38	-1.05	28.13	-0.71	26.86	-0.79
32	1984	7	21.24	-0.36	24.96	-0.66	28.35	-0.45	26.74	-0.48
33	1984	8	20.17	-0.48	24.5	-0.49	28.17	-0.51	26.34	-0.48
34	1984	9	20.37	0.01	24.35	-0.5	28.61	-0.08	26.43	-0.29
35	1984	10	20.52	-0.3	23.95	-0.97	28.28	-0.38	25.93	-0.76
36	1984	11	21.5	-0.09	24.03	-0.95	27.99	-0.64	25.41	-1.24
37	1984	12	22.58	-0.21	23.7	-1.44	27.44	-1.05	25	-1.57
38	1985	1	23.59	-0.87	24.51	-1.12	27.71	-0.59	25.43	-1.14
39	1985	2	24.87	-1.2	25.19	-1.18	27.55	-0.55	25.67	-1.05
40	1985	3	25.74	-0.78	26.11	-1.03	27.38	-0.81	26.23	-0.99
41	1985	4	24.25	-1.22	26.52	-0.98	27.72	-0.78	26.8	-0.98
42	1985	5	22.29	-1.91	26.12	-0.96	28.06	-0.73	27.11	-0.74
43	1985	6	21.75	-1.07	25.6	-0.83	28.08	-0.76	26.86	-0.79
44	1985	7	20.44	-1.16	24.74	-0.88	28.28	-0.52	26.69	-0.53
45	1985	8	19.29	-1.36	24.4	-0.59	28.32	-0.36	26.5	-0.32
46	1985	9	19.44	-0.92	24.15	-0.7	28.33	-0.36	26.25	-0.47
47	1985	10	19.9	-0.92	24.15	-0.77	28.28	-0.38	26.19	-0.5
48	1985	11	20.69	-0.9	24.28	-0.7	28.52	-0.11	26.19	-0.46
49	1985	12	22.4	-0.39	24.29	-0.85	28.53	0.04	26.11	-0.46
50	1986	1	24.61	0.15	24.73	-0.9	28.11	-0.19	25.79	-0.78
51	1986	2	26.06	-0.01	25.81	-0.56	27.93	-0.17	25.94	-0.78
52	1986	3	25.91	-0.61	26.84	-0.3	27.97	-0.22	26.65	-0.57
53	1986	4	24.58	-0.89	27.17	-0.33	28.21	-0.29	27.44	-0.34
54	1986	5	23.38	-0.82	26.68	-0.4	28.58	-0.21	27.5	-0.35
55	1986	6	21.98	-0.84	26.3	-0.13	28.84	0	27.69	0.04
56	1986	7	21.12	-0.48	25.7	0.08	28.9	0.1	27.37	0.15
57	1986	8	20.97	0.32	25.02	0.03	29.04	0.36	27.15	0.33
58	1986	9	20.44	0.08	25.25	0.4	29.18	0.49	27.33	0.61
59	1986	10	21.07	0.25	25.62	0.7	29.38	0.72	27.57	0.88
60	1986	11	22.03	0.44	25.92	0.94	29.4	0.77	27.73	1.08
61	1986	12	23	0.21	25.86	0.72	29.19	0.7	27.7	1.13
62	1987	1	25.3	0.84	26.69	1.06	29.02	0.72	27.91	1.34
63	1987	2	27.14	1.07	27.42	1.05	28.93	0.83	28.02	1.3

You should be familiar with conditional formatting from the Advanced chapter. You can see in the table on the left, that lowest values in each region are light blue. Highest values are bright red, with pale yellow to show the intermediate values. You can see at a glance where the El Niño events have taken place because each region is red during those months of the year. In the data on the right, you can see the bands appear in 2015, 2017, 2018 and 2019 leading up to the bushfires of 2019- 2020. Comparing later data to the earlier data you can see in1982 -1987, the bands appearly strong only twice in a 5 year period, while between 2014 and 2020, we have 6 bands of hot water spreading across the pacific in as many years. You can see how it moves from region 1&2 to 3 then 4 over a few months.

2014	2	25.4	-0.75	25.56	-0.81	28.37	0.27	26.18	-0.55
2014	3	25.86	-0.78	26.9	-0.24	28.71	0.52	26.99	-0.22
2014	4	25.23	-0.37	27.73	0.23	29.13	0.63	28.01	0.24
2014	5	25.57	1.3	27.69	0.61	29.56	0.77	28.31	0.46
2014	6	24.51	1.64	27.32	0.89	29.43	0.59	28.11	0.46
2014	7	22.98	1.36	26.27	0.65	29.09	0.29	27.4	0.18
2014	8	21.91	1.27	25.51	0.52	29.14	0.46	27.02	0.2
2014	9	21.3	0.96	25.31	0.45	29.34	0.65	27.17	0.45
2014	10	21.54	0.75	25.58	0.66	29.31	0.64	27.17	0.49
2014	11	22.33	0.74	25.88	0.91	29.52	0.88	27.5	0.85
2014	12	22.9	0.08	25.94	0.8	29.4	0.91	27.35	0.78
2015	1	24.13	-0.39	25.99	0.36	29.16	0.86	27.1	0.53
2015	2	25.59	-0.55	26.55	0.18	29.12	1.02	27.29	0.56
2015	3	26.69	0.06	27.29	0.15	29.32	1.13	27.79	0.58
2015	4	26.95	1.35	28.17	0.67	29.73	1.23	28.56	0.78
2015	5	26.71	2.43	28.28	1.19	29.88	1.09	28.88	1.03
2015	6	25.42	2.54	28.1	1.66	29.93	1.09	28.96	1.32
2015	7	24.48	2.87	27.79	2.17	29.8	1	28.82	1.6
2015	8	22.88	2.24	27.33	2.34	29.66	0.98	28.89	2.07
2015	9	22.91	2.57	27.48	2.63	29.73	1.04	29	2.28
2015	10	23.31	2.52	27.58	2.66	29.79	1.12	29.15	2.46
2015	11	23.83	2.24	27.91	2.93	30.3	1.67	29.6	2.95
2015	12	25.01	2.19	27.99	2.85	30.11	1.63	29.39	2.82
2016	1	25.93	1.41	28.21	2.58	29.65	1.35	29.17	2.6
2016	2	26.81	0.67	28.36	1.99	29.55	1.45	29.12	2.4
2016	3	27.57	0.93	28.7	1.57	29.53	1.34	28.9	1.68
2016	4	25.83	0.23	28.34	0.84	29.39	0.89	28.87	1.09
2016	5	24.55	0.27	27.11	0.03	29.39	0.6	28.15	0.3
2016	6	23.17	0.29	26.31	-0.12	29.36	0.52	27.53	-0.12
2016	7	21.79	0.17	25.14	-0.48	29.06	0.26	26.73	-0.49
2016	8	21.03	0.39	24.53	-0.46	28.68	0	26.28	-0.54
2016	9	20.87	0.53	24.67	-0.18	28.48	-0.21	26.11	-0.61
2016	10	21.18	0.39	24.47	-0.45	28.26	-0.4	25.96	-0.73
2016	11	21.68	0.09	24.58	-0.4	28.27	-0.37	26.1	-0.55
2016	12	23.35	0.53	24.78	-0.36	28.35	-0.14	26.16	-0.41
2017	1	25.75	1.23	25.61	-0.02	28.18	-0.12	26.25	-0.32
2017	2	27.76	1.62	27	0.63	28.03	-0.07	26.87	0.14
2017	3	28.52	1.89	27.7	0.57	28.13	-0.06	27.34	0.13
2017	4	26.53	0.93	28.09	0.59	28.65	0.15	28.1	0.32
2017	5	25.06	0.78	27.6	0.51	29.08	0.29	28.3	0.46
2017	6	22.98	0.1	26.73	0.3	29.39	0.55	28.19	0.55
2017	7	21.54	-0.07	25.85	0.23	29.21	0.4	27.61	0.39
2017	8	20.19	-0.45	24.82	-0.17	28.87	0.19	26.67	-0.15
2017	9	19.67	-0.67	24.17	-0.68	28.69	0	26.29	-0.43
2017	10	19.45	-1.34	24.28	-0.64	28.55	-0.11	26.23	-0.46
2017	11	20.44	-1.15	23.92	-1.05	28.46	-0.18	25.79	-0.86
2017	12	21.44	-1.38	24.05	-1.09	28.24	-0.25	25.8	-0.77
2018	1	23.71	-0.81	24.48	-1.14	28.03	-0.27	25.82	-0.75
2018	2	25.57	-0.57	25.36	-1.01	27.86	-0.24	25.83	-0.9
2018	3	25.83	-0.8	26.37	-0.76	28.14	-0.05	26.48	-0.73
2018	4	24.58	-1.02	27.12	-0.38	28.63	0.12	27.42	-0.36
2018	5	23.73	-0.54	26.94	-0.15	29.01	0.22	27.72	-0.13
2018	6	22.19	-0.69	26.72	0.29	29.16	0.32	27.85	0.2
2018	7	21.43	-0.19	26.05	0.43	29.1	0.3	27.52	0.3
2018	8	20.66	0.02	25.14	0.15	29.19	0.51	27.11	0.29
2018	9	20.31	-0.03	25.2	0.35	29.17	0.48	27.1	0.38
2018	10	21.23	0.43	25.78	0.86	29.61	0.95	27.55	0.86
2018	11	22.27	0.68	26.02	1.05	29.59	0.95	27.64	0.99
2018	12	23.6	0.78	26.12	0.98	29.52	1.03	27.53	0.96
2019	1	25.1	0.58	26.17	0.54	29	0.7	27.08	0.51
2019	2	26.45	0.31	26.91	0.55	29.06	0.96	27.41	0.68
2019	3	26.8	0.16	27.89	0.76	29.1	0.91	28.22	1.01
2019	4	25.68	0.08	28.17	0.67	29.24	0.73	28.6	0.82
2019	5	24.38	0.1	27.69	0.6	29.58	0.79	28.57	0.72
2019	6	22.62	-0.26	26.81	0.38	29.62	0.78	28.24	0.59
2019	7	21.34	-0.28	25.68	0.06	29.73	0.92	27.63	0.41
2019	8	20.2	-0.44	24.89	-0.1	29.5	0.82	26.97	0.15
2019	9	19.5	-0.84	24.61	-0.24	29.33	0.64	26.7	-0.02
2019	10	20.02	-0.77	25.12	0.21	29.64	0.98	27.31	0.62
2019	11	21.32	-0.27	25.46	0.48	29.47	0.84	27.26	0.61
2019	12	23.16	0.34	25.47	0.33	29.5	1.01	27.07	0.5
2020	1	24.55	0.03	25.81	0.18	29.28	0.98	27.09	0.53
2020	2	26.56	0.42	26.61	0.24	29.17	1.08	27.14	0.42
2020	3	27.11	0.48	27.43	0.29	29.22	1.03	27.82	0.61
2020	4	26	0.4	28.01	0.51	29.29	0.78	28.32	0.54
2020	5	24.24	-0.04	26.82	-0.27	28.94	0.15	27.59	-0.26
2020	6	22.13	-0.74	25.75	-0.68	29.07	0.23	27.3	-0.35
2020	7	20.44	-1.18	25.08	-0.54	28.83	0.02	26.89	-0.33
2020	8	19.69	-0.95	24.42	-0.57	28.47	-0.21	26.18	-0.64
2020	9	19.48	-0.86	23.58	-1.27	28.29	-0.41	25.77	-0.95
2020	10	19.63	-1.16	23.62	-1.3	27.89	-0.77	25.34	-1.35

It appears that increased ocean temperatures, the increased occurrence of El Niño is in direct relationship with climate change. (Source: https://www.csiro.au/en/Research/OandA/Areas/Oceans-and-climate/Climate-change-information)

Specialist

Our hypothesis: 'Did El Niño cause the 2019-2020 Victorian bushfires?' needs more data before we can accept or reject it.. We can see there is a relationship with El Niño and the occurrence of the 2009 bush fires, the 2014-2015 bush fires and the 2019-2020 bush fires. We do not have enough information about other factors that could have played a part. Let's identify other data we need: major Australian bush fire dates and locations and the rainfall and temperatures for those locations.

Each bush fire season in Australia hosts hundreds of fire events around the country. So to limit the scope of the investigation, we are only going to use the major events that have occurred in Victoria during the period of time outline by the El Niño data (1982 - 2020).

For this investigation we have identified these major Victorian bush fires. The Ash Wednesday fires n 1983. The longest bush fire season on record (before 2019) 2006-2007. The Black Saturday fires 2009 nd the largest bushfire on record. 2019-2020 NE region Victoria.

The Australian Bureau of Meteorology provides statistics for rain, temperature, wind speed, and direct for every weather station in the country. I have chosen Bairnsdale data to display below with conditional formatting where dark blue is high rainfall and orange is the lowest. Each column is the monthly average rainfall for each year. You can see that it is difficult to find a pattern of rainfall. The months October, November and December appear to be the wettest months. We can see that dry spells in 1982, 2006 and 2019 lead up to three of these major bush fires. (Source: Bureau of Meteorology, Climate Data Online)

There does not appear to be a drought leading up to the fires in 2009 in Bairnsdale. Further below are average monthly temperatures in Bairnsdale for each year. Likewise this data is not providing us with any correlation. If we look at some of the news reports at the time, scientists identified extreme high temperatures that provide the conditions for fires. The Bureau of Meteorology presents data that supports the hypothesis that El Niño effects can vary. 2016 became one of the warmest years because of a powerful El Niño, but not as warm as 2019. The 2019-2020 El Niño was considered weak by comparison with 2015-2016. The strongest El Niño in recent times was identified as responsible for the Victorian Alpine Fires and the Ash Wednesday Fires in 1983.

RAINFALL

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual	FIRES
2	1982	78.6	10.2	145.6	11.2	20.2	33.4	18.6	15	48.8	36.4	4	34.4	456.4	
3	1983	33.8	5.4	65.2	73.4	132.4	34.2	53	42.8	91	79	30.4	48	688.6	FEB
4	1984	71.4	35.8	30.2	68.3	34.2	29	155.7	40.6	68.2	24.8	39.2	46.4	643.8	
5	1985	42	7.6	53.6	112	28.2	99.4	35.8	42.4	62.4	123.8	151.2	156.8	915.2	
6	1986	59.4	8.2	6.8	30.6	45.3	8	35	37	60.6	47.4	119.1	41.2	498.6	
7	1987	52.2	61.6	46.8	16.7	35.3	31	112.7	18.6	52.6	46.4	39	65	577.9	
8	1988	41.5	13.3	41.4	79.1	86	21.4	26.3	43.7	83.3	30.3	222.2	54.6	743.1	
9	1989	17.4	20.2	87	70.4	55.7	91.7	91	40	49.9	69	58.3	52.8	703.4	
10	1990	3	50.7	62.2	144.7	25.1	15	38.1	74.6	73.5	94.6	43	47.6	672.1	
11	1991	115.8	14.5	37.8	23.8	15.1	106.7	115.8	51.1	46.8	33.4	9.3	62.2	632.3	
12	1992	82.4	61	48.4	49.5	24	99	20.3	51.6	134.4	71.2	109.2	126.7	877.7	
13	1993	45.6	55	58.4	14.8	23.9	23.2	60.4	22.2	152.1	96	52.6	77.4	681.6	
14	1994	26.7	191.7	28	34.1	33.4	53.2	14	7.8	52.1	44.3	90	55.4	630.7	
15	1995	113.2	30.8	41	40.6	49.1	40.1	35.4	23.9	64.3	124.1	93.4	81.7	737.6	
16	1996	85.4	105.2	16.4	56.9	31.9	20.5	88.6	28.4	40	50.6	94.2	37.6	655.7	
17	1997	50.8	9.8	56.4	9.6	37	37	20.8	11.2	42.2	35.2	34.6	32.3	376.9	
18	1998	35.3	30.7	17.6	18.2	13.1	247.8	24	35.8	26.4	63.8	124.8	73.2	710.7	
19	1999	89	104	62.8	54.2	34.6	22.2	25.6	34.8	37.6	60.8	28	58.8	612.4	
20	2000	58.4	21.4	58.7	57.6	100.6	52.4	29	49.4	77.6	59.6	55	7.2	626.9	
21	2001	48	36.6	54	69.8	31.2	45.8	71.6	61.9	47	63.4	120.8	90.4	740.5	
22	2002		97.5	41	143.8	27.6	69.4	20.6	7	22.2	46.2	36.6	46.6		
23	2003	7.2	16.1	23.8	67.6	17.2	22.6	31.6	55	41.2	98.2	61.2	62.4	504.1	
24	2004	53.4	42	4.9	157.6	41.8	21.8	33.4	43.6	42.8	32.8	75.4	78	627.5	
25	2005	38.6	87.2	32.3	40.2	14.2	22.4		37.4	56.4	34.2	87	46		
26	2006	74		6.6		69.4	30.2	62	45	38	6.8	16.6	19		DEC
27	2007	9.4	100.3	68	47.4	19.8		86.9	35.2	21.8	24.6	101.2	40.6		MARCH
28	2008	74.8	61.4	10.6	19.4	23.8	10.8	53.4	26.2	30	19.8	152.8	78.6	561.6	
29	2009	5.2	52.2	16	50.8	13.6	17.6	27.2	45.8	46.2	58.3	48.6	47.4	428.9	FEB
30	2010	24.4	109	60	20.6	51.4	42.4	14.4	64.2	28		57.5	97.9		
31	2011	27.2	88.8	78.2	60.8	48.2	63.8	71.2	67.6	41.5	92.8	108.6	53.4	802.1	
32	2012	44.4	65.4	152		71.2	95	14.3	36	32.2	36.8	57	31		
33	2013	7.2	42.8	51.6	38.6		253.8	26.4	19	71	79.2	69.6	40.6		
34	2014	29.6	7.4	46.8	94.4	21.2	70.1	19.5		50.8	68.2	44.2	161		
35	2015	58	28.2		195			57.8	61.7	35.4	80.2	61.2	51.4		
36	2016	99.2	10.4	85.2	25.8	44.7	109.2	109	23.8	96.7	92.3	52.6	27.6	776.5	
37	2017	14.4	27.2	52.6	78.8	18.4	17.8	11.2	32	31.5	43.7	24.4	108.8	460.8	
38	2018	65.5	25.2	11.2	7	46		26.2	21.1	30.5	41.8	77	50		
39	2019	24	39.2		34.2	54.4		37.4		34.7	18.8		16.2		DEC
40	2020			33.6	85.2		23.3		99.6						MARCH

TEMPERATURES

For more depth, rainfall and temperature data needs to be collected for more than just one location around Victoria. Looking at areas of the map, it could be possible to identify points where fires occur frequently and compare it with areas where fire rarely occurs.

You can see that some data is missing and conditional formatting can provide existence validation.

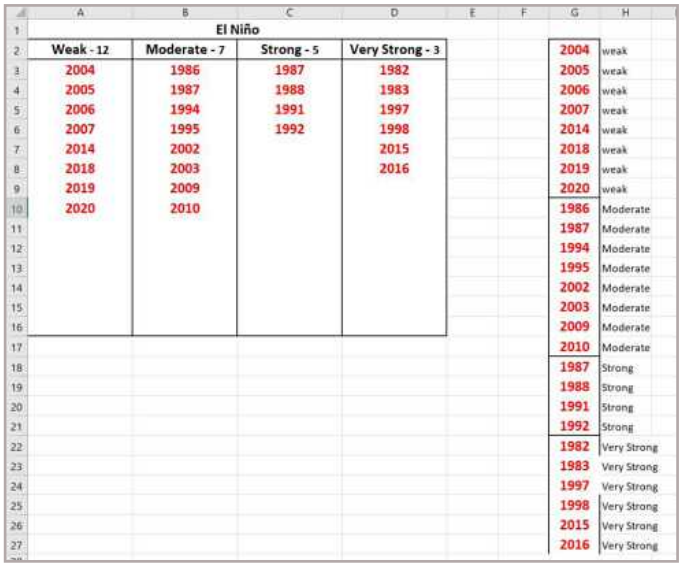
Finding maximums and averages in Excel can easily be done with formula.

Let's apply a Look Up table to our El Niño events. I found the data that identifies when each El Niño occurred and it's strength. Let's go through the process of making that data usable for comparison to our rainfall data.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	FIRES
2														
3	1983								15.7	16.4	17.5	21.5	24.3	FEB
4	1984	24.4	25.2	22.4	20	17.2	15.5	13.4	15.2	15.8	19.3	22.7	22.3	
5	1985	24.4	25.4	25.1	20.3	17.5	14.2	13.8	15.3	16.3	19.3	19.9	22.7	
6	1986	22.9	24.8	25.1	21.3	17.1	14.1	14.1	15.8	17	19.4	20.7	22.2	
7	1987	24.8	25.4	21.7	22.1	18.2	15	14.5	14.6	19	19.3	22.8	22.3	
8	1988	28.6	24.9	24.7	21.3	17.8	15.7	15.2	16.1	18.8	21.4	21.4	24.1	
9	1989	25.2	26.9	24.4	20.4	18.1	14.2	13.8	14.3	17.1	19.2	21.6	25.1	
10	1990	26.8	24	24.9	21	17.8	15.1	15.1	14.6	17.5	20	21.6	25.6	
11	1991	26.2	24.6	24.7	20.8	17.7	17	14.3	15.4	17.1	20.7	22.3	22.4	
12	1992	22.7	23.5	24.4	21.2	18.2	14.6	15	15.1	15.4	18.9	19.5	22.3	
13	1993	25.9	26	22.4	22.8	18	14.7	15.5	17.4	17	18.8	20.4	23.2	
14	1994	24.9	24.3	21.1	21	17.9	14.7	15.8	15.1	16.4	19.9	20.7	25.7	
15	1995	26	26.4	21.8	18.7	16.8	14.2	13.4	17	16.3	17.7	20.3	20.2	
16	1996	23	22.1	22.9	18.8	17.3	15.4	14	15.6	18.2	20.6	20.1	20.9	
17	1997	26.8	28.3	22.4	21.9	17.2	15.8	14.2	16	16.8	21.1	24.3	25.1	
18	1998	27	27	25.9	20.9	18	14.6	13.3	15.1	18.7	19.7	19.7	23.7	
19	1999	25.6	26.8	23.7	19.5	19.1	15.8	15.8	17.2	19.9	20.7	21.8	24.8	
20	2000	24.3	29.9	24.1	21.2	16.8	15.2	14.5	15.5		18.8	21.2	25.7	
21	2001	28.3	27.7	24.6	21.1	16.4	16.2	14.6	15.7	18.4	18.8	19.6	20.5	
22	2002	24.3	23.2	23.8	21.3	17.9	15.7	15.5	16	19.1	20.9	24	23.7	
23	2003	27.7	25.6	23.2	20.2	18.5	16.1	15.3	16	17.7	17.3	21.7	25.4	
24	2004	24.4	26.2	24.4	21.1	16.6	15.6	14	16.3	16.8	19.7	22	22.6	
25	2005	25.9	23.7	22.9	23.8	18.2	16.8	15.7	16.8	17.6	21.5	23.2	25.8	
26	2006	27.3	25.5	25.2	19.6	16.5	13.7	14.1	16	18.3	20.5	22.4	23.1	DEC
27	2007	28	27.4	23.5	20.5	20	13	13.8	16.5	17.5	20.9	21.6	24	MARCH
28	2008	26.6	22.7	25.9	20.4	18.1	16.5	14.7	15.1	19.6	21.9	21.5	22.2	
29	2009	27.4	24.9	24.7	21	18.2	15.6	16	18.1	19.7	18.4	26.1	25.6	FEB
30	2010	27.4	26.3	25.4	22.4	17.8	14.4	14.5	14.7	16.6	20	22.6	23.5	
31	2011	26.4	24.9	22.8	20.2	16	15.3	14.4	16.9	18.7	19.9	23	22.6	
32	2012	26.8	25.5	22.8	21.4	17.5	14.4	14.9	15.7	18.8	20.6	22.9	25.4	
33	2013	27.6	26.9	26.4	20.4	18.1	14.1	15.8	17.3	19.6	20.3	20.7	25.1	
34	2014	27.4	27.5	25.7	20.7	18.8	15.3	15.3	15.1	18.7	20.7	23.2	24	
35	2015	25.3	26.3	23.7	19	17.6	14.2	13.9	14.3	17.5	23.3	22.3	26.2	
36	2016	24.9	25.8	24.1	22.9	19.4	14.9	15	16.4	17.3	20.4	21.1	25.4	
37	2017	27.3	25.1	26.3	21.3	17.6	15.1	16.1	16.1	19.4	21.8	24.6	24.8	
38	2018	26.8	26.8	24.6	23	19	15.1	16	16.3	18.5	21	22.1	26.3	
39	2019	28.6	26.9	24.5	21.5	18.3	15.8	15.5	15.5	18.5	21.7	22.7	25.3	DEC
40	2020	25.6	23.6	22.8	20	16.7	15.2	14	15.4	19	19.4			MARCH

Specialist

On the right is data I collected from NOAA (Climate.gov). I copied the data into Excel. Unfortunately, I can't use it for a VLOOKUP in the format it is in, so I copied each column into a single column using fill-down to fill in each of the intensities. Then all I had to do was sort a-z by the year to create a VLOOKUP table.



El Niño			
Weak - 12	Moderate - 7	Strong - 5	Very Strong - 3
2004	1986	1987	1982
2005	1987	1988	1983
2006	1994	1991	1997
2007	1995	1992	1998
2014	2002		2015
2018	2003		2016
2019	2009		
2020	2010		

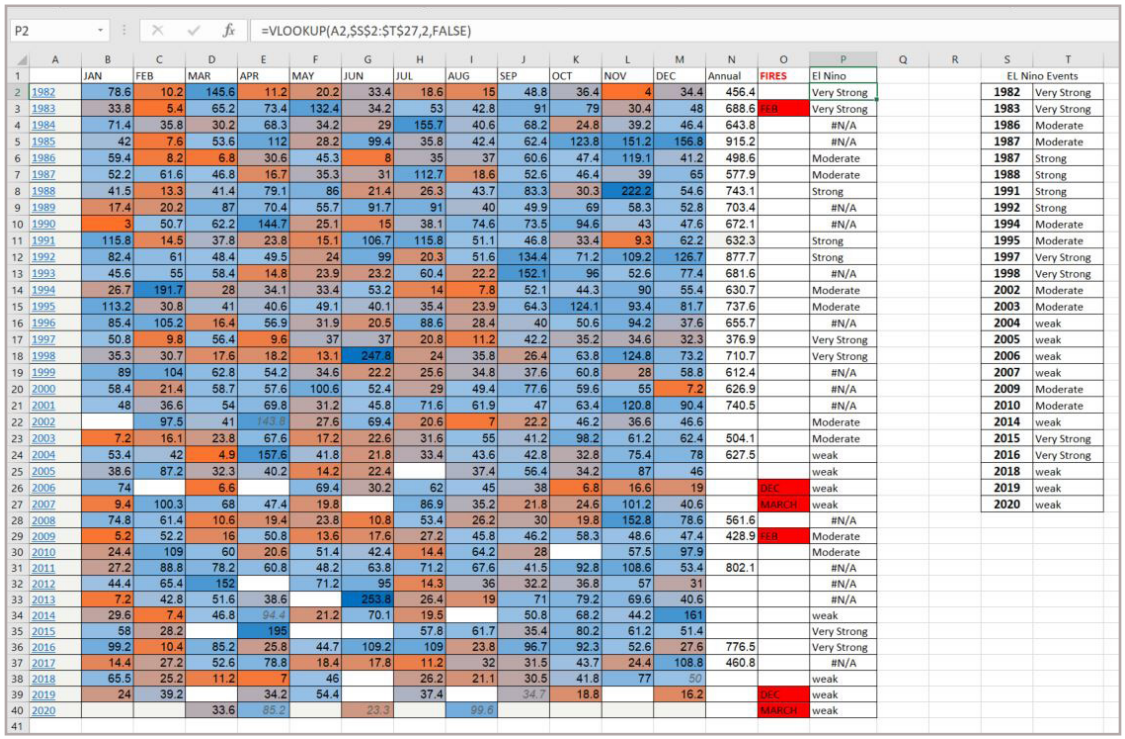
2004	weak
2005	weak
2006	weak
2007	weak
2014	weak
2018	weak
2019	weak
2020	weak
1986	Moderate
1987	Moderate
1994	Moderate
1995	Moderate
2002	Moderate
2003	Moderate
2009	Moderate
2010	Moderate
1987	Strong
1988	Strong
1991	Strong
1992	Strong
1982	Very Strong
1983	Very Strong
1997	Very Strong
1998	Very Strong
2015	Very Strong
2016	Very Strong

Below, you can see the VLOOKUP table in columns S and T. In the column labelled "El Niño" (P) you can see each year has an intensity. This was done using the VLOOKUP.

You can see that P2 is currently selected and it has the following formula:

=VLOOKUP(A2,$S$2:$T$27,2,FALSE)

It checks the year in A2 and looks up the table in range S2:T27 (using absolute cell referencing). The formula returns the data in the second column (2). FALSE indicates that it is looking for an exact match. The missing years (La Niña) return #N/A.



P2 =VLOOKUP(A2,$S$2:$T$27,2,FALSE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual	FIRES	El Nino
1982	78.6	10.2	145.6	11.2	20.2	33.4	18.6	15	48.8	36.4	4	34.4	456.4		Very Strong
1983	33.8	5.4	65.2	73.4	132.4	34.2	53	42.8	91	79	30.4	48	688.6	FEB	Very Strong
1984	71.4	35.8	30.2	68.3	34.2	29	155.7	40.6	68.2	24.8	39.2	46.4	643.8		#N/A
1985	42	7.6	53.6	112	28.2	99.4	35.8	42.4	62.4	123.8	151.2	156.8	915.2		#N/A
1986	59.4	8.2	6.8	30.6	45.3	8	35	37	60.6	47.4	119.1	41.2	498.6		Moderate
1987	52.2	61.6	46.8	16.7	35.3	31	112.7	18.6	52.6	46.4	39	65	577.9		Moderate
1988	41.5	13.3	41.4	79.1	86	21.4	26.3	43.7	83.3	30.3	222.2	54.6	743.1		Strong
1989	17.4	20.2	87	70.4	55.7	91.7	91	40	49.9	69	58.3	52.8	703.4		#N/A
1990	3	50.7	62.2	144.7	25.1	15	38.1	74.6	73.5	94.6	43	47.6	672.1		#N/A
1991	115.8	14.5	37.8	23.8	15.1	106.7	115.8	51.1	46.8	33.4	9.3	62.2	632.3		Strong
1992	82.4	61	48.4	49.5	24	99	20.3	51.6	134.4	71.2	109.2	126.7	877.7		Strong
1993	45.6	55	58.4	14.8	23.9	23.2	60.4	22.2	152.1	96	52.6	77.4	681.6		#N/A
1994	26.7	191.7	28	34.1	33.4	53.2	14	7.8	52.1	44.3	90	55.4	630.7		Moderate
1995	113.2	30.8	41	40.6	49.1	40.1	35.4	23.9	64.3	124.1	93.4	81.7	737.6		Moderate
1996	85.4	105.2	16.4	56.9	31.9	20.5	88.6	28.4	40	50.6	94.2	37.6	655.7		#N/A
1997	50.8	9.8	56.4	9.6	37	37	20.8	11.2	42.2	35.2	34.6	32.3	376.9		Very Strong
1998	35.3	30.7	17.6	18.2	13.1	247.8	24	35.8	26.4	63.8	124.8	73.2	710.7		Very Strong
1999	89	104	62.8	54.2	34.6	22.2	25.6	34.8	37.6	60.8	28	58.8	612.4		#N/A
2000	58.4	21.4	58.7	57.6	100.6	52.4	29	49.4	77.6	59.6	55	7.2	626.9		#N/A
2001	48	36.6	54	69.8	31.2	45.8	71.6	61.9	47	63.4	120.8	90.4	740.5		#N/A
2002		97.5	41	143.8	27.6	69.4	20.6	7	22.2	46.2	36.6	46.6			Moderate
2003	7.2	16.1	23.8	67.6	17.2	22.6	31.6	55	41.2	98.2	61.2	62.4	504.1		Moderate
2004	53.4	42	4.9	157.6	41.8	21.8	33.4	43.6	42.8	32.8	75.4	78	627.5		weak
2005	38.6	87.2	32.3	40.2	14.2	22.4		37.4	56.4	34.2	87	46			weak
2006	74		6.6		69.4	30.2	62	45	38	6.8	16.6	19		DEC	weak
2007	9.4	100.3	68	47.4	19.8		86.9	35.2	21.8	24.6	101.2	40.6		MARCH	weak
2008	74.8	61.4	10.6	19.4	23.8	10.8	53.4	26.2	30	19.8	152.8	78.6	561.6		#N/A
2009	5.2	52.2	16	50.8	13.6	17.6	27.2	45.8	46.2	58.3	48.6	47.4	428.9	FEB	Moderate
2010	24.4	109	60	20.6	51.4	42.4	14.4	64.2	28		57.5	97.9			Moderate
2011	27.2	88.8	78.2	60.8	48.2	63.8	71.2	67.6	41.5	92.8	108.6	53.4	802.1		#N/A
2012	44.4	65.4	152		71.2	95	14.3	36	32.2	36.8	57	31			#N/A
2013	7.2	42.8	51.6	38.6		253.8	26.4	19	71	79.2	69.6	40.6			#N/A
2014	29.6	7.4	46.8	94.4	21.2	70.1	19.5		50.8	68.2	44.2	161			weak
2015	58	28.2		195			57.8	61.7	35.4	80.2	61.2	51.4			Very Strong
2016	99.2	10.4	85.2	25.8	44.7	109.2	109	23.8	96.7	92.3	52.6	27.6	776.5		Very Strong
2017	14.4	27.2	52.6	78.8	18.4	17.8	11.2	32	31.5	43.7	24.4	108.8	460.8		#N/A
2018	65.5	25.2	11.2	7	46		26.2	21.1	30.5	41.8	77	50			weak
2019	24	39.2		34.2	54.4		37.4		34.7	18.8		16.2		DEC	weak
2020			33.6	85.2		23.3		99.6						MARCH	weak

1982	Very Strong
1983	Very Strong
1986	Moderate
1987	Moderate
1987	Strong
1988	Strong
1991	Strong
1992	Strong
1994	Moderate
1995	Moderate
1997	Very Strong
1998	Very Strong
2002	Moderate
2003	Moderate
2004	weak
2005	weak
2006	weak
2007	weak
2009	Moderate
2010	Moderate
2014	weak
2015	Very Strong
2016	Very Strong
2018	weak
2019	weak
2020	weak

All these diagrams are difficult to read and use, so when we produce our report we need to summarise the data and refer to our diagrams. Never attempt to add an illustration, table or diagram without referring to it in the text.

Data Analysis Report

All reports should have a similar structure to scientific reports:

- Title
- Introduction or background information
- Hypothesis
- Method of data analysis
- Results with diagrams
- Infographic
- Conclusion
- Bibliography

Specialist

So far this chapter has covered the topic: El Niño and its influence on Victorian bush fires. We identified our hypothesis: Did El Niño cause the 2019-2020 Victorian bushfires? We have investigated appropriate data and manipulated and analysed the data to find a relationship between major fires in Victoria and El Niño.

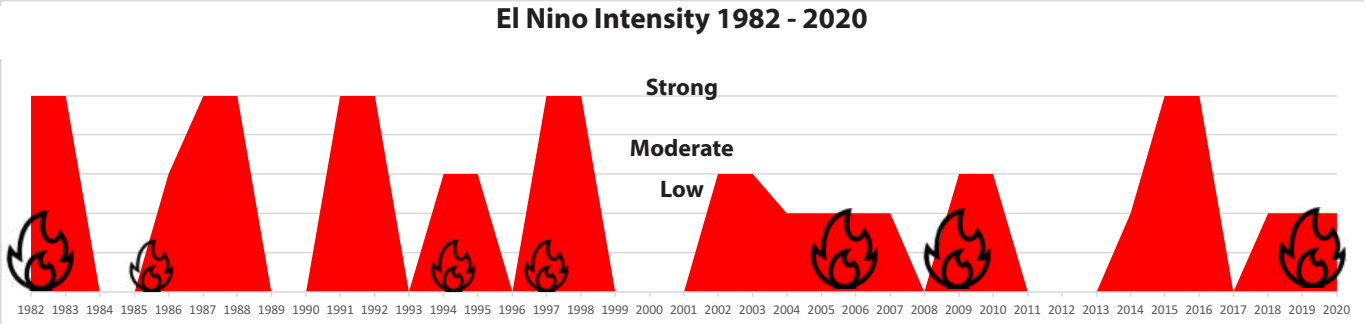
Let's investigate our key results:

Results & Discussion

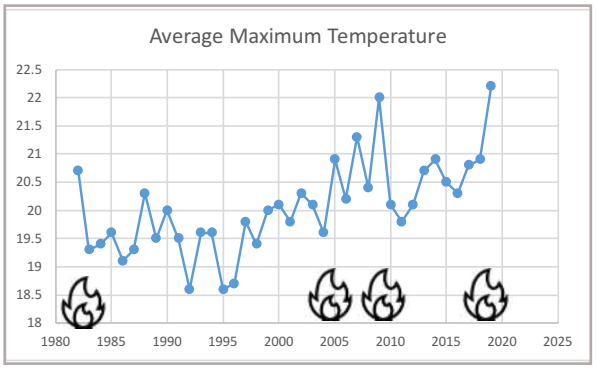
El Niño events are becoming more frequent and are recurring each year without a break. They are not necessarily more intense.

Major bush fires in Victoria have coincided with:

- frequent El Niño events
- dry periods over October through to February when higher rains are usually expected
- unusually high temperatures and high winds.

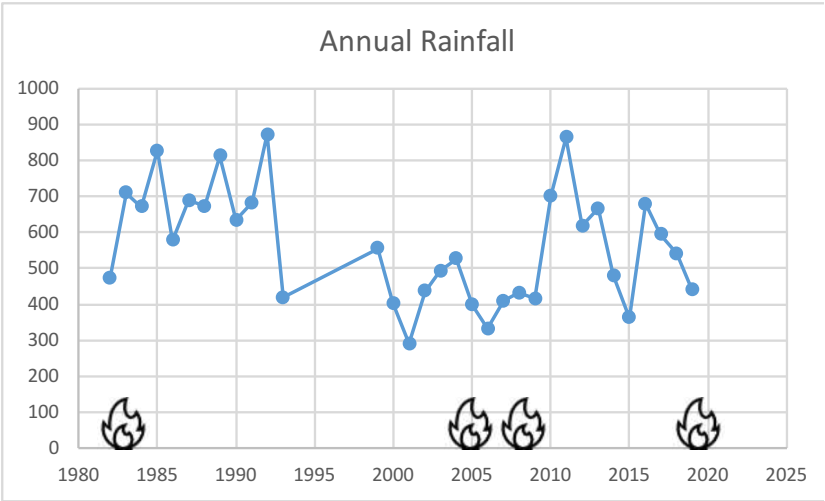


In the graph above, I have added the major fires in Victoria as flame icons, against the intensity and repetition of El Nino each year. I have also added major bush fires in other states of Australia in 1985, 1994-95 and 1997. It is interesting that there appears no clear pattern. From 2005 to 2020 you could be mistaken to think that major fires occur after prolonged and repeated El Niño events. The period of 1987 to 1993 with stronger El Niño intensity over four years, did not result in major fires. It could be argued that with higher temperatures due tto climate change, these major fire events are more frequent and require less influence from El Niño.



In the graph on the left you can see that the average maximum temperatures for Victoria have steadily increased over 40 years and the average temperatures for 2009 and 2019 are at their highest peaks. These peaks coincide with the two catastrophic bush fires in Victoria.

In the graph on the right, we can see the annual rainfall for each year in Victoria. Low rainfall coincides with the 1982, 2005, 2009 and 2019 fires. You can clearly see a long trend of low rain fall between 1993 till 2009. This prolonged dry period of time combined with the very high temperatures provided perfect conditions for a major bush fire.



Specialist

Infographics & Visualisation

In the Advanced chapter we introduced Infographics as an accessible instrument to communicate complex data. Infographics are static, and used as posters to inform. They may use the following features:

- limited colour palette or use of colours, that are linked to the purpose or subject of the infographic
- use of line to organise the layout, to separate, divide or connect ideas
- use of whitespace to keep the infographic from looking crowded
- Charts and graphs depicting data
- secondary data to support collected data
- use of repetition - repeated font types, image sizes, colours, formats etc.
- headings and labels which are provocative or interesting, draw the reader in.
- balance in the overall layout make the infographic more appealing
- use of a metaphor in how the data is displayed.

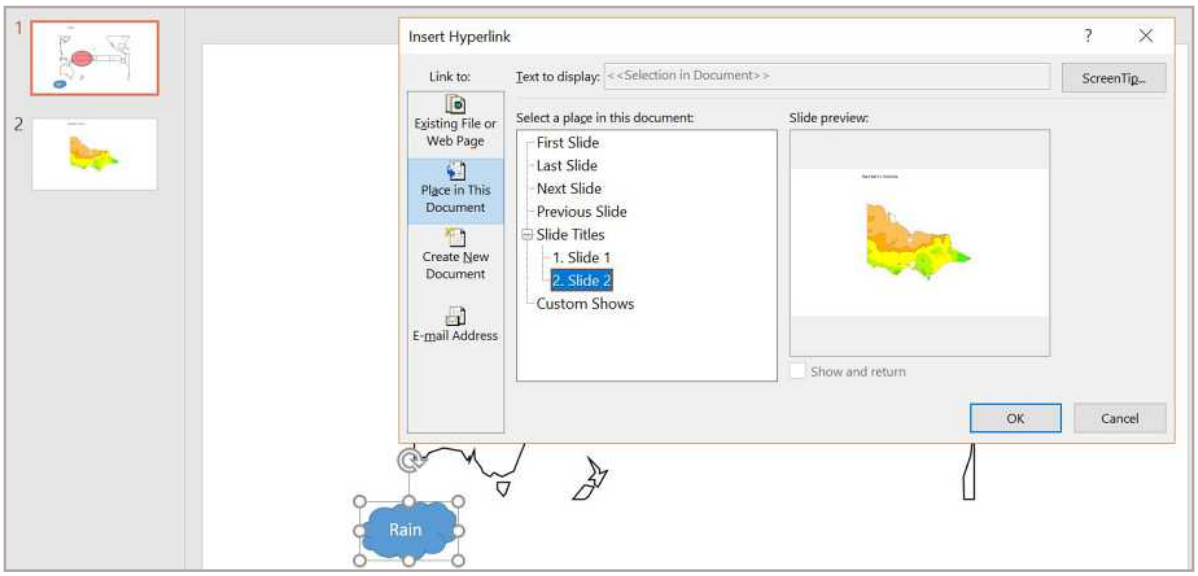
Visualisations take infographics one step further. During the 2020 presidential elections, the world was glued to Google's excellent visualisations of the election results. You can see in the screen shot on the right, the results on the map of the US. You could click on any state and be provided with more information. You can see the progress bars at the top of the screen and every few hours as new data was made available, the map was updated. This is an example of interactivity that transforms an infographic into a visualisation.

Hans Rosling was a data scientist who produced some amazing videos that are available on YouTube. He founded software that can assist in data analysis, and it is demonstrated on the Gapminder website:

https://www.gapminder.org/.

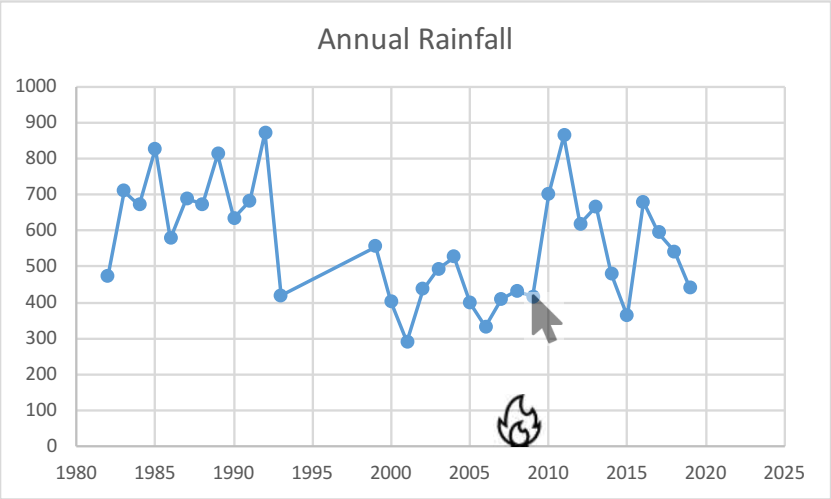
Animation is also a powerful way of illustrating relationships in data. To fully appreciate the power of animation in data presentations, look for Hans Rosling's bubble chart data videos online or on the Gapminder site. They show in a highly effective way, how data changes through time.

So how can we develop interactive, animated presentations? Online there are plenty of powerful tools that allow you have control over how your data is presented. To access all the features, there is often a fee. Let's go back to our Foundation Chapter where we learned how to animate in PowerPoint. We can also create an interactive interface. You can see below, the cloud has been selected and with a RC, "Hyperlink" can be chosen. The window allows you to select a "Place in this Document" and which slide.



Specialist

Using simple shapes you can create “hotspots” on graphs to allow for animations to be “triggered”. For example, the graph below allows the user to click on any dot along the line. When the 2009 dots is clicked the fire icon will appear. Once you create an animation such as a Fade In of the fire icon, you can select “Trigger” from the Animation menu and choose which object on the slide will activate the animation. It is an easy way of making a visualisation interactive and animated.



Visualisations are more complex than Infographics so they need to be easy to use, and easy to create. Here are a few characteristics your visualisation should have.

Visual Appeal

It needs to look good. It needs to look authoritative. If it uses poor choices in colour and design, it may not look reliable. Ensure you effectively use the elements and principles of design outlined in the Intermediate chapter.

Correct Information

There is no point in having a fantastic looking visualisation if the information being presented is incorrect. Always check your presentation against your data to ensure all the processes are presenting the facts correctly.

Accessibility

If you are designing a visualisation, you are designing a user interface. It must be able to be used by your audience. If they can not find the right button, or how to play the animation, then your visualisation will not be as effective.

Keep it Simple

If you do not have access to a Fast Development online visualisation tool (such as Venngage) and need to rely on PowerPoint to create your presentation, keep it simple! Don’t spend too much time on complex animations and image generation. Make sure you are very sure of the key information you want communicated and focus on that.

4c. Specialist Assessment Tasks

In Specialist Level students learned skills in:

- Collecting data
- Analysing data
- Spreadsheet formula
- Designing infographics.

Students developed knowledge and understanding of:

- Data analysis
- Project design
- Analysis reporting.

Project One Project Proposal

Students will research a topic that they will investigate using a primary data collection tool and report on their findings. From their findings they will develop a hypothesis. They must present their research from secondary sources to outline the purpose of their project.

Project Proposal Marking Criteria

- A data collection tool related to their chosen topic
- Raw data from the investigation.
- A clearly written hypothesis
- An appropriate summary of secondary research to inform the nature of the data analysis project
- Identification of the source of data that will be analysed.

Project Two Data Analysis

Students will download appropriate data sets from online sources related to their topic. Students will apply a wide range of analysis techniques in spreadsheets to investigate their hypothesis. Students will produce charts and graphs to illustrate their findings.

Data Analysis Marking Criteria

- Methods of data manipulation are appropriate for the data set.
- More than two data sources have been included in the analysis.
- Correct analysis of the data has been made.
- Appropriate graphs and charts accurately display the data.

Project Three Data Analysis Report

Students will represent their findings in a report with the following structure:

- Title
- Introduction or background information
- Hypothesis
- Method of data analysis
- Results with diagrams
- Infographic
- Conclusion
- Bibliography.

Data Analysis Report Marking Criteria

- The report structure correctly and formally presents hypothesis, background information and data analysis from previous projects
- Results are clearly presented with diagrams, referred to in the text
- A successful infographic that summarises the findings effectively is included
- The conclusion describes the findings in summary
- A full bibliography of references where data has been obtained and other secondary source information to support findings.

Project Four Visualisation

Students will interpret their findings using the interactive features of a visualisation.

Visualisation Marking Criteria

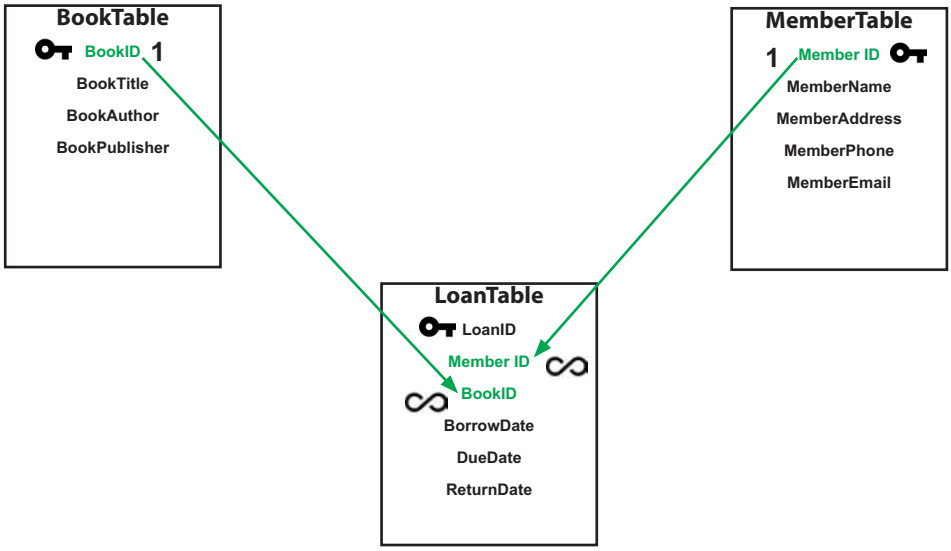
- Interactivity enhances the understanding of research findings
- Animation enhances the understanding of the research findings
- The design of the visualisation uses effective features of an infographic
- The interface of the visualisation ensures it is easy to use
- The visualisation is visually pleasing.

4d. Transaction Processing Systems (Extension)

Transaction Processing Systems

A transaction processing system (TPS) is an information system that we use every day, when we buy something online, when we borrow a book from the library, when we join a social networking site, when we check our timetable.

In the Advanced chapter, we developed a basic TPS for a library. The transactions the system processed were book loans, adding a new book or adding a new library member. You can see in the diagram below how a TPS uses relationships between different tables. The diagram below is called a Relationship Schema. It shows that the ID for each book is related to ONE record in the Book Table but it can be linked to and infinite number of transactions in the Loan Table. This relationships is called "one-to-many". Look at the relationship between the Member Table and the Loan Table. One member record can relate to any number of loans. This means a book can be borrowed by many different members and a member can borrow many different books.



Our TPS from the Advanced chapter included:

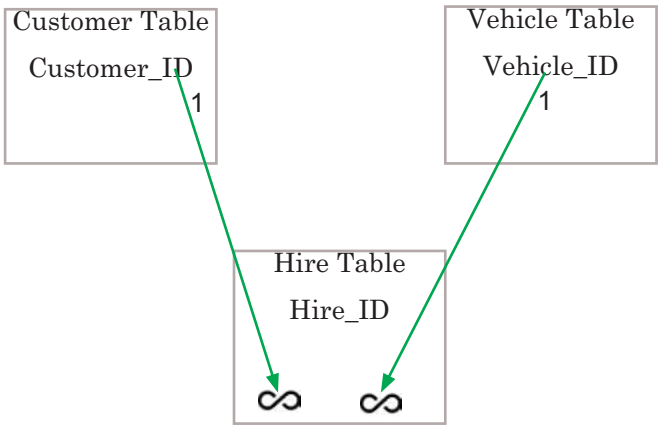
- designing tables
- adding sample data to our tables
- creating relationships
- creating forms for each navigations and for data manipulation on each table
- creating queries and reports from the query results.

To avoid repetition of instructions, let's revisit the Advanced chapter that covers skills in databases and knowledge on TPS. We are going to use these instructions to develop a more sophisticated system. We are going to create a TPS for a vehicle rental company, such as Budget Rent-a-Car. This relational database will run behind the website so customers can log in and book a vehicle for when they need it.

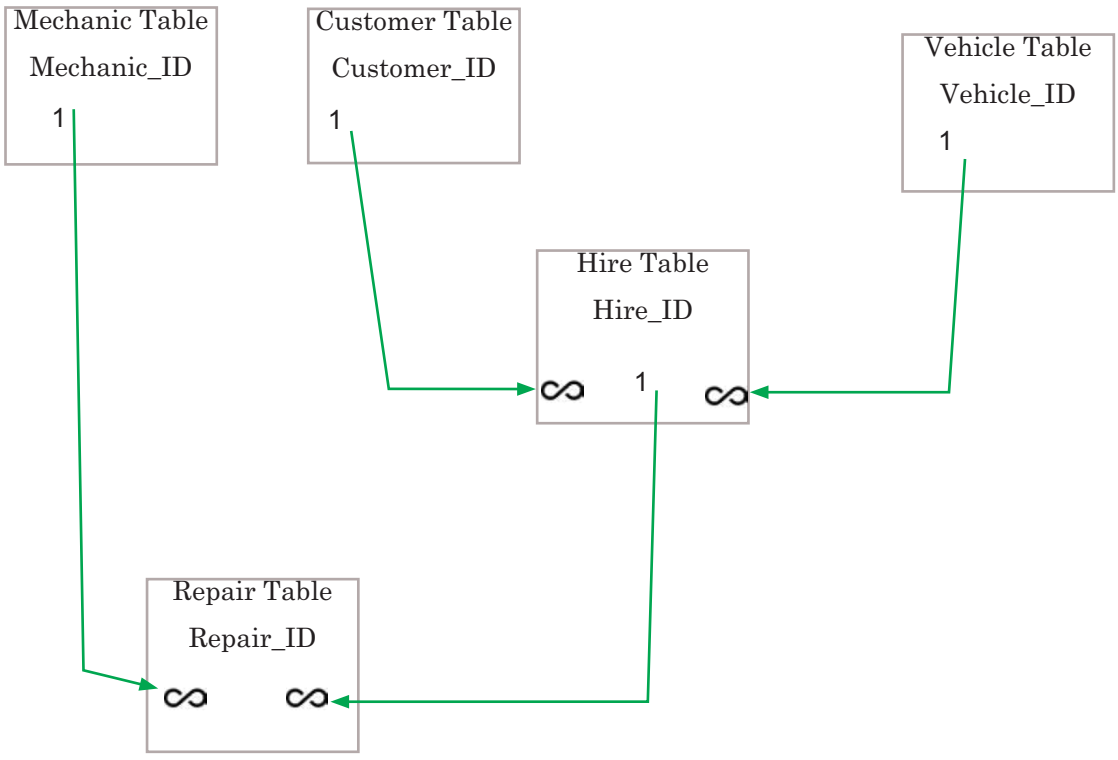
Specialist

Relationship Schema

Let's identify the entities first. These are the customers and the vehicles. They will be connected through a transaction table. See the diagram below.



This relationship schema looks familiar. Let's add some extra entities such as mechanics. When cars are return damaged, they need to be repaired and the cost is invoiced to the customer responsible. This will require a transaction table to manage this data. Let's call it the Repair Table.

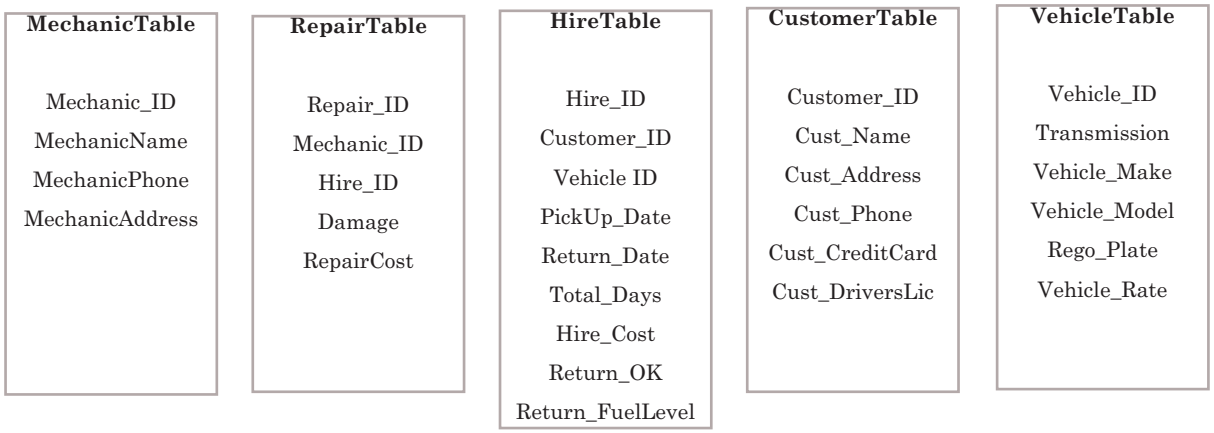


Our new relationship schema above connects our mechanics to our hire records. This means when we are creating a relationship between the two transaction tables we are able to pull along our customer and vehicle records to the repair table too. You will find that creating a relational database is far easier than developing a software solution from scratch.

Data Dictionaries

Using data dictionaries, we need to design our tables. We want to keep a record of our customers details including their payment details in case they do not return a vehicle, or the return it very badly damaged. We need to keep records on each vehicle, what type it is, log book entries and the registration number. The hire table needs to create records that include the date and location the vehicle is hired and the date and location it is returned. Other information we may need includes: the distance travelled, any damage, other drivers of the vehicle, fuel levels at the beginning and end of hire period. If damage is recorded, a new record in the repair table needs to be created. This record will contain the Hire record ID, the Mechanic ID, the extent of the damage, the cost of repair.

Below is the list of fields for each table. A full Data Dictionary is included for the Hire table to demonstrate a couple of new data types: boolean and calculated.



DATA DICTIONARY			
Field Name	**Data Type**	**Size**	**Description**
Hire_ID	AutoNumber	10	New unique identification number for each hire record.
Customer_ID	Number	6	Unique ID of customer already in the system
Vehicle_ID	Number	4	Unique ID of vehicle already in the system
PickUp_Date	Date/Time	14	Date and Time customer picks up vehicle DD/MM/YYYY HH:MM
Return_Date	Date/Time	14	Date and Time customer returns vehicle DD/MM/YYYY HH:MM
Total_Days	Calculated	3	[Return_Date]-[PickUp_Date]
Hire_Cost	Calculated	5	[Vehicle_Rate] * [Total_Days]
Return_OK	Boolean	1	Default to FALSE. If there is damage, check the box = TRUE.
Return_FuelLevel	Text	20	One Quarter, Half, Three Quarters, Full. (Combobox)

Let's look at our HireTable above in detail. The Hire_ID is a primary key, that is a new number, automatically generated by the system each time a vehicle is hired. The size is 10 bytes. This means the largest value can be 9,999,999,999. That's a lot of transactions!

We need the Customer_ID as a foreign key. It is a primary key in the Customer_Table. Including the foreign key makes the relationship between the tables. The Vehicle_ID is also a foreign key from the Vehicle_Table to create that relationship. These the data in the foreign keys are already created and stored in their entity tables.

The user will need to enter the date and time when the customer picks up the vehicle and when they plan to return the vehicle. In the description we have included a "mask" for the data. A mask demonstrates to the user how to enter the data. The date should be DD/MM/YYYY while the time is formated HH:MM.

The next field is a calculated field where we take away the PickUp_Date from the Return_Date to store the number of days the vehicle will be hired. The formula can be written in much the same way as an Excel formula. You could also use "=DateDiff(PickUp_Date, Return_Date)".

The Hire_Cost is also a calculated field where the Vehicle_Rate (from the Vehicle_Table) is multiplied by the Total_Days. Now Vehicle_rate is not present in this table. We need to call it up from it's own table:

[Total_Days] *[VehicleTable].[Vehicle_Rate]

The dot between the name of the table its field indicates the path to find the data you want to use in the calculation. See Fig 4.13 for the Access "Expression Builder" window that opens up when you choose "calculated" as a data type.

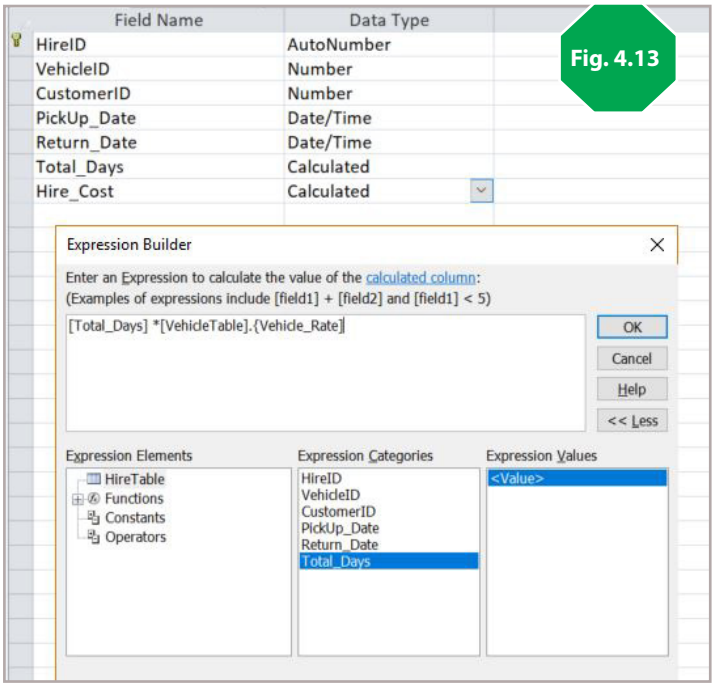


Fig. 4.13

The next field is called Return_OK and it a boolean data type. A boolean can only hold one of two data states: true or false. The Return_OK is defaulted to FALSE and will be displayed as a checkbox on the form. If the vehicle is returned damaged this box will be checked and consequently will be set to TRUE.

Now there is some coding we need to do from the Form. You can see below in Fig 4.14, the HireTable in Design View. The check box, Return_OK is highlighted (in yellow). Double click the object and this opens the Property Sheet that allows us to control the properties of the checkbox. Under the Event tab (circled) some options are made available. On Click has a button at the far right so you can access the Code Builder window. You can see the code in the bottom right of the screen and directly below in green.

This code runs if the checkbox Return_OK is checked by the user. If it is, then the button I have created called "BookMechanic" will become visible. Otherwise the button will not be visible. This means we need to set the visibility of the BookMechanic button to "No". Make sure your checkbox is enabled.

If you have set your object correctly and entered the code attached to the checkbox, the button "BookMechanic" will appear with an instruction to book a mechanic.

You can see that the code used by Microsoft Access is Visual Basic (VB). There are plenty of support websites for VB and how it can be used in Access. Try the links below for more tips:

http://www.functionx.com/vbaccess/Lesson01.htm

https://www.tutorialspoint.com/vb.net/vb.net_database_access.htm

```
Private Sub Return_OK_Click()
If Me!Return_OK.Value = True Then
    Me!BookMechanic.Visible = True
Else
    Me!BookMechanic.Visible = False
End If
End Sub
```

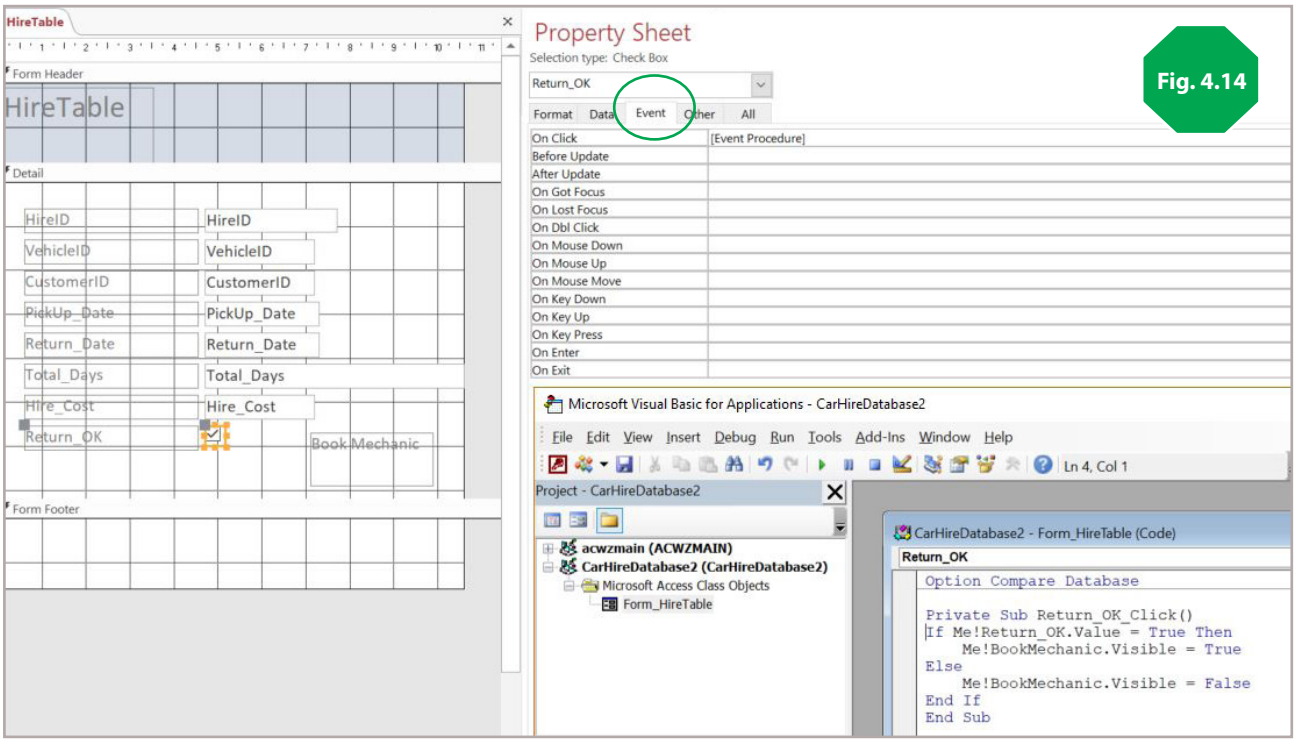


Fig. 4.14

Specialist

Activity 1

As a class, students should recreate the Car Hire relational database, to ensure they can get the calculated fields working and the checkbox event. Before progressing into the next section, make sure you have meaningful data in each table. Let's make sure you have a John Smith in your customer database who has returned a vehicle damaged.

Structured Query Language

Structured Query Language (SQL) is a language that retrieves data from a relational database. It is a very powerful way of accessing data in the format that you want it. In our Car Hire System, we have five separate tables. SQL can access data in all the tables keeping the relationships intact.

We have data about a customer, John Smith in our Customer table. He borrows the Toyota Camry and returns it damaged. We book a mechanic who details the car who sends us the full cost of repairs. The data pertaining to all this information is spread across all five tables. An SQL query can identify the tables, the fields, the condition and how the data will be displayed. We might write a query that identifies the name and contact details of the customer so we can inform him of the cost of the damage to the vehicle he borrowed. We can also make sure all the information about the hire is included such as when the car was picked up, when it was returned and which vehicle.

The SQL Structure is SELECT, FROM, WHERE, ORDER.

SELECT identifies the tables we need to access

FROM identifies the fields in each table.

WHERE identifies the condition, and ORDER sorts the data in a use friendly way.

Lets' write our SQL for a report we can sent to John about the bill he needs to pay for the damage to the Camry. We need to access all five tables to get the data we need so our first line will be:

```
SELECT CustomerTable, VehicleTable, HireTable, RepairTable, MechanicTable.
```

Now we need to think about what data we need to access from these tables. We need the name and address of the customer, the vehicle details, the details of the hire, the mechanic contact, (in case the customer wants to talk to them) the details of the repair and, the final cost. So let's identify all those fields in the next SQL line:

```
FROM Cust_Name, Cust_Address, Vehicle_Rego, Vehicle_Make, Vehicle_Model, Vehicle_
Rate, PickUp_Date, Return_Date, Hire_Cost, Return_OK, MechanicName, MechanicPhone,
Damage, RepairCost.
```

Now we need to determine the condition. We want all the data that is connected to John Smith, when he hired the vehicle on the 16th of May where Return_OK = TRUE. Here is the SQL line:

```
WHERE Cust_Name = "John Smith" AND PickUp_Date = 16 May 2021 AND Return_OK = TRUE.
```

We are searching for only one hire report, so ordering the data will not be required, but if we had a query where the only condition was Return_OK = TRUE, you may end up with ALL the customer accident reports and you will need to order them. You might want to order them by customer_name in alphabetical order:

```
ORDER Cust_Name Asc.
```

Specialist

So our full SQL query will look like this:

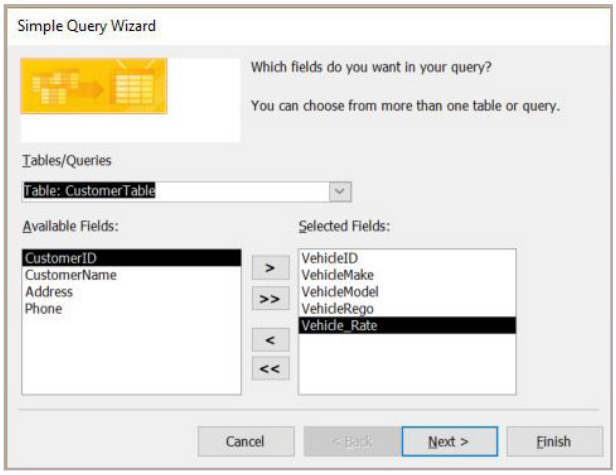
SELECT Customer_Table, Vehicle_Table, Hire_Table, Repair_Table, Mechanic_Table

FROM Cust_Name, Cust_Address, Vehicle_Rego, Vehicle_Make, Vehicle_Model, Vehicle_Rate, PickUp_Date, Return_Date, Hire_Cost, Return_OK, MechanicName, MechanicPhone, Damage, RepairCost

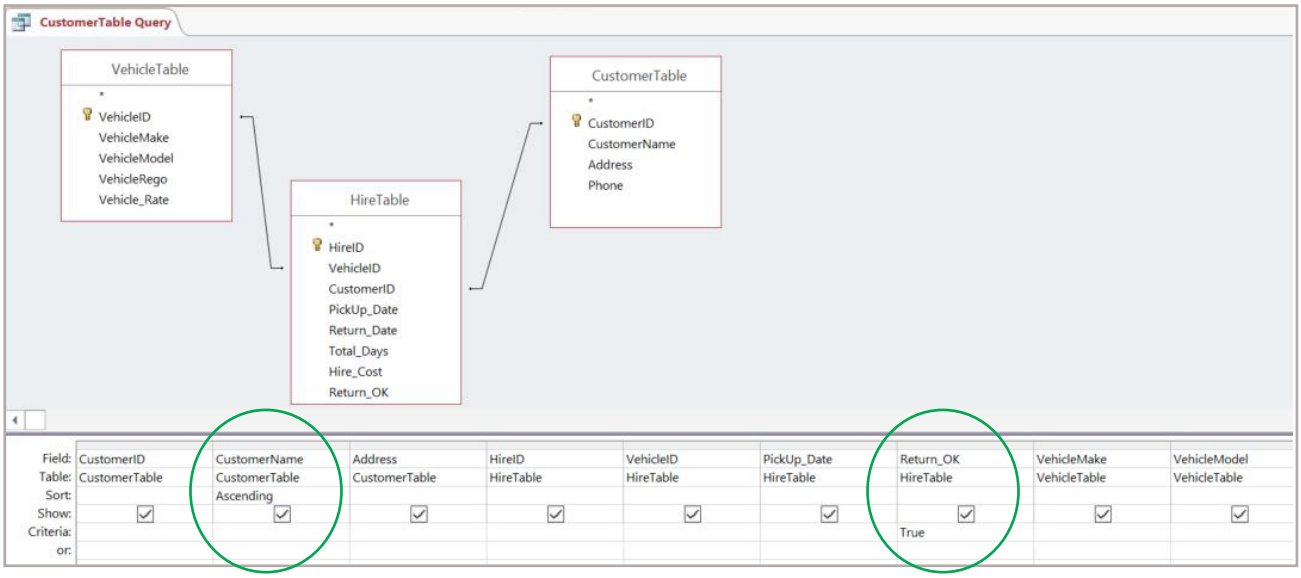
WHERE Cust_Name = “John Smith” AND PickUP_Date = 16 May 2021 AND Return_OK = TRUE

ORDER Cust_Name Asc

Microsoft Access has a wizard for creating queries where you add the tables, then the fields to your query. Then you write your condition and order. You can see in the window on the right, you can select each table and add all the fields you require to the query.



In the window below, I have created a simple query to return data on all customers who have returned vehicles with damages. I have used the wizard (right) to add the tables and fields to the query. Once you open the Design View of the query, you will see the schema and all the fields below in the table.



You can see the table above identifies the Field Name, then the Table Name, Sort, Show, Criteria and Or. In the ‘Sort’ row, “ascending” has been added to the CustomerName field. All data will be sorted by CustomerName in alphabetical order. In the ‘Show’ row, you can see the check boxes. You may not want all the data visible in your query. You may only want to include it in order to sort the data or search the data. The ‘Criteria’ row is where we write our conditions. I have added “True” under the Results_OK field, so that the query will find all the records associated with damages. It is easier to use the Access Wizard when creating queries, than writing the SQL code. There are a few extra syntax elements to include to identify the inner links between tables. Below is the SQL for the Query designed above.

SELECT CustomerTable.CustomerID, CustomerTable.CustomerName, CustomerTable.Address, HireTable.HireID, HireTable.VehicleID, HireTable.PickUp_Date, HireTable.Return_OK, VehicleTable.VehicleMake, VehicleTable.VehicleModel

FROM VehicleTable INNER JOIN (CustomerTable INNER JOIN HireTable ON CustomerTable.[CustomerID] = HireTable.[CustomerID]) ON VehicleTable.[VehicleID] = HireTable.[VehicleID]

WHERE (((HireTable.Return_OK)=True))

ORDER BY CustomerTable.CustomerName;

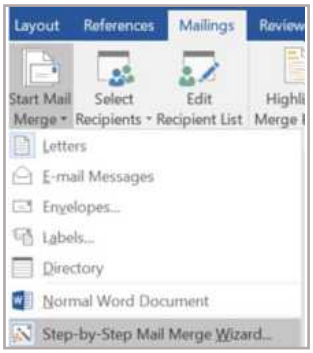
CustomerTable Query

CustomerID	CustomerNa	Address	HireID	VehicleID	PickUp_Date	Return_OK	VehicleMake	VehicleMode
2	Pigeon McGee	Frankston	1	1	11/03/2020	☑	Mazda	929
4	Tim Lachlan	Fitzroy	3	3	16/03/2020	☑	Toyota	Camry
(New)			(New)			■		

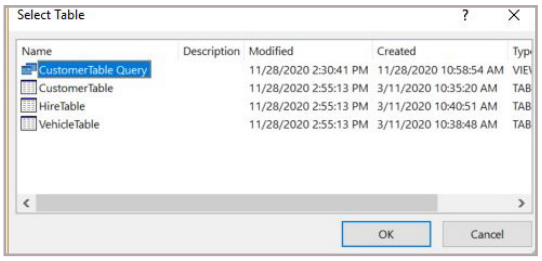
Mail Merge

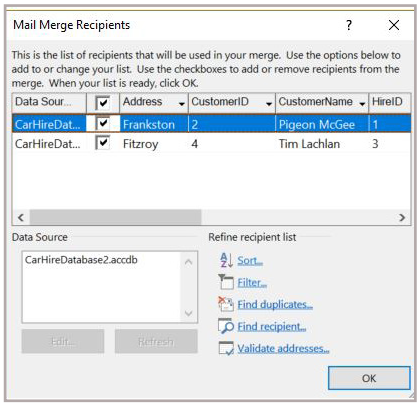
Above is the data returned from our query. We only have two customers that have caused damage to vehicles. In other organisations, you might run a query and it return hundreds of records. Each of the customers need to be contacted and sent a bill for the damages. If we had hundreds of customers, it would take too long to address those emails, so we use the results of our query to complete a process called a mail merge. Access has a function called "Word Merge" under the External Data menu. We can use this if we have prepared word document with fields.

In Microsoft Word there is a 'Mailings' menu. If you select 'Start Mail Merge' and then choose the Step by step Mail Merge Wizard, Word will take you through the stages of connecting your word document to your Access Database and pulling the fields into the word document.



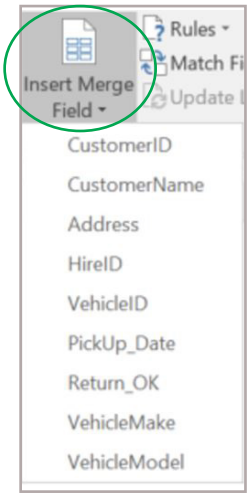
You need to have your Access database saved and closed when you search from Word. You will need to browse to where your database is stored to make the connection. It is fairly straight-forward to connect the database and select the query you created. See the screen-shots below.

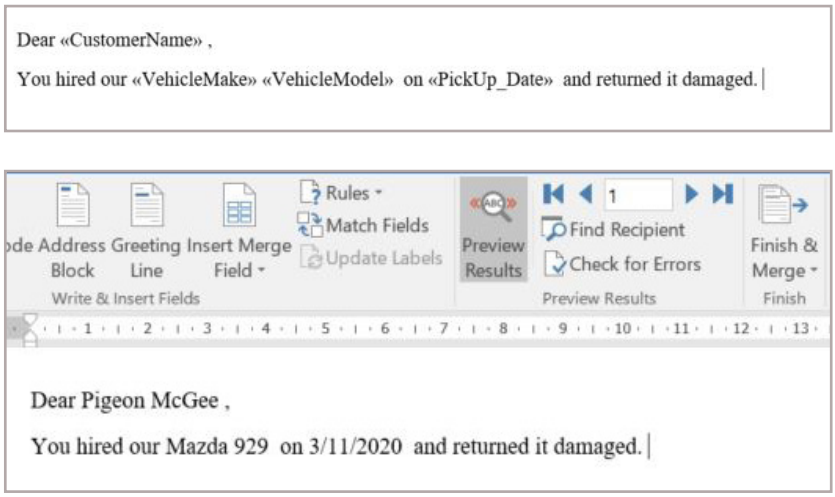




Once you have your database connected, you can write your letter. Instead of writing 'Dear Mr Smith', we can now add the Customer Name field instead into the location where you want the name. The 'Insert Merge Field' button (circled below) will appear in Word's Mailings ribbon and you can select which field from the database you would like to add. You can see below, that all the fields from the query are available in Word for you to place into the letter. The fields appear in << tags>> and when you preview or complete the merge, you can see all the data from our database placed into the letter.

This is a very powerful tool for all business communications.





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Activity 2

Create two queries for your database, one to contact all the customers about a new deal over the holiday season, and one to remind customers who have damaged vehicles to pay the expenses.

Create two separate mail merges. Export your mail merge to PDF.

Relational Databases and VB

Using Microsoft Access is an easy way to build your first relational database and get it working. You can connect Access databases to Visual Basic programs in the same way. Store you Access database in the your VB.net 'bin' folder. While in Visual Studio, select the 'Project' menu and select 'Add New Data Source'. Follow the prompts to link your program to your Access database.

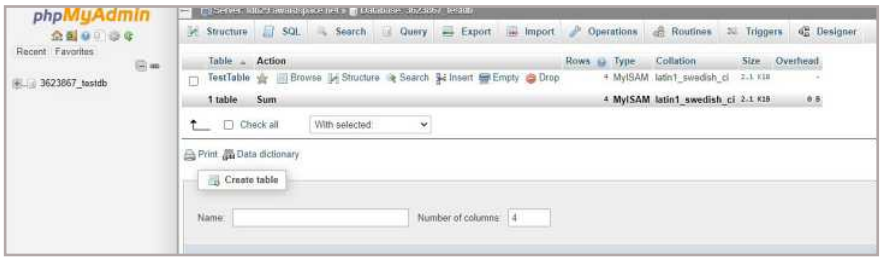
Below is the VB code for accessing the passwords and usernames stored in an Access database called "MyAccessDatabase.accdb". It contains user data that includes FirstName and LastName. It reads all the records until both username and password are the same as the text entered into the two textboxes. It is a simple sample code to demonstrate how to connect your VB code to a relational database in Access.

```
Imports System.Data.OleDb
Public Class Program
    Dim provider As String
    Dim dataFile As String
    Dim connString As String
    Dim myConnection As OleDbConnection = New OleDbConnection

    Private Sub LoginButton_Click(sender As Object, e As EventArgs) Handles LoginButton.Click
        provider = "Provider=Microsoft.ACE.OLEDB.12.0;Data Source ="
        dataFile = "../MyAccessDatabase.accdb"
        connString = provider & dataFile
        myConnection.ConnectionString = connString
        Dim cmd As OleDbCommand = New OleDbCommand("SELECT * FROM [Passwords] WHERE [userID] = '" &
            TextBox1.Text & "' AND [Password] = '" & TextBox2.Text & "'", myConnection)
        myConnection.Open()
        Dim dr As OleDbDataReader = cmd.ExecuteReader
        Dim userFound As Boolean = False
        Dim FirstName As String = ""
        Dim LastName As String = ""

        While dr.Read
            userFound = True
            FirstName = dr("FirstName").ToString
            LastName = dr("LastName").ToString
        End While

        If userFound = True Then
            welcome.Show()
            welcome.Label1.Text = "Welcome " & FirstName & " " & LastName
        Else
            MsgBox("Sorry, username or password not found", MsgBoxStyle.OkOnly, "Invalid Login")
        End If
        myConnection.Close()
    End Sub
End Class
```

Relational Databases and Web Development

If you are creating a web application you will need to connect your pages to a database. phpMyAdmin is the most common web database tool. It is free with XAMPP and available in most server cPanel tools. Depending on the set up and the version of phpMyAdmin, you need to click on "Databases" and you will find yourself in front of the interface below. We start building our database structure in the same way we did in Access, by designing the tables. You should select "Create Table", add the name and the number of columns (fields) you will need. The submit button is called "go" and it can be located on the far right of the screen.

Once you have opened the Table Structure window, you will see it should look like the layout below. You can see the table name at the top, where you add more columns.



The key features you need to know include

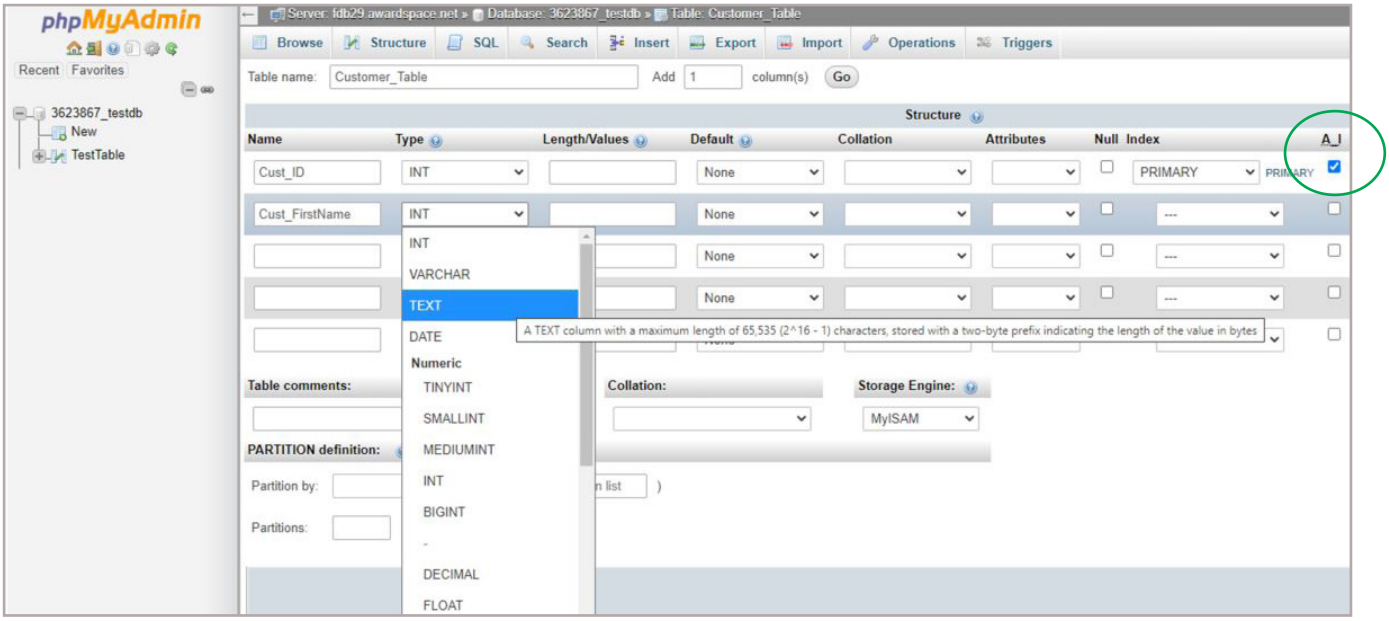
Name - the name of the field. You can see I have already added Cust_ID and Cust_FirstName.

Type - identifies the data type of the field. There is a pull-down menu shown below, that allows you to choose from some options.

Length/Values - defines the size of the field.

Default - set the field to empty or another value until it is changes by the user.

A_I (circled) is the Automated Index. This is your auto-number for your primary key.



It is highly likely that your tables have been created using MyISAM engine and you will need to change the engine from MyISAM to InnoDB. To do this, access phpMyAdmin and select your database table. Then click on SQL, place the following query and then click on Go:

```
ALTER TABLE my_table ENGINE = InnoDB;
```

This will now allow you to create foreign keys in your transaction table. With your Hire table selected you can select "Relation view". It is here where you can add your foreign keys from the other tables (Customer_ID and Vehicle ID). These will then appear as in your transaction table with greyed keys.

Finally, you can select the database name, then under the "More" menu select 'Designer' so you can create your schema.

Setting up a database for a web app is very complex. I recommend investigating some online tutorials such as:

https://alexwebdevelop.com/php-with-mysql/

https://www.w3schools.com/sql/default.asp

Activity 3

Students who have completed all the work for Software Development and eCommerce can apply the skills explored here in TPS to add a relational database to their projects as extension work.

Transactional Processing Systems are by far the most implemented digital systems. They are also the most complex. To create a school timetable requires multiple tables and relationships between room, student, teacher, time period and subject data. All connections are controlled by SQL.

Here is a brief overview of SQL:

SELECT - extracts data from a database

UPDATE - updates data in a database

DELETE - deletes data from a database

INSERT INTO - inserts new data into a database

CREATE DATABASE - creates a new database

ALTER DATABASE - modifies a database

CREATE TABLE - creates a new table

ALTER TABLE - modifies a table

DROP TABLE - deletes a table

CREATE INDEX - creates an index (search key)

DROP INDEX - deletes an index

WHERE Conditions:

=	Equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
<>	Not equal. Note: In some versions of SQL this operator may be written as !=
BETWEEN	Between a certain range
LIKE	Search for a pattern
IN	To specify multiple possible values for a column

JOINING DATA:

(INNER) JOIN: Returns records that have matching values in both tables

LEFT (OUTER) JOIN: Returns all records from the left table, and the matched records from the right table

RIGHT (OUTER) JOIN: Returns all records from the right table, and the matched records from the left table

FULL (OUTER) JOIN: Returns all records outside of a relationship.

For more details on SQL the best source is https://www.w3schools.com/sql/default.asp

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