Theory Book

INFORMATION TECHNOLOGY

11
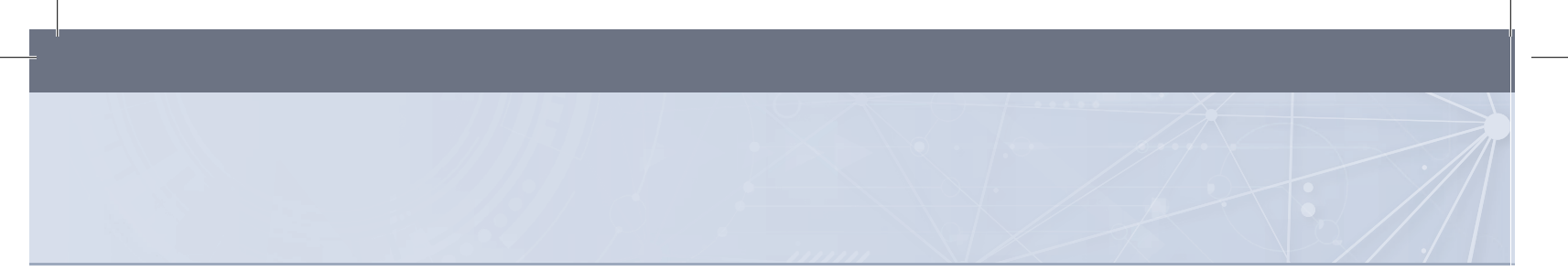
basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

CAPS

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Contents

Dear Learner

Welcome to the *Theory Book for Information Technology Grade 11*. Please read the information below about the book before you start using it. This book provides you with all the information you need to cover the Grade 11 Information Technology curriculum. It will also help you develop the skills, attitudes and values you need to be successful in your studies.

Each chapter in the book has the following features, which are meant to help you learn:

Overview

This is an overview of the contents and the units of the chapter

CHAPTER OVERVIEW	
Unit 1.1	Motherboard
Unit 1.2	Purpose and role of cache memory and caching
Unit 1.3	Memory as part of a computer system
Unit 1.4	Computer performance

Learning outcomes

These are the objectives that are addressed in the chapter. It states what you should be able to do by the end of the chapter and gives you an idea of what will be expected of you as a learner. After completing each chapter, ask yourself, 'Am I able to do everything stated in the learning outcomes?'. If not, you should revise the content covered in the chapter.

Learning outcomes

At the end of this chapter you should be able to
- describe the motherboard
- describe the purpose and role of the motherboard
- describe the purpose and role of components that form part of the motherboard
- describe the purpose and role of expansion cards
- explain how data is transferred between computer components
- describe caching and web caching
- describe memory as part of a computer system

WHAT MOST SCHOOLS DON'T TEACH

Before getting started, watch the video in the QR code

https://www.youtube.com/watch?v=nKIu9yen5nc

PLAYLIST

Click on the QR code to access a playlist of videos that will teach you different skills you will need to know for this course.

https://m.youtube.com/playlist?list=PLY8n0zQCEkppKq4Pe_LHzcxQlQSimwk4S

Introduction

The introduction is a brief summary of why you will be learning the content that is covered in the chapter. Sometimes it will give you a brief background of how far technology has come, while at other times it will just give you a short summary that introduces the content that will follow in the chapter.

INTRODUCTION

In Grade 10 you learned about several different input-, processing-, output-, and storage devices. In this chapter you will look at hardware and extend your knowledge while learning more about the component connecting these devices – the motherboard. You will also learn about computer memory, including RAM and ROM, in greater detail.

New words

These are difficult words that you may not have encountered before. A brief explanation for these words are given.

New words

CPU – the processing unit responsible for processing general instructions

GPU – the part of a computer responsible for processing the instructions that create a picture on the screen

Activities

These cover questions you have to answer based on the content presented before them. Activities will help you check whether you have understood the content presented in the book or not.

Activity 1.2 *continued*

c. What is the CPU?
   - **A.** It is the brain of the computer which runs all programs and processes all software instructions
   - **B.** It is the short-term memory of the computer which can store and retrieve active programs and data at very high speeds
   - **C.** It stores the motherboard's operating software, called the BIOS.
   - **D.** All of them
   - **E.** None of them

'Take note' and 'Did you know' boxes

The boxes provide extra, interesting content that might caution you to 'take note' of something important; or give you additional information. Note that the content in the 'Did you know' boxes will not be part of your exams.

Did you know

In 1975, the computer scientist, Fred Brooks, said that just because it takes one woman nine months to make a baby, it does not mean that nine women can make a baby in one month. This is known as Brooks' law and it is also true for multiple processors!

Take note

See Figure 1.5 on page 8 below for more information.
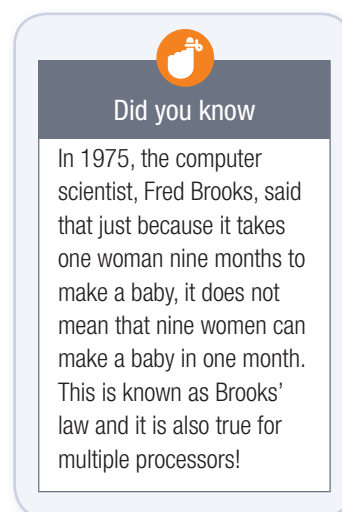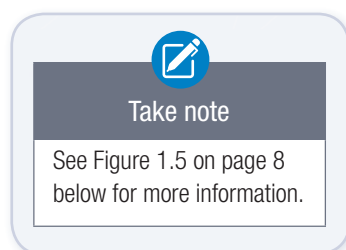
QR Codes, Videos and Screen captures

These will link you to online content. When you are in the eBook, you can easily access the links.

QR CODE

https://www.youtube.com/watch?v=nQlB5qcl3R8
https://qrs.ly/5ra5pml
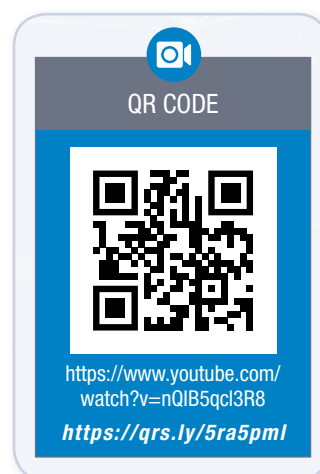
Consolidation activities

This is a revision activity based on what you have covered in the chapter. Take time to answer the questions on your own. You teacher may also use these to assess your performance during class.

CONSOLIDATION ACTIVITY   Chapter 1: Hardware

1. Choose the correct answer.
    a. Which one of the following is true of the motherboard?
        A. Provides physical structure for other hardware
        B. Allows processing of data
        C. Temporary storage of the computer
        D. Permanent record of our programs and data
    b. Which one is NOT a feature of RAM?

HARDWARE

CHAPTER OVERVIEW	
Unit 1.1	Motherboard
Unit 1.2	Purpose and role of cache memory and caching
Unit 1.3	Memory as part of a computer system
Unit 1.4	Computer performance

Learning outcomes

At the end of this chapter you should be able to
- describe the motherboard
- describe the purpose and role of the motherboard
- describe the purpose and role of components that form part of the motherboard
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- explain how data is transferred between computer components
- describe caching and web caching
- describe memory as part of a computer system

INTRODUCTION

In Grade 10 you learned about several different input-, processing-, output-, and storage devices. In this chapter you will look at hardware and extend your knowledge while learning more about the component connecting these devices – the motherboard. You will also learn about computer memory, including RAM and ROM, in greater detail.

In Grade 11 we introduce new and interesting concepts and expand your knowledge of computers and computer programming. To make sure this new knowledge is placed in the context of information you already understand, each chapter starts with a brief overview of the core concepts covered in Grade 10. This gives you an opportunity to refresh any knowledge you might need to understand the concepts being taught in this chapter. If there are concepts covered in the Grade 10 overview that you struggle with, the 'In a Nutshell' link allows you to jump directly to the appropriate section in the Grade 10 textbook so that you can revise any work.

HARDWARE IN A NUTSHELL

Computer hardware refers to the physical components that make up a computer. This includes devices that stand on their own like monitors and keyboards, but also components inside the computer like the **CPU** and motherboard. Hardware can be grouped into the following categories:

- **Input devices:** any device that allows you to add data to a computer, like a keyboard, mouse, camera or microphone.
- **Memory:** the storage space in a computer where data is temporarily kept while it is being processed.
- **Output devices:** a device that takes data from a computer and makes it available to the user in a way the user understands. Examples include monitors, speakers and printers.
- **Storage devices:** a device that stores data permanently. Different storage devices like hard disk drives, CDs and flash drives simply store different amounts of data.
- **Processing devices:** the computer devices responsible for implementing instructions and doing calculations. You learned about two processing devices: CPUs and **GPUs**.
- **Communications devices:** devices, such as modems and routers, that allow a computer to connect to other computers on a network.

All these devices are connected inside a computer by the motherboard, a **printed circuit board** (or **PCB**).

New words

CPU – the processing unit responsible for processing general instructions

GPU – the part of a computer responsible for processing the instructions that create a picture on the screen

Activity 1.1

1.1.1 Fill in the missing words in the crossword puzzle below.
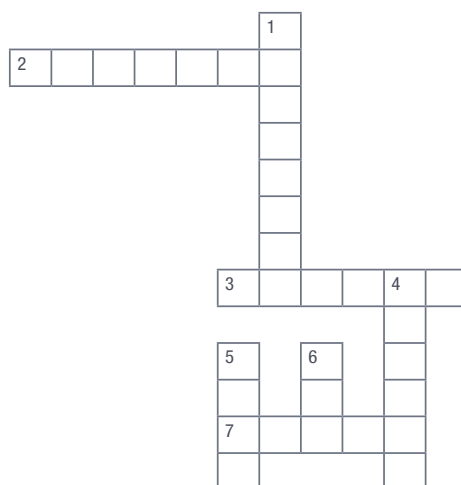
DOWN	ACROSS
1. physical components that make up a computer make up a computer	**2.** a commonly used output device
4. allows you to connect to other computers on a network	**3.** the storage space in a computer where data is temporarily kept while it is being processed
5. connects a monitor to a computer	**7.** allows you to add data to a computer
6. responsible for implementing calculations in a computer	

1.1 Motherboard

Imagine you are a computer. As a computer, your body parts act as input devices. They take signals from your environment, translate them into electrical signals and send them to your brain. For example, if it is too cold or warm. Your brain is like the processing device (or CPU). It receives millions of signals from your environment, interprets them, makes decisions and finally sends commands to your body. These commands are received by output devices that convert the decisions from your brain into something visible that people can see. For example, you will put a long-sleeved top on if it's cold.

In a similar way, a computer's motherboard is responsible for connecting all the hardware devices and sending signals from one device to the next.

Did you know

There is often nothing wrong with the arms and legs of quadriplegics (people who are unable to use these limbs). Instead, damage to the spinal cord prevents them from sending a signal to their limbs, which, in turn, prevents them from using these limbs.

PURPOSE AND ROLE OF THE MOTHERBOARD

The motherboard is a large printed circuit board with specific slots for every hardware component, which have been designed so that only the correct components will fit. In principle, the motherboard performs four key tasks. It:
- provides physical structure for other hardware.
- connects the hardware.
- provides power to the hardware.
- sends signals between the hardware.

COMPONENTS AS PART OF THE MOTHERBOARD

The following image shows where most of the important devices are connected to the motherboard.
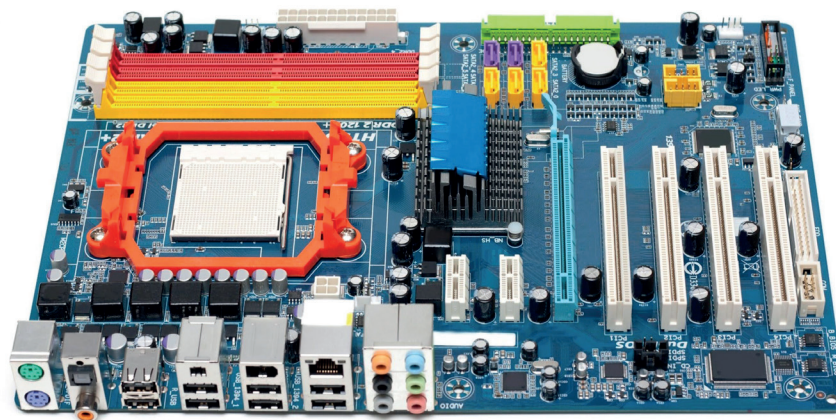
Figure 1.1: *A motherboard is a large PCB with slots for all the hardware*

QR CODE

https://www.youtube.com/watch?v=nQIB5qcl3R8

https://qrs.ly/5ra5pml
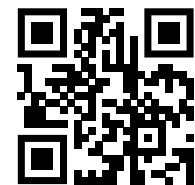
Animation

Animation showing a motherboard, then zooming in on the following slots:

CPU   RAM   ROM   PCIe

PCIe ×16 (for the graphics card)   SATA   Power

WATCH ONLINE
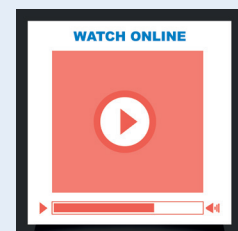
The motherboard connects all the hardware, if you look closely in the image below, you will notice that there are lines all over the motherboard. These are the circuits that transfer data between different components.
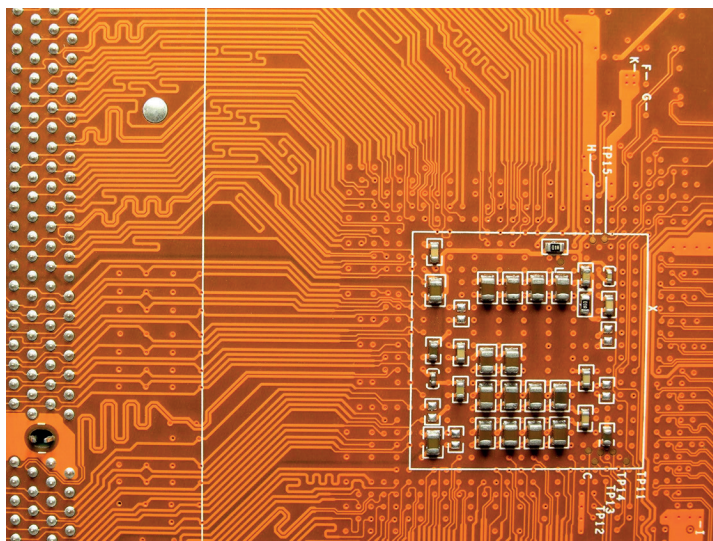
Figure 1.2: *Small zig-zags are added to routes to make sure the signals arrive at the same time*

Looking at Figure 1.2 you may also notice that the circuits are not always the same width. This is because the width of a circuit determines how much data it can carry, with wider circuits being able to transport more data. For example, a component like the GPU requires very wide circuits because it is responsible for receiving and sending millions of instructions each second, while a 3,5 mm sound port might require a lower width circuit.

Processing devices which do the hard work of manipulating the data and performing the calculations needed by your computer. These devices receive the data from the RAM, perform sets of instructions, and returns the processed data to the RAM. The two most important processing devices in modern computers are Central Processing Unit and Graphics Processing Unit. The most important components that can be connected to the motherboard are shown in the table below.

COMPONENT	DESCRIPTION
BIOS chip	A computer's BIOS (or Basic Input/Output System), is the first set of instructions that run every time a computer is started up. The BIOS is stored on your computer's ROM (or read-only memory) and is responsible for making sure your computer starts up correctly. However, the BIOS application can also be accessed by users to specify the hardware settings to the motherboard.
CPU	The Central Processing Unit (CPU) is the most important component of the computer. It is the brain of the computer which runs all programs and processes all software instructions. Central Processing Unit (CPU) is responsible for processing general instructions. Every application makes use of the CPU to collect, decode and execute instructions as required by the application.
GPU	Graphics Processing Unit (GPU) is responsible for processing the instructions that create the pictures on your screen, for example, three-dimensional games rely heavily on the GPU to create their images.

QR CODE

https://www.youtube.com/watch?v=zIYkol851dU

COMPONENT	DESCRIPTION
RAM	The RAM (or random-access memory) is the short-term memory of the computer which can store and retrieve active programs and data at very high speeds. Your computer can access and utilise the data in the RAM immediately without delay. All data is erased from your RAM when your computer is turned off.
VRAM	Video Random Access Memory is the memory used to store image data that the computer displays. It acts as a buffer between the CPU and the video card. When a picture is to be displayed on the screen, the image is first read by the processor and then written to the VRAM.
ROM (Read-only memory)	The ROM (or read-only memory) stores the motherboard's operating software, called the BIOS.

MOTHERBOARD SLOTS

To connect these components (as well as other, expansion components) to the motherboard, motherboards contain several slots. These slots include:

- **CPU slot:** The CPU socket (also called the ZIF socket) is used to connect the CPU to the motherboard. Intel and AMD each have their own sockets, and each brand occasionally change their standard socket when a new generation of CPUs is released.
- **DIMM slot:** The DIMM slot is used to connect the computer's RAM to the motherboard.
- **PCI/PCIe:** The Peripheral Component Interconnect (PCI) or PCI express slots allow you to plug additional hardware like a GPU, sound card, ethernet card or Wi-Fi card into the computer.
- **GPU/PCIe x16:** this is a high-speed slot generally used for the computer's graphics card since it receives and sends the most data.
- **SATA:** The Serial AT Attachment (SATA) port is used to connect internal storage devices such as hard drives to the computer.
- **Power:** the main power connection connects the motherboard to the power supply which connects to a normal household power outlet. This supplies power to the motherboard and all connected components.

Did you know

To prevent damage to the CPU, a Zero insertion force (ZIF) socket is a type of socket or electrical connector that needs no force for insertion. The CPU is placed on it and clamped into position.
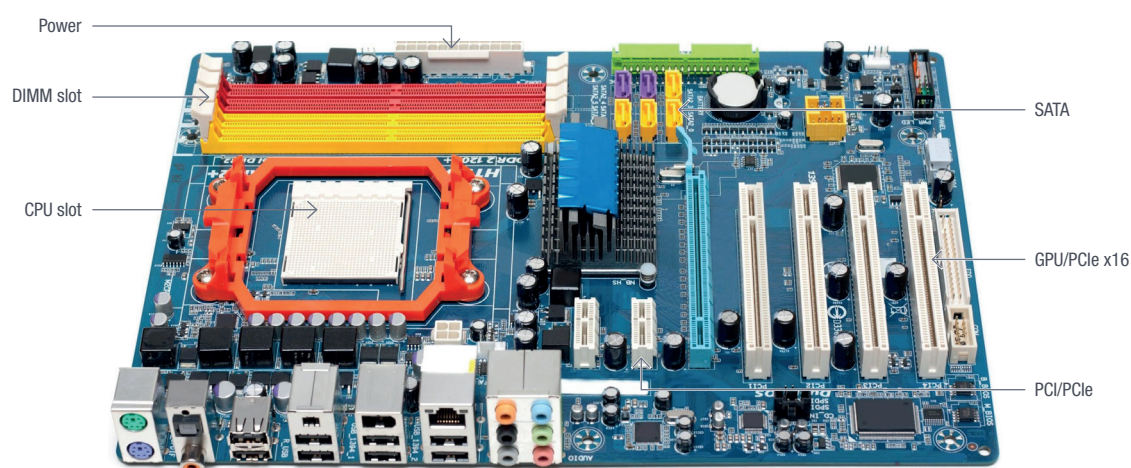
Figure 1.3: *Motherboard slots*

MOTHERBOARD BUSSES

The path connecting different components on a motherboard is called a **bus**. Buses are not just the electrical circuit, but the whole communication system between two devices, including the hardware components (such as the port and the circuit), and the electrical conductors, the communication **format** and the software. A single bus can allow multiple simultaneous connections between components. For example, a single USB (universal serial bus) can receive and send information to multiple USB devices at the same time.

In other sections of the motherboard, data may be transferred using point-to-point connections. These connections are made directly between two components on the motherboard and do not allow additional connections to be made. These point-to-point connections are typically built into the motherboard and CPU to allow them to communicate more easily.

The motherboard bus is a set of wires that connects one part of the motherboard to communicate with other parts of the motherboard. It also serves as an interface between the CPU and various external devices. The motherboard bus can be one of two types:

- An internal bus is the communication highway of the motherboard, sending data and instructions to the different parts within the motherboard. It links the different parts of the computer to the CPU and the main memory.
- The external type of motherboard bus (expansion bus) is the interface for peripheral devices like hard disks, CD-ROM drives, and flash drives to get connected to the CPU. The shape of each interface is unique preventing one from plugging a device to a wrong port, which could cause damage to the device while being connected to the CPU.

All buses have:

- A control bus, which is used by the CPU to send signals to the different parts of the computer system to keep the actions of the different parts coordinated.
- A data bus, which provides the path to transfe data and instructions among the different components of the computer. It is assisted by the address bus, which provides the physical address of data in the system memory to help data transfers.
- A power bus, which energises the different components of the computer system.

MODULAR DESIGN

Computers are built using a **modular** design. This means that, rather than being made from a single component, it is built from several different components (or modules). Because components are not built into the motherboard (or soldered onto the motherboard), you can remove or replace these components with new components at any time. This allows you to create thousands of different computers with different components, different speeds and different abilities.

For example, if you wanted to build a computer for use in the IT class, you might buy a motherboard and then add an entry level CPU (like an Intel Core i3), 4 GB

of RAM and a 500 GB hard drive. In contrast, you could use the exact same motherboard to build an incredible gaming PC by adding more RAM, one or two GPUs and replacing the Intel Core i3 CPU with a Core i5 or Core i7 CPU. The table below compares the two different computers.

The modular design also means that you can repair or replace individual parts of the computer. If a component such as a RAM module stops working for some reason, then you can replace just that RAM module and not have to buy a whole new computer.

Table 1.1: *Comparison between two computers*

COMPONENT	BASIC COMPUTER	INCREDIBLE COMPUTER
Motherboard	The same motherboard for both computers	
Case	The same case or chassis for both computers	
CPU	Core i3-8100 (4 × 3,6 GHz)	Core i7-8700K (12 × 4,7 GHz)
GPU	Built-in GPU	2 × GeForce RTX 2080 Ti
RAM	1 × 4 GB (2000 MHz)	2 × 8 GB (3000 MHz)
Storage	500 GB hard drive	500 GB solid-state drive 8 000 GB hard drive
Other items	–	Liquid cooling system 900 W power supply
Approximate cost	R9 500	R82 000

PURPOSE AND ROLE OF EXPANSION CARDS

As you saw in the list of motherboard slots, the PCI and PCI-express slots allow you to add (or expand) the features of your computer through the use of expansion cards. These are circuit boards for computer components that are purchased separately and use the PCI or PCI-express slots to connect to your computer.
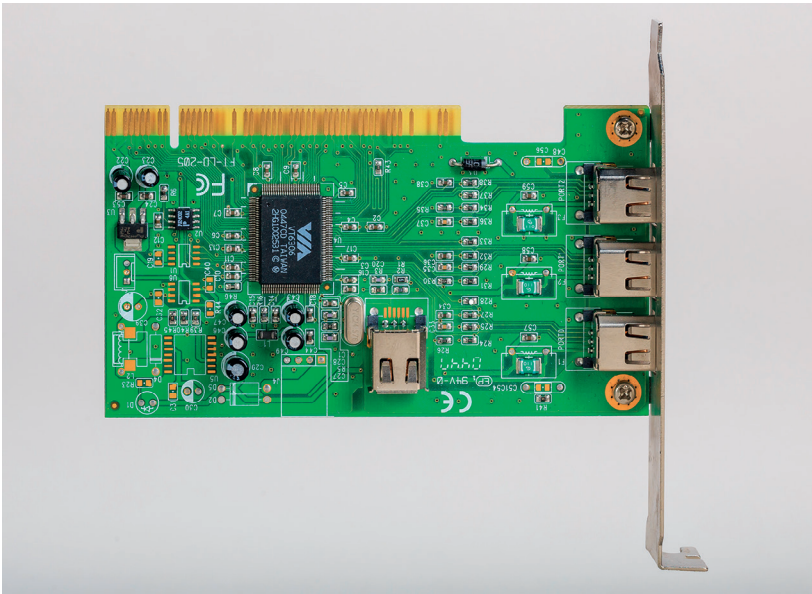
Figure 1.4: *An example of an expansion card*

Did you know

In September 2014, an internet user called The *Stilt* overclocked his AMD CPU from its normal speed of 4 000 MHz to an incredible 8 722 Mhz. By 2018, this was still the highest speed a normal desktop CPU has ever run at! However, the CPU generated so much heat at this temperature that liquid nitrogen (which has a temperature of −196 °C) had to be poured directly onto the CPU to keep it cool.

Popular examples of expansion cards include:

- Ethernet card that allows you to connect to a wired network.
- Wi-Fi card that allows you to connect to a wireless network.
- Sound card for improved sound quality or surround sound capabilities.
- TV Capture card that allows you to capture videos and store them on your computer.
- Storage controller that allows you to add additional or faster hard drives.

FLOW/TRANSFER OF DATA BETWEEN COMPONENTS

After reading the information on the components of the motherboard we will see that the basic routes the motherboard uses to transfer these signals are shown below:
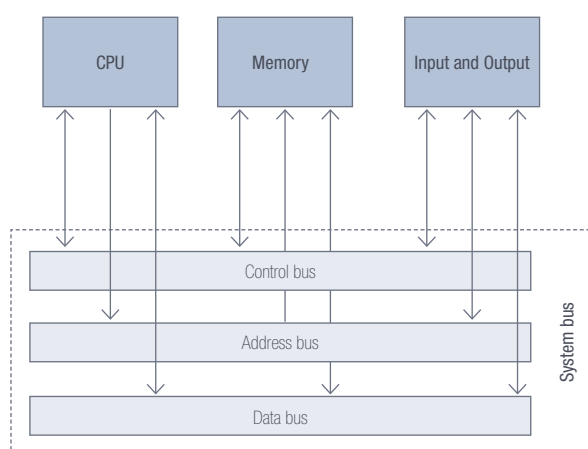
Figure 1.5: *The flow of data between components*

Activity 1.2

1.2.1 Choose the correct answer.

    a. Which of the following is NOT a key task of the motherboard?

        A. It provides physical structure for other hardware.

        B. It connects the hardware.

        C. It uses a combination of capacitors and transistors to store data.

        D. It provides power to the hardware.

        E. All of them.

    b. What is the motherboard?

        A. It is the part of the computer where the data is stored and from where memory can only be retrieved but not overwritten or deleted during normal operation.

        B. It is the part of the computer that transfers data between components

        C. It is a circuit board for computer components that are purchased separately and use the PCI slots to connect to your computer.

        D. It is the first set of instructions that run every time a computer is started up.

        E. It is a large printed circuit board with specific slots for every hardware component, which have been designed so that only the correct components will fit

c. What is the CPU?

   A. It is the brain of the computer which runs all programs and processes all software instructions

   B. It is the short-term memory of the computer which can store and retrieve active programs and data at very high speeds

   C. It stores the motherboard's operating software, called the BIOS.

   D. All of them

   E. None of them

d. What is the purpose of the USB port?

   A. This port allows for connecting to a monitor, or on a laptop, to an additional analogue monitor

   B. It provides a connection to a keyboard, mouse or other electronic devices such as cell phones or external hard drives.

   C. This port allows a computer to be connected to a network of other computers, printers, servers and routers using a physical network cable

   D. This port allows high quality image and sound output from the computer to TV screens.

   E. It allows the connection of earphones or speakers to the computer

e. How is data transferred in a motherboard?

   A. Using light (optical)

   B. Using electromagnetic signals

   C. Data is not transferred on a motherboard

   D. Using point-to-point connections and buses

   E. All of the above

f. What is a computer's BIOS?

   A. It is a way to increase the speed of your computer drastically.

   B. It is the first set of instructions that run every time a computer is started up

   C. It is part of the operating system

   D. It is short for Best Input / Output System

   E. All of the above

g. What does it mean that a computer has a modular design.

   A. Its looks like a cube/rectangle.

   B. It consists out of one solid module or block.

   C. It is built from several different components or modules

   D. None of the above

h. Which one is NOT an example of an expansion card?

   A. A Wi-Fi card that allows you to connect to a wireless network

   B. An ethernet card that allows you to connect to a wired network.

   C. A sound card for improved sound quality or surround-sound capabilities

   D. A TV Capture card that allows you to capture videos from your television and store them on your computer

   E. A hard disk drive that allows your computer to store more data.

1.2.2 Choose a term/concept from COLUMN B that matches a description in COLUMN A. Write only the letter next to the question number (e.g. 2.1 – A). There can be more than one answer to a question.

COLUMN A	COLUMN B
1. The short-term memory of the computer which can store and retrieve active programs and data at very high speeds	**A.** HDMI port
2. IT allow you to plug additional hardware like a GPU, sound card, ethernet card or Wi-Fi card into the computer.	**B.** ROM
3. This port allows high quality image and sound output from the computer to TV screens	**C.** Bus
4. This port allows a computer to be connected to a network of other computers, printers, servers and routers using a physical network cable.	**D.** BIOS
5. The path connecting different components on a motherboard.	**E.** Ethernet port
6. It stores the motherboard's operating software, called the BIOS.	**F.** Wi-Fi card
7. These connections are made directly between two components on the motherboard and do not allow additional connections to be made	**G.** Point-to-point connections
8. A popular examples of an expansion card.	**H.** Ethernet card
9. You can enable or disable motherboard features using the _____	**I.** RAM
10. This is stored on your computer's ROM and is responsible for making sure your computer starts up correctly.	

1.2.3 Your younger brother suggests that you upgrade the BIOS of the older motherboard for the motherboard to be faster and more powerful.

    i. What is the BIOS?

    ii. List the FOUR main tasks of the BIOS.

    iii. Where is the BIOS stored?

1.2.4 Look at the following two advertisements for desktop computers and answer the following questions.

COMPUTER 1	COMPUTER 2
2Intel I3 2.8 GHz	Intel I5 4570T 3.6 GHz
500 GB HDD	1TB HDD
2 GB RAM	4 GB RAM
21' LCD colour monitor	24' Monitor, 1920 × 1080 Resolution
DVD/CD Writer Combo-Drive	Blue Ray Combo Drive
MS Windows 8.1 Home Basic	MS Windows 10 Home
Optical Mouse	Wireless Mouse and Keyboard
Free Zeon Ink-jet printer	Free: Multifunctional Laser Printer,
Free Flatbed Scanner	20 MP digital Camera,
Ergonomically designed QWERTY Keyboard	5 in 1 card reader
Free Digital Camera.5-inch (diagonal) LED-backlit display	With USB Hub included

a. Explain why, in Computer 2, the storage specification must be bigger than the memory specification.

b. What is the speed of the CPU given in the specifications of Computer 2?

c. What is the main function of the hard drive?

d. Identify the following equipment from each computer:

    i. Motherboard

    ii. RAM

    iii. Output devices

    iv. Storage devices

1.2 Purpose and role of cache memory and caching

Caching is a technique used by computers to store data that is likely to be used soon, in a faster form of memory so that it can be accessed more easily. Certain components, like the CPU, have a small amount of physical cache memory built into them so that they can quickly access the information they need, rather than waiting for the information to be sent to them through the busses.

Caching refers to the use of a faster medium to prevent a slower medium from slowing down the performance of a computer.

There are three important forms of caching:
- **CPU cache:** the difference in speed between a computer's CPU and RAM has recently become too large. As a result, the RAM cannot provide all the information the CPU needs. This means that the CPU would waste time waiting for data and instructions to come from the RAM. This would then cancel out the advantage of having a fast CPU. To prevent this problem, many CPUs now have a small, high-speed cache built into the CPU, where it can temporarily store a small amount of the data it needs.
- **Disk cache:** a small amount of RAM that is built into a hard disk drive. It stores data being sent or received by the hard disk plates for a short period of time. In this situation, the RAM works faster than the storage.
- **Web cache:** a small area on a computer's hard drive where images and pages from the world wide web are stored. This allows you to quickly load those images from your computer (rather than over a slow internet connection) the next time you open a page. In this situation, the Hard drive works faster than the internet connection.

> **New words**
>
> **world wide web** – refers to the millions of websites that are hosted on the internet

Case Study — Cache, RAM and storage

To better understand the relationship between your computer's cache, RAM and storage, you can think about a scenario in which you would like to purchase something. Your money can be stored in three places:

1. Your pockets (cache)
2. Your wallet (RAM)
3. Your bank account (hard disk)

The easiest and quickest way to get access to your money is if you already have money in your pockets. If this is the case, you can pay and immediately receive your item. However, your pockets do not have much space for money and any money found in your pockets is removed when you wash your pants. Cache works in the same way in that it is the quickest way to store small amounts of data but is cleared frequently.

The second easiest way to get access to your money is to look in your wallet. While a wallet allows you to store more money (generally, enough money to do shopping), it also takes more effort to look for this money. In the same way, RAM generally allows you to store the data you will need at any time but does not allow you to permanently store your data.

The slowest way to get access to your money is to go to the bank. This takes a much, much longer time, but the bank allows you to store much larger amounts of money. As a result, whenever you make a big purchase (such as a house or a car), you will need to go to the bank. In a similar way, your hard drive is much slower than either RAM or your cache, but it also allows you to permanently store thousands of times more data. Whenever you open a new program, your computer slowly reads this data from your hard drive into your RAM, from where it can be accessed more quickly.

Let's continue using the metaphor of the human body. In the human body, there is one critical element that you still need so that you can make decisions – that is, your memory. For example, when you see a fire burning, you do not need to do any calculations to know that you should keep your hand out of the fire. Instead, you learned that information through your life experiences and it is stored in your memory. You can therefore decide what to do without calculating everything from first principles.

In a similar way, a computer also needs a memory to store information. A computer has three important types of memory. These are:
- RAM (short-term memory)
- storage devices (long-term memory)
- ROM (read-only memory).

In this unit, we briefly discuss each of these types of memory.

ROM

As you have learned, the read-only memory (or ROM) stores the computer's BIOS. As the name suggests, your computer's read-only memory can only be retrieved but not overwritten or deleted during normal operation. This prevents the accidental deletion of the instructions needed to use the computer.

You may be wondering how 'read-only' memory can be used to store a user's settings. As the ROM cannot be changed normally, the settings are saved on a tiny piece of memory connected to the ROM called the CMOS. Unlike the ROM, the CMOS needs to have power to keep its data. To ensure that the CMOS continues to store the BIOS settings (even when the computer is turned off and disconnected from power) the CMOS is connected to a small battery.

RAM

In your day-to-day life, you need your short-term memory to remember the things you are working on. For example, while you are driving a car, you always need to be aware that you are driving a car. Forgetting this for even a few seconds could result in a serious accident! Short-term memories are thus memories that are readily accessible.

Did you know

The BIOS is stored permanently on your computer's ROM, rather than its hard drive, since your motherboard cannot access the hard drive until it has loaded the settings from the BIOS. Since the ROM is connected directly to the motherboard, the motherboard is programmed to communicate with the ROM without needing any additional instructions.
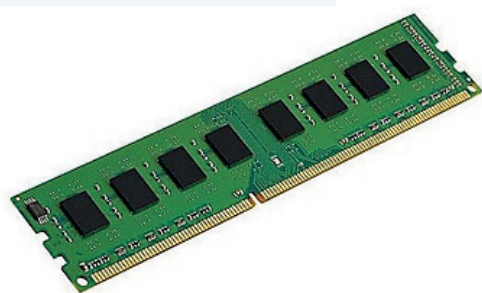
On a computer, all active programs and data that is currently being worked on is stored in its RAM. Since the RAM is closely connected to your CPU and has very high read and write speeds, it can ensure that your CPU has access to all the data it needs when it needs the data. Without RAM, your computer would need to read and write all data it is using to your hard drive, which is much slower than the RAM. As a result, your CPU would spend a lot of time waiting for data to be loaded.

Figure 1.6: *A RAM module*

Examples of data stored in RAM include:

- information currently shown on the screen.
- applications running in the background.
- instructions the computer is busy with.
- instructions the computer might need next.
- data the computer might need next.

Since RAM is only used for short-term memory storage, it is cleared the moment you turn off your computer.

TEMPORARY AND PERMANENT STORAGE

In general, computer storage and memory can be grouped into temporary storage and permanent storage solutions. Temporary storage solutions are typically managed directly by the computer and all data is removed from the temporary storage once the computer is turned off.

Temporary storage includes:

- **RAM:** RAM is electronic memory and comprises of a combination of capacitors and transistors to store data. RAM is temporary memory used to store data that the computer is currently using. RAM is volatile since all information is cleared from the RAM once the computer is restarted.
- **Cache memory:** Cache memory is also called CPU memory. It Is very fast and works directly with the CPU to store small amounts of information that may be needed by the CPU.
- **Disk cache memory:** Instead of the CPU having to wait for data to be stored on a slow hard disk, it sends the information to be saved to the disk cache memory. From the disk cache, the data is written to the hard drive, which stores it permanently.

Permanent storage includes:

- **Magnetic:** Magnetic tape and hard disk drives use magnetic properties to store and retrieve information. This allows large amounts of information and programs to be stored permanently, although the devices take longer to write and read the information than RAM.
- **SSD (Solid State Drives):** As with RAM, SSDs store data on a chip, which means that it uses electricity to store data rather than magnetism like conventional hard drives or lasers like DVD drives. However, unlike RAM, SSDs can store data permanently. SSDs are faster but more expensive than a hard disk drive.
- Flash drives use the same technology as SSD's but usually have a smaller capacity and are designed to be a portable form of storage.
- **Optical storage media:** CD, DVD and Blu-ray disks are cheap, portable media that can be used to store data. While these disks can have a high capacity, they are slower to read from and write to than all the previous storage types.

QR CODE
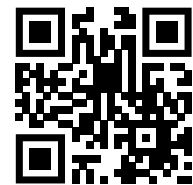
https://www.youtube.com/
watch?v=_0ZtFrh_q_g

https://qrs.ly/cja5pn9

The table below summarises the biggest differences between RAM, storage devices and ROM.

Table 1.2: *Differences between RAM, storage devices and ROM*

RAM	HARD DRIVE	ROM
Small capacity	Large capacity	Tiny capacity
Very high speed	Normal speed	Very slow speed
Temporary, cleared when it loses power	Permanent, but can be changed by the user	Permanent, cannot readily be changed by the user
No user control; managed automatically by OS	User controlled, can choose what to store on it	No user or operating system control; is preloaded with software

Activity 1.3

1.3.1 Indicate whether the following statements are TRUE or FALSE. Write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. Change the underlined word(s) to make the statement TRUE. You may not simply use the word 'NOT' to change the statement. NO mark will be awarded if only FALSE is written down.

a. Without <u>ROM</u>, your computer would need to read and write all data it is using to your hard drive, which is much slower and as a result, your CPU would spend a lot of time waiting for data to be loaded.

b. The reason why BIOS settings can be stored on the ROM, is because the CMOS continues to store the BIOS settings when the computer is switched off as it is connected to a small battery.

c. Since RAM is only used for short-term memory storage, it is <u>saved</u> the moment you turn off your computer.

d. Magnetic tape and hard disk drives use magnetic properties to store and retrieve information, allowing large amounts of information and programs to be stored <u>temporarily</u>.

e. Hard drive has a large capacity and normal speed. It can be a <u>permanent storage device</u> and is user controlled.

f. Caching refers to the use of a <u>faster</u> medium to prevent a <u>slower</u> medium from slowing down the performance of a computer.

g. <u>CPU-cache</u> is a small amount of RAM that is built into a hard disk drive. It stores data being sent or received by the hard disk plates for a short period of time.

h. The hard drive is much <u>slower</u> than either RAM or cache, but it allows you to permanently store a lot more data.

1.3.2   The following image indicates the sizes of L1 and L2 cache memory.
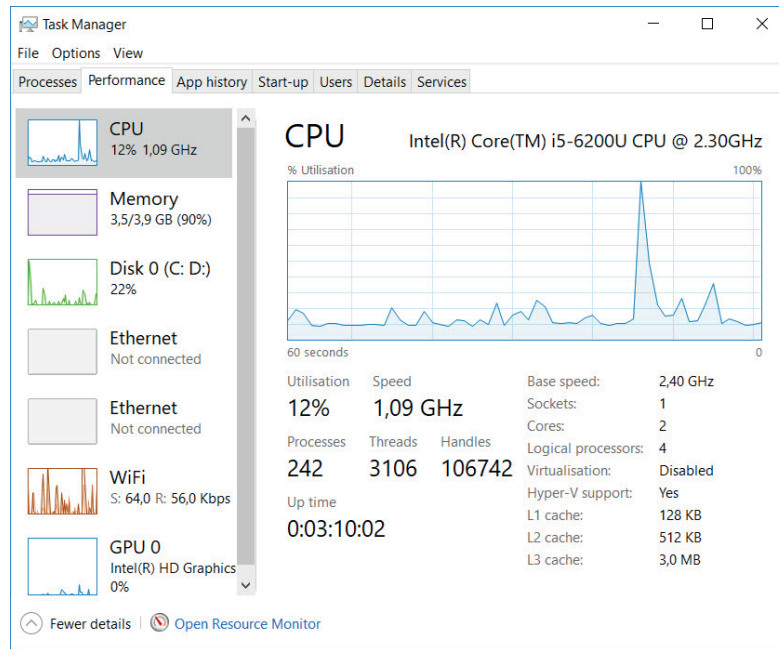
a.   What is cache memory?

b.   What is the purpose of caching?

c.   Why does cache memory improve the performance of the CPU in a computer system?

1.3.3   Peter placed a magnet next to his computer case. Now his computer does not load the operating system. Explain what could have happened.

1.3.4   You are helping one of the technicians evaluate the IT setup in an office complex. You meet with the complex management to decide on a few issues.

a.   The chairman wants to know what RAM and ROM are. Explain what they are, giving ONE example of each.

b.   One member says he has heard that one can use a hard drive as RAM, so he suggests they save costs and leave out the RAM. Is this true? Explain your answer.

c.   Name THREE expansion cards which can connect into the motherboard slots.

d.   One committee member says he thinks it would be good if all the new motherboards have upgraded cache memory, but he says he cannot find it. Explain where this cache memory is and why it cannot be upgraded.

1.4 Computer performance

Having looked at some of the differences between mobile technologies and traditional desktop computers, it is useful to see exactly how the different computer components influence the performance of a computer or smartphone. The four specific components have already been discussed in the previous units, Table 1.3 summarises the most important components of a computer, as well as the factors affecting their performance.

Table 1.3: *Hardware components*

COMPONENT	PURPOSE	PERFORMANCE FACTORS
CPU	Completes the general processing tasks of the computer.	Number of cores Clock speed (MHz/GHz) Cache size and speed Generation 1/2/3, etc.
GPU	Completes the graphics processing tasks of the computer.	Clock speed (MHz/GHz) Amount of built-in RAM Memory clock speed Release date
RAM	Very high-speed storage which temporarily stores data the CPU is using.	Generation (DDR3 or DDR4) Amount of RAM (GB) Clock speed (MHz/GHz)
ROM	It stores the BIOS, the motherboard's operating software	
HDD	Slower, mechanical storage device used for long-term storage of data.	Amount of space (GB/TB) Revolutions per minute (RPM)
SSD	Faster, electronic storage device used for long-term storage of data.	Amount of space (GB/TB)
Motherboard	Connects all the components of the computer.	Correct socket for CPU Correct size for chassis Ports / PCI-e slots
Monitor	Displays the images generated by the computer.	Resolution Frame rate Colour accuracy

Computer performance can be seen and experienced by the amount of useful work that is accomplished by a computer system. The work that is performed can be measured in terms of accuracy, efficiency and speed of executing computer program instructions to show level of computer performance.

High performance computers typically involve one or more of the following factors:
- Short response time for a given piece of work.
- High throughput which refers to the rate of processing work.
- Low utilisation of computing resource(s).
- High availability of the computing system or application.
- Fast (or highly compact) data compression and decompression.
- High bandwidth.
- Short data transmission time.

What's most important in terms of computer performance, depends on the intended use of the computer. With so many options of speeds of a CPU and the number of processing cores, to the size and speed of the RAM all work together to enhance the overall performance of a computer system.

A single slow component such as a standard hard drive in a high-end computer as shown below would impact the performance significantly of the computer system.

Table 1.4: *Computer Performance comparison*

LOW END COMPUTER	HIGH END COMPUTER
Intel / AMD: 2/4 processing Cores	Intel / AMD: 8/16 Processing Cores
2/4 Gb Ram (2000MHz)	16/32 Gb Ram (4000MHz)
Standard Hard Drive	Solid State Drive

The best way to evaluate hardware components is by doing online research. Websites like Anandtech and Guru3D.com specialises in testing hardware and will be able to tell you exactly how much faster one component is than another. They will also provide you with up-to-date information on which components are the best and most cost-effective to purchase.

A factor affecting a computer's performance is the speed of the storage devices. In the previous Units, you saw how the capacity of the RAM affects your computer's performance. However, before the data can be stored in your RAM, it needs to be loaded from your storage device. If the storage device has a low speed, it might take a long time for the information to be loaded into your RAM, causing your computer to slow down.

Storage speed is especially important in five situations:
- When opening a program or opening a large data file, at which point all the data needs to be transferred from your storage device to your RAM.
- When loading your operating system, since all your operating system's data and processes need to be loaded into your RAM.
- Installing large applications on a storage device, since the new files need to be created on the storage device.
- When storing large amounts of data on a storage device (such as saving a large video to hard drive).
- When transferring data between two storage devices (such as copying files from one drive to another).

Activity 1.4

1.4.1 Choose the correct answer.

a. What is the purpose of the CPU?

A. Completes the graphics processing tasks of the computer.

B. Completes the general processing tasks of the computer

C. Slow, long-term storage of data used on the computer

D. Fast, long-term storage of data used on the computer

b. What is the purpose of the GPU?

A. Completes the general processing tasks of the computer

B. Slow, long-term storage of data used on the computer

C. Connects all the components of the computer.

D. Completes the graphics processing tasks of the computer

c. What is the purpose of the ROM?

A. It stores the BIOS, the motherboard's operating software

B. Connects computers to a network and the internet.

C. Fast, long-term storage of data used on the computer.

D. Very high-speed storage which temporarily stores data the CPU is using.

d. What is the purpose of the HDD?

A. Very high-speed storage which temporarily stores data the CPU is storing

B. Very high-speed storage which temporarily stores data the CPU is using

C. It stores the BIOS, the motherboard's operating software

D. Slow, long-term storage of data used on the computer.

e. What is the purpose of the router?

A. Displays the images generated by the computer.

B. Connects all the components of the computer.

C. Connects computers to a network and the internet.

D. Completes the general processing tasks of the computer

1.4.2 Choose a term/concept from COLUMN B that matches a description in COLUMN A. Write only the letter next to the question number (e.g. 1 – A).

COLUMN A	COLUMN B
1. CPU cache	**A.** It is a small area on a computer's hard drive where images and pages from the world wide web are stored for a short period of time.
2. Disk cache	**B.** It is a small amount of RAM that is built into a hard disk drive which stores data being sent or received by the hard disk plates for a short period of time.
3. Computers	**C.** _____ have more and better communication devices, making them better at connecting to the internet from anywhere in the world.
4. Smartphone	**D.** It is a small, high-speed cache built into the CPU where it can temporarily store the data it needs.
5. Web cache	**E.** _____ have more RAM and faster processing devices, making them better suited to tasks that require significant processing power.

1.4.3 Choose the correct answer.

a. What causes a computer program to stutter, stall, or take a long time to complete a task?

- **A.** All three
- **B.** The speed of the storage device.
- **C.** Slow CPU.
- **D.** A RAM capacity that is too small.

b. What is the speed of the CPU a direct measurement of?

- **A.** The CPU's clock speed.
- **B.** Network speed
- **C.** How many instructions it can complete per second.
- **D.** The computer's cache and RAM.

c. When does low network speed affect a computer's performance?

- **A.** When switching between two open applications.
- **B.** When storing large amounts of data on a storage device.
- **C.** When loading your operating system.
- **D.** When watching multimedia over the network.

1.4.4 Choose the answer and write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. Change the underlined word(s) to make the statement TRUE. (You may not simply use the word 'NOT' to change the statement.)

a. When programs stutter, stall or take a long time to complete a task, the CPU is <u>too slow</u>.

b. The speed of the CPU and its ability to run multiple processes have a direct effect on the <u>CPU's</u> performance.

c. The speed of the CPU is a direct measurement of how many instructions it can complete per <u>minute.</u>

d. The CPU's clock speed indicates how frequently it will complete an instruction per <u>second</u>.

e. The CPUs ability to do <u>a single task</u> determines how good it is.

f. Data that the computer is using, is <u>permanently</u> stored by the cache and RAM.

g. Since the cache and RAM are both much <u>faster</u> than the computer's hard drive, this ensures that the CPU has access to the data it needs.

h. If a computer's RAM capacity is too small, using the computer will become much slower as information needs to constantly be added to and removed from the <u>CPU</u>.

i. Your computer (or CPU's) cache is <u>a slower</u> form of memory, used to send and store all the information the CPU needs.

j. Storage speed is <u>unimportant </u>when opening a program or a large data file.

k. Storage speed is <u>important </u>when loading your operating system.

l. Network speed also affects the computer's performance. If the time to download a video is <u>shorter</u> than the video time, the video will stutter if you try to play it on YouTube.

m. The network speed will <u>negatively</u> affect a computer's performance when downloading applications or games from the internet.

n. Buses are the <u>electrical circuit</u> as well as the whole communication system between two devices, including the hardware components, the electrical requirements, the communication format and the software.

o. A faster GPU will allow you to <u>browse the web</u> much more quickly.

1.4.5 Answer the following questions in your own words:

a. Which four computer components can have a significant impact on a computer's performance?

b. Why does the speed of a storage device determine how quickly a new program opens?

c. Why does the computer become slower if the RAM's capacity is too small?

1.4.6 After owning the same computer for many years, you decide to upgrade your computer by purchasing a new CPU. Fortunately, the CPU still uses the same socket as your motherboard, so you can install the CPU without replacing the motherboard. However, after using your new CPU for a few days, you are disappointed that it has not improved your computer's speed as much as you hoped it would, especially in games.

With this scenario in mind, answer the following questions.

a. Although your computer has a brand-new CPU, you only have 2GB of RAM that is more than 10 years old. How can RAM affect the performance of your computer?

b. Thinking back, your HDD might be even older than your RAM and runs at only 5 400 RPM. How will this affect your computer's performance?

c. Give three situations in which the speed of a hard disk drive is important.

d. Poor performance in games is often associated with a slow graphics card (or GPU). Why is this?

1.4.7 Sandy has been experiencing the following problems whenever she is on the network. The webpages and web applications take a long time to open. She cannot download certain applications or games from the Internet. Whenever her computer starts downloading updates from the Internet, she knows it Is going to take forever.

a. What causes this to happen?

b. List at least THREE other problems that she Is most probably experiencing.

c. What can she do to fix her problems?

1. Choose the correct answer.

   a. Which one of the following is true of the motherboard?

      A. Provides physical structure for other hardware

      B. Allows processing of data

      C. Temporary storage of the computer

      D. Permanent record of our programs and data

   b. Which one is NOT a feature of RAM?

      A. Small capacity   B. User controlled

      C. Very high speed   D. Slow

   c. The form of cache which stores data sent or received by the hard disk plates for a short time is called…

      A. CPU cache   B. Disk cache

      C. Web cache   D. None of the above

   d. Which one of the following is the most important component of a motherboard?

      A. CPU   B. RAM

      C. ROM   D. GPU

   e. Which ONE of the following represents access speed in descending order?

      A. Cache, RAM, hard disk, CD   B. RAM, cache, CD, hard disk

      C. CD, hard disk, RAM, cache   D. RAM, cache, hard disk, CD

   f. When comparing RAM, ROM and a hard drive, which device is user controlled?

      A. RAM   B. ROM   C. Hard drive

      D. None   E. A, B and C

   g. Which of the following are permanent storage devices?

      A. Magnetic tape and HDD, SSD, flash drive, optical storage media

      B. RAM, Cache memory, ROM, HDD, SSD

      C. Magnetic tape and HDD, RAM, ROM

      D. HDD, SSD, RAM, ROM

      E. None of the above

   h. What is an advantage of a modular computer design?

      A. Broken components can be removed or replaced with new components at any time.

      B. Modular design allows manufacturers to create thousands of different computers with different components, different speeds and different abilities.

      C. The parts are easily interchangeable as long as the user uses parts that support the same standard interface

      D. All of the above

      E. None of the above

   i. Which changes can the user make through the BIOS settings.

      A. Clock speed of the CPU   B. Speed of the cooling fans   C. Voltage of the CPU

      D. All of them   E. None of them

2. Choose the answer and write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. Change the underlined word(s) to make the statement TRUE. (You may not simply use the word 'NOT' to change the statement.)

   a. The Peripheral Component Interconnect (PCI) slots (or expansion slots) allow you to plug additional hardware like a GPU, sound card, ethernet card or Wi-Fi card into the computer.

   b. The ROM is the short-term memory of the computer which can store and retrieve active programs and data at very high speeds.

   c. The path connecting different components on a CPU is called a bus.

   d. Hard drives use the same technology as SSD's but usually have a smaller capacity and are designed to be a portable form of storage

   e. The BIOS is the first program to run when a computer starts up.

3. List any TWO tasks that a motherboard performs.

4. What is an HDMI port? Do not just give what the abbreviation stands for.

5. List TWO ways HDMI ports can be used.

6. Briefly explain what a bus does and how it is used in a motherboard.

7. Your uncle has retired and has started a household tiles marketing business that he will run from home. He is planning to use two rooms in the main house and the garage, which is detached approximately 10 m away from the house, as a showroom to be fitted with multimedia display equipment. He has been reading a bit about computer hardware and software and needs clarification from you.

   a. Most of his literature refer to the modular design of the computer system.

      i. What does the term modular design mean?

      ii. Give TWO advantages of modular design.

   b. Most books that he reads state that the performance of the computer depends on the amount of RAM it has.

      i. Expand the term/abbreviation RAM.

      ii. Why is RAM essential for the computer?

      iii. Give THREE characteristics of RAM.

      iv. RAM is usually supplied as small, rectangular electronic boards. What are these boards called?

   c. Your uncle has been told that the computer system uses caching as one of its techniques to speed up its operations.

      i. Describe the term caching in a computer system.

      ii. State the TWO types of caching found in the computer system.

      iii. Identify TWO parts of the computer system which use caching.

8. You have decided to buy the following laptop for your start-up web designing business.

   Use the laptop specifications to answer the following questions

   a. Identify the CPU manufacturer.

   b. What is the speed of the CPU?

   c. What is the size of the CPU cache and RAM?

   d. Is it normal for the RAM to have a much higher storage capacity than the cache? Give reasons for your answer.

SOFTWARE

CHAPTER OVERVIEW	
Unit 2.1	Types of operating systems
Unit 2.2	Compilers and interpreters
Unit 2.3	Overview of processing techniques
Unit 2.4	Virtual machines and virtualisation

Learning outcomes

At the end of this chapter you should be able to:
- describe the various types of operating systems in terms of cost, size, hardware needed and platform
- explain what language compilers and interpreters are
- describe and compare three different processing techniques: multi-tasking, multi-threading and multi-processing
- give the purpose and examples of virtual machines
- describe virtualisation

INTRODUCTION

Android succeeded in making smartphones useful, everyday tools that anyone could use. It has millions of applications that users can install – most of them free. It allows people to easily connect to the internet and allows people from across the world to access the internet from their homes. Smartphones also replace many devices including phones, digital cameras, alarms, music players and even computers. Finally, it works with a larger number of different devices, many of which are affordable. Thanks to a combination of these factors, Android was installed on 85% of all smartphones in 2018 and 42% of all computers (including desktop computers, notebooks and servers). In contrast, the iOS operating systems (used by iPhone) work on a very small number of expensive devices.

In this chapter, you will learn more about system software, including operating systems like Android. The chapter will start by looking at operating systems in

Figure 2.1: *The first Android-based smartphone, the HTC Dream (photo by Akela NDE)*

New words

virtualisation: – refers to the act of creating a virtual (rather than actual) version of something

utilities – small programs which help users to maintain their computers

system software – a type of computer program that is designed to run a computer's hardware and application programs

user interface – the way in which people interact with computer programs or a website

driver – a set of instructions that tells the operating system how to communicate with a specific piece of hardware

stand-alone operating system – a complete operating system that works directly on a computer (or smartphone) to make sure that the tasks of the operating system are completed

network operating system – an operating system that is designed to help other computers on a network

embedded operating system – an object, software or hardware that is independent and does not need an external program or device to run it

greater detail, before looking at a few of the different processing techniques that is, memory systems software. The chapter will then look at how application instructions are converted into a language your CPU can understand, before ending with a look at virtual memory and virtualisation.

Let's refresh your memory on software and operating systems by reading the *Software in a nutshell* section.

SOFTWARE IN A NUTSHELL

Software refers to digital items made up of 1s and 0s that tell your computer what to do. There are many different types of software, including applications, games and utilities. However, the focus of this chapter will be on a category of software called system software, which is responsible for managing your computer. It does this in several important ways, including:

- translating the instructions from your software to a language your hardware can understand
- sending these instructions to the correct hardware
- receiving information from the hardware (such as button presses on a keyboard) and sending it to the software
- allowing different applications to communicate with each other
- making sure all the hardware and software on your computer are working correctly.

The most important type of system software is the operating system, which controls your hardware and software, provides a user interface for users to interact with, and manages the resources of the computer.

The operating system has thousands of small tasks that it processes to ensure your computer continues to run smoothly. These tasks can be summarised as:

- managing and interpreting the signals sent and received by your hardware
- understanding and communicating with different hardware devices using drivers
- managing a computer's memory and storage
- monitoring your hardware's performance
- providing an interface for users to interact with the computer
- allowing the computer's hardware to interact with its software
- allowing computers to connect and communicate over a network.

In Grade 10 you learned that there are three main types of operating systems: stand-alone operating systems, network operating systems and embedded operating systems.

Stand-alone operating systems can work directly on computers (or smartphones, like Android) and make sure that the tasks of the operating system are completed. Almost all home computers, office computers and smartphones use stand-alone operating systems.

Network or server operating systems are operating systems that are not designed to be used on their own, but rather to help other computers on a network. These operating systems form the backbone of the world's largest network: the internet. Finally, embedded operating systems are operating systems designed to be used on a single device with a very specific purpose (such as a SmartTV or video camera).

Activity 2.1	Revision activity

2.1.1 Name the TWO broad categories of software.

2.1.2 List two ways software helps manage your computer.

2.1.3 What Is an operating system?

2.1.4 Briefly explain three tasks that the operating system does to ensure that a computer runs smoothly.

2.1.5 Give ONE difference between a stand-alone operating system and a network operating system.

2.1.6 Can the committee member load both operating systems? Briefly motivate your answer.

2.1 Types of operating systems

Operating systems play a critical role in many different areas of a computer's functioning, including the computer's:

- hardware
- software
- processes
- storage
- memory
- networks

In this unit, you will look at the three operating systems (stand-alone, network and embedded) you already know in more detail.

Table 2.1: *Comparison between various operating systems*

	STAND-ALONE	NETWORK	EMBEDDED
Description and purpose	To manage the hardware and software of a computer and to provider a user interface for computer users.	To provide a service to or manage computers connected to the same network.	To run the software for a specific appliance or tool.
Cost	There are many open-source operating systems that are available for free. However, most people on desktop computers will use the Microsoft Windows 10 operating system, which costs between R1 000 and R3 000.	Linux-based network system are very popularly used and free, while the price for Microsoft Windows Servers range from R6 000 to R90 000, depending on the version.	Embedded operating systems are almost always sold as part of the hardware device. That is, you cannot purchase a SmartTV without an embedded operating system being pre-installed.
Size	Small to large. There are a few operating systems that require 1 GB or less, but Windows 10 requires 16 GB of free space.	Small to large. Most network operating systems require a significant amount of free disk space.	Most embedded operating systems are very small.
Hardware	HDD, CPU, RAM	NIC	Processor, RAM, ROM
Examples	Windows Home Edition Ubuntu	Windows Server Red Hat Server	

2.2.1 Fill In the missing words in the crossword puzzle below.
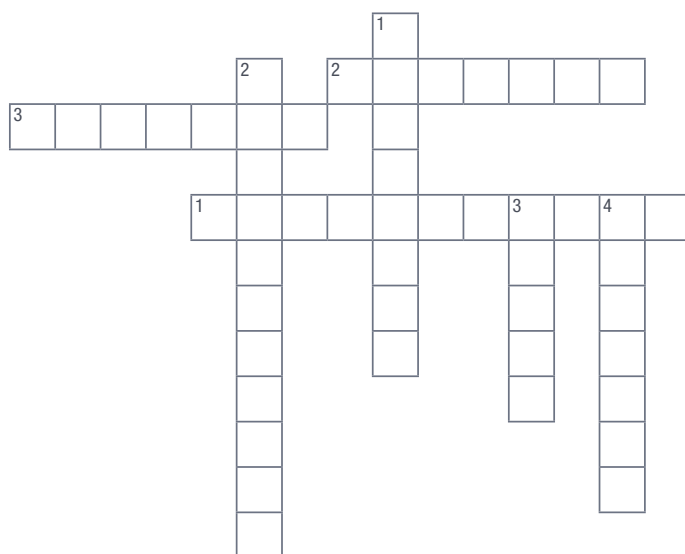
ACROSS	DOWN
1. To manage the hardware and software of a computer	**1.** To run the software for a specific tool or appliance
2. An example of an embedded operating system	**2.** Many computers are connected to each other but are presented as a one computer
3. Example of a stand-alone operating system	**3.** A network system that is free and popular to use
	4. This type of operating system requires 8 GB – 32 GB space

Programming languages have been designed so that humans can read and write it more easily.
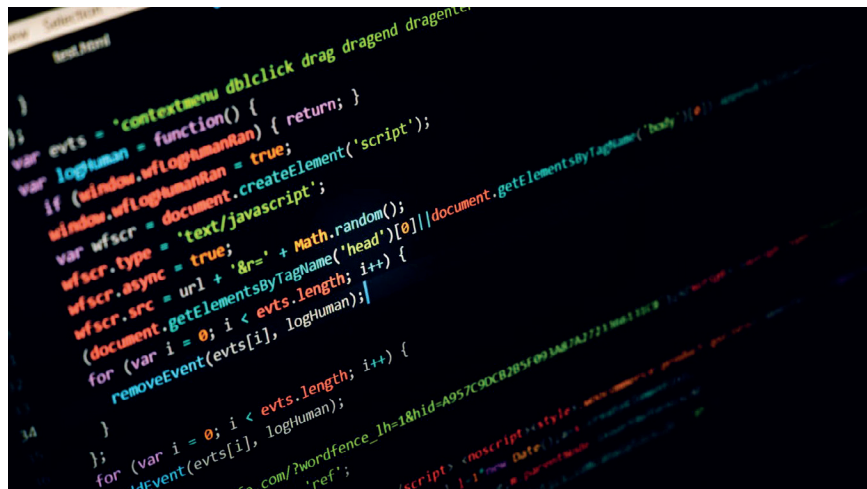
Figure 2.2: *Programming languages are designed to be understood by people*

Most modern programming languages value the importance of programming code that is simple, easy to read and easy to use.

Unfortunately, because programs are made up of lines of code, they are often not as simple to read or understand as you might want them to be. Programs in a modern programming language are still much, much easier to understand than **machine code**. Machine code refers to the instructions delivered directly to your CPU and is written in **binary** (or **hexadecimal**) and gives instructions. This might include references to memory addresses, logical operations or any other instruction for your CPU to complete.

Your CPU can only understand **interpreted** or **compiled** code. In this unit you will learn about interpreters and compilers and see how they differ.

INTERPRETER

In computer terms, the programming interpreter reads the first line of the code, interprets it into machine code and sends it to the CPU to be processed. It then interprets the next line and sends that to the CPU, and so on. By interpreting the program line by line, the program can immediately start running. However, since every line needs to be interpreted before it can run, the program will often run a bit more slowly than a compiled program. The source code is interpreted as the program is run, the interpreter (and interpreted language) must be installed on the same computer that the program is running. An example of an interpreted language is JavaScript.

<div style="border:1px solid">

New words

machine code – The executable instruction code provided by all running computer system programs and applications

binary – describes a numbering scheme in which there are only two possible values for each digit: 0 and 1

hexadecimal – describes a numbering system consisting of 16 digits [0 … 15]

</div>

COMPILER

In contrast to an interpreter, the compiler takes the entire source code and translates it into machine code. This translated code is saved as an executable file on the computer that can be opened on any computer without requiring the computer to have a compiler. Examples of compiled languages include BASIC, C++, Delphi and Java.

The following table summarises the main differences between interpreters and compilers.

Table 2.2: *Summary of the main differences between interpreters and compilers*

INTERPRETER	COMPILER
Interprets and sends code to the CPU line by line.	Translates and compiles entire program before sending it to the CPU.
Faster to open program, but slower once opened.	Slower to open program, but faster once opened.
Continues interpreting and running the code until an error occurs, at which point the program crashes.	Stops compiling the moment an error occurs, which means the program never opens.

Follow the QR link in the margin to watch an old but very simple video explaining the difference between compilers and interpreters.

Activity 2.3

2.3.1 List TWO differences and similarities between programming code and machine code.

2.3.2 You are interested in IT and are work-shadowing at a friend's IT business for the holidays. You know that programming language is a lot easier for people to read. Unfortunately, your CPU cannot understand this program since it only understands machine code. To solve this problem, you need an interpreter or compiler.

    a. What is an interpreter?

    b. Explain how an interpreter works.

    c. List TWO ways how a compiler is different from an interpreter.

    d. List ONE advantage a compiler has over an interpreter.

Video

Animation comparing an interpreter and a compiler.
Interpreter looks at line of text, converts it to random binary, then sends it to CPU. It does this line for line and the application shows on a monitor. Compiler reads all the lines, then converts all lines to random binary, then sends the whole bunch to the CPU. While all this is happening, a monitor shows a loading sign.

QR CODE

https://www.youtube.com/watch?v=_C5AHaS1mOA
https://qrs.ly/oka5pnn

2.3   Overview of processing techniques
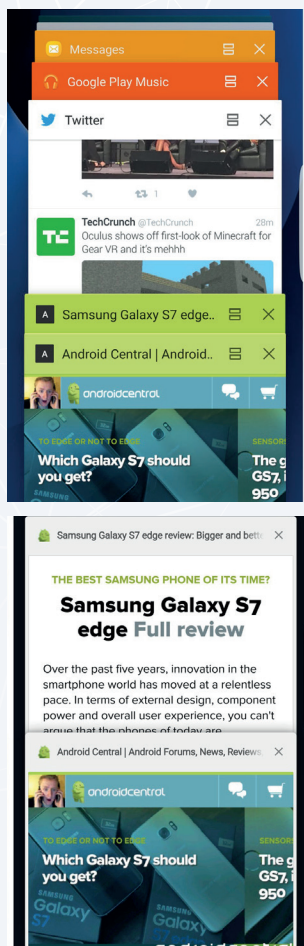
Figure 2.3: *Modern operating systems allow you to open multiple tasks at the same time*

On very old operating systems, you could only load one program into the computer's memory at a time. This means you could only run one program at a time! When this program was not doing anything, the CPU would also not be doing anything. Today, most people would not be happy with a computer that could only run one task at time; they want to be able to multitask!

On a computer, multitasking allows you to run multiple tasks (also called processes or applications) at the same time. For example, you may want to listen to music while browsing the internet on your computer. More than this, you want your computer to continue running all its background services like checking for emails, updating applications and managing your network at the same time.

Example 2.3.1	How many processes are you running?

On Windows 10, you can see a list of all these tasks running in the background by opening the *Task Manager*. To open the *Task Manager*:
- Open your *Start Menu* and enter the words "task manager".
- Open the *Task Manager* desktop application that is found.

You can also open the *Task Manager* by pressing the CTRL-SHIFT-ESC hotkey on your keyboard. Once opened, you will see a list of every process running on your computer. On most Windows 10 computers, there will be more than 50 applications and processes running at any time.
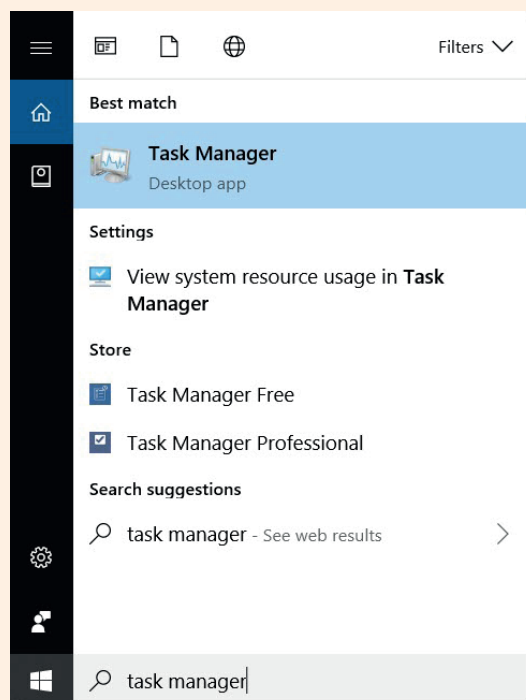
Figure 2.4: *Example of searching for 'task manager' in the start menu*

So how can a single CPU complete various tasks for dozens of different processes at the same time? The CPU completes tasks using the following techniques:

- multitasking
- multiprocessing
- multithreading.

Let's look at each of these processing techniques.

MULTITASKING

Figure 2.5 shows an example of the Windows *Task Manager* application. As the image shows, only 3% of the CPU is being used. This means that there are times when the CPU is idle and waiting to receive new instructions.

Figure 2.5: *Only 3% of this CPU's capacity is being used*

Rather than waiting for a single program to send new instructions, **processor multitasking** allows the operating system to send instructions from different processes to a single processor. If the instructions are sent and completed quickly enough, the processor can complete all the instructions from multiple app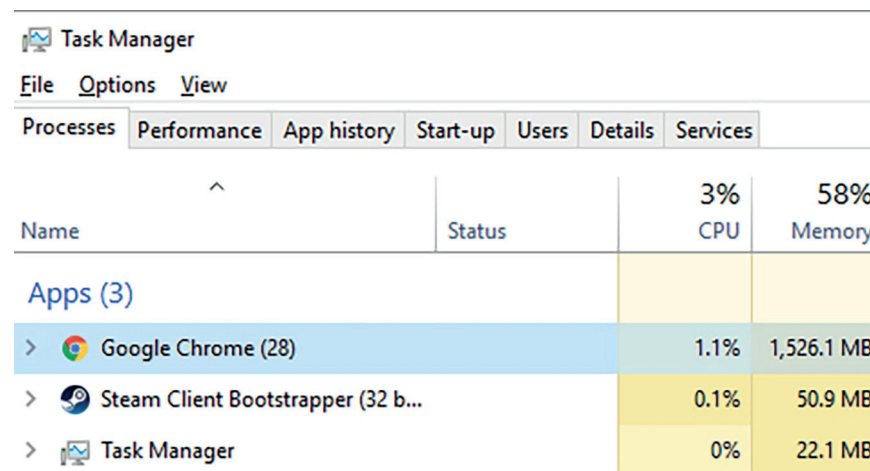lications without causing any of the applications to slow down. In this way, you can run multiple applications (or processes) on one processor seemingly at the same time.

MULTIPROCESSING

Where both multitasking and multiprocessing use the same processor to quickly swap between different tasks or threads, **multiprocessing** uses multiple processors to complete tasks. Today, many CPUs (including smartphone CPUs) are made up of more than one processor (called a **core**). Each core is then able to complete program instructions on its own.

Technically, a CPU with four cores should be able to complete four times as many instructions as the same CPU with only one core. However, in practice this is not always the case. For example, in most applications the instructions need to be executed one after the other. When this is the case, it does not make sense for one core to complete the first instructions while another core completes the last instructions.

Did you know

One reason why your smartphone's battery discharges even when the screen is turned off and you are not using it, is that your CPU is still running tasks. This includes checking for updates, looking for and downloading messages and emails, and making sure you are connected to an internet-enabled network.

New words

multitasking – the ability of the OS to quickly switch between many computing tasks to give the impression the different applications are executing simultaneously

multithreading – operations within a single application are divided into threads. Each of the threads can run in parallel. The OS divides processing time among each thread within the application

threads – a way for a program to split itself into two or more simultaneously running tasks

Did you know

In 1975, the computer scientist, Fred Brooks, said that just because it takes one woman nine months to make a baby, it does not mean that nine women can make a baby in one month. This is known as Brooks' law and it is also true for multiple processors!

Multi-core processors therefore allow you to process multiple threads or multiple processes more quickly but may not improve the performance on any single process.

Example 2.3.2   How are the processors being used?

The *Task Manager* can also show how each of the processors is being used. To see the processor utilisation:
- Open the *Task Manager* and go to the *Performance* tab.
- Right click on the graph and hover over the *Change graph to* option.
- Select the *Logical processors* option.

The graph should change from a single graph to a few smaller graphs with each graph showing the utilisation of one of the processors. The Ryzen 5 1600X CPU has twelve logical processors, so the figure below shows how much each of these processors has been used over the last 60 seconds.
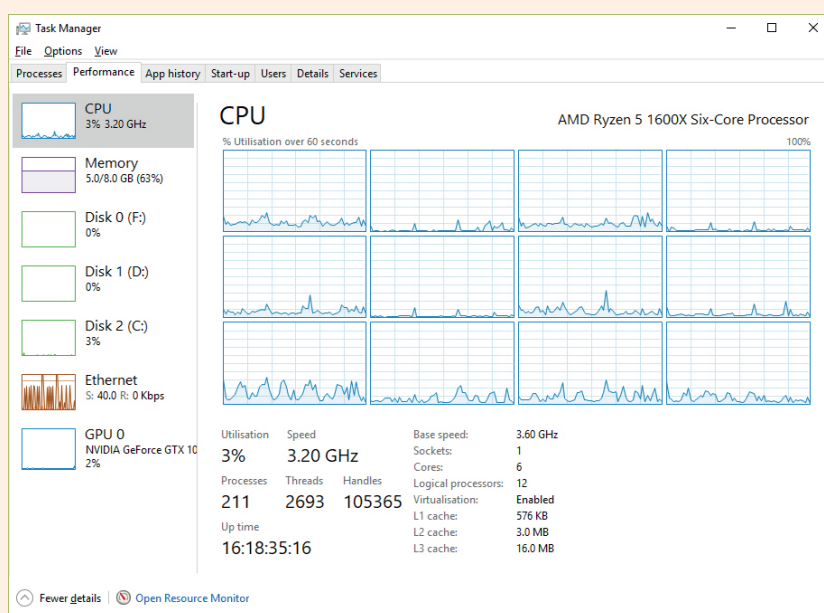
Figure 2.6: *Utilisation of a computer's twelve logical processors*

MULTITHREADING

Where multitasking allows your computer to complete the instructions for different processes by quickly switching between them, **multithreading** completes the instructions for multiple different tasks inside the same program (called **threads**) by quickly switching between them. Instructions from the same program are divided into multiple threads. Each thread can be run independently and executed when the CPU has time available between tasks.

Imagine that you are browsing the internet and decide to download a large file. If a program could only run one task at a time, you would have to stop browsing the internet while your browser downloads this file, and you would only be able to continue browsing the internet once the download has completed.

Fortunately, multithreading allows your computer to split this task into separate threads, with one thread managing the downloads while another thread manages

your browsing. Your CPU can then quickly swap between these threads, so that both your downloads and your browsing continue without interruption.

Example 2.3.3 How many threads are you running?

The *Task Manager* not only shows the number of processes open on your computer, but also the number of threads running. To see the number of threads:
- Open the *Task Manager*
- Click on the *Performance* tab at the top of the *Task Manager*
- Select the *CPU* graph from the panel on the left

In the main window you will see a graph showing how much of the CPU's total capacity has been used over the last 60 seconds. Right underneath that is a lot of numbers, including the number of processes (211 in Figure 2.6) and threads (2 723 in Figure 2.6). Based on the figure, there are therefore roughly 13 threads open for each process.
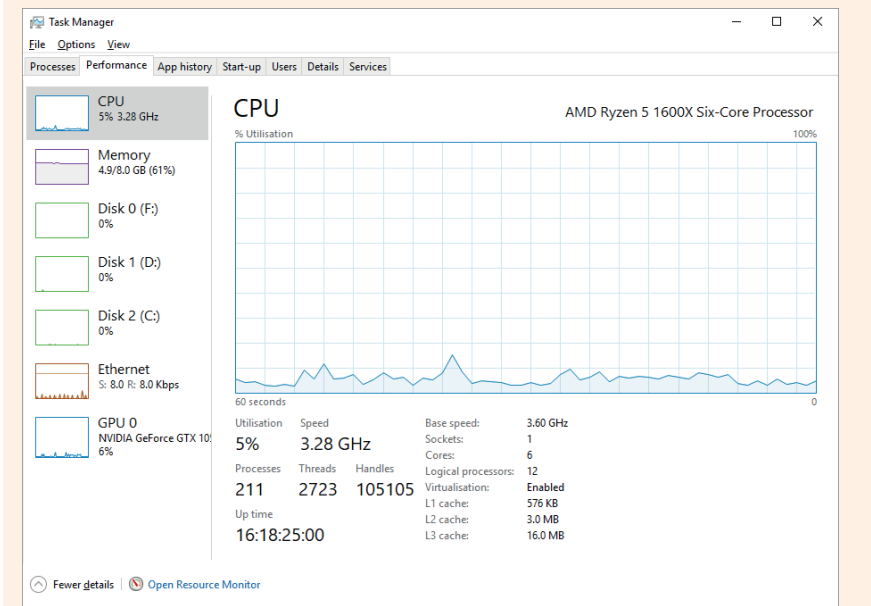
Figure 2.7: *The processes and threads are shown in the Performance tab*

The following table highlights the differences between multiple threads and multiple processes.

New words

multiprocessing – the use of two or more CPUs within a single computer system

core – the processing unit that receives instructions and performs calculations or actions based on those instructions

Did you know

Multithreading is simply multitasking within the same program!

Case Study — Virtual memory

A technique used by the OS to increase the capacity of the RAM by creating a temporary or dedicated file on the hard disk drive. This allows the user to execute applications, which require more RAM than is physically availabe on the computer. This file is called a page file. When this happens, your computer can become incredibly slow as it is constantly busy moving data between your RAM and virtual memory. If this issue becomes serious enough, your computer can get stuck in a loop where it takes so long to load data into your RAM, that by the time the data has been loaded, it immediately needs to unload that data to make space for new data. This is called thrashing.

Activity 2.4

2.4.1 On a computer, multitasking allows you to run multiple tasks at the same time. Look at the image below and answer the questions that follow.

a. How many tasks are running at the same time based on this image?

b. Give another name for a task that runs on a computer.

c. Give TWO advantages of multitasking on computers.

d. Give ONE disadvantage of multitasking.

2.4.1 Do the following tasks on a computer that runs Windows 10. Using what you have learnt. Determine the following:

a. How many processes are running on the computer's operating system?

b. How many threads are running on the computer's operating system?
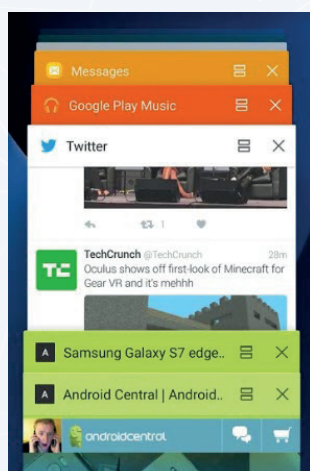
2.4 Virtual machines and virtualisation

Virtualisation is the act of creating a virtual device. Each virtual device acts as a node and is allocated its own virtual hardware, CPU, RAM and storage space.

These virtual machines behave in the same way as a real computer. For a virtual machine to be created, the host machine has to be capable of hosting a virtual machine. A virtual machine must have its own operating system and its own applications installed. The different virtual machines also do not have access to the host computer or any of the other virtual machines.

USES OF VIRTUAL MACHINES

The following list gives some of the most popular reasons for using virtual machines:

- Virtual machines allow users to install operating systems. If you wanted to test out an open source operating system like Ubuntu, then a virtual machine allows you to do so without interferring with your computer.
- Virtual machines can be used to install an application that might contain a virus. Testing it on a virtual machine will allow you to see if the application contains a virus. If it does, you can simply delete the entire virtual machine.
- The image of the virtual harddrive can be used to back up your computer, or to transfer all your data to a new computer.
- Virtual machines enable mobile developers to develop applications for different versions of Android and iOS without having to own hundreds of different devices.

If you want to see how to create your own virtual machine, you can follow the QR code in the margin.
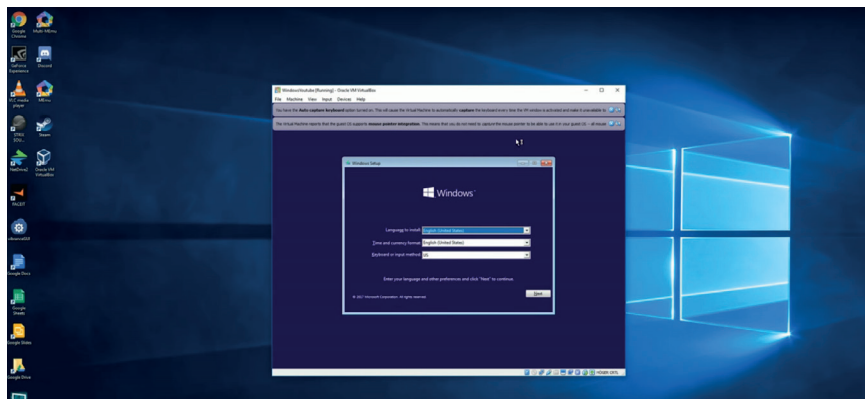
Figure 2.8: *Screenshot on how to set up a virtual machine*

QR CODE

https://www.youtube.com/watch?v=XItj08D5KPk

https://qrs.ly/uza5pof

QR CODE

https://www.extremetech.com/computing/198427-how-to-install-windows-10-in-a-virtual-machine

https://qrs.ly/fpa5poj

QR CODE

https://www.youtube.com/watch?v=sB_5fqiysi4

https://qrs.ly/6ca5pom

Activity 2.5

Discuss the following in groups

2.5.1 What is a virtual machine?

2.5.2 What can virtual machines be used for?

2.5.3 From what you have learned, what are the advantages AND disadvantages of such machines?
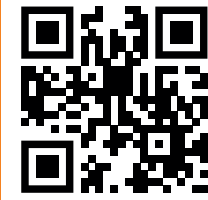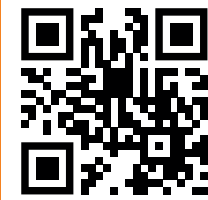
1. Choose the correct answer.
   a. Which is NOT an example of a type of processing?
      A. Multithreading   B. Multitasking   C. MultiRAM   D. Multiprocessing
   b. Which one of the following is a function of software?
      A. Translating the instructions from your software to a language your hardware can understand
      B. Sending these instructions to the correct hardware
      C. Making sure all the hardware and software on your computer are working properly
      D. All of the above
   c. Which one of the following best describes a Stand-alone system?
      A. To provide a service to or manage computers connected to the same network.
      B. To manage the hardware and software of a computer and to provider a user interface for computer users.
      C. To run the software for a specific appliance or tool.
      D. To connect different computers and present them as a single computer
   d. Which one of the following converts programming language for humans to understand?
      A. Compiler   B. Convertor   C. CPU   D. Python
   e. What is a task also known as?
      A. Process   B. Application   C. Network   D. A and B

2. Choose the answer and write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. Change the underlined word(s) to make the statement TRUE. (You may not simply use the word 'NOT' to change the statement.)
   a. With processor multitasking, a single processor splits its time between different processes.
   b. Distributed operating systems are almost always sold as part of the hardware devices.
   c. Machine code refers to the instructions delivered directly to your CPU
   d. Windows 10 is an example of an open source operating system
   e. Virtual machines help you to write and test programs for different operating systems.

3. What is system software?

4. List TWO ways system software allows your computer to run smoothly.

5. What is a network operating system?

6. Give TWO principles that all Python programmers should follow.

7. Briefly explain how an interpreter works in a computer.

8. List THREE different processing techniques a CPU uses to complete a task.

9. Briefly explain how virtual machines can allow multiple people to use the same computer at the same time.

10. In the IT workshop there is a lot of debate that goes on. One of the junior technicians who is just out of school starts asking questions.
    a. He has heard of multitasking and asks what it is. Describe in your own words what you understand by the term multitasking.
    b. Explain how multithreading works and give an example.

11. Having the world at your fingertips through Internet so commonly used nowadays, you and your cousin decide to take your entrepreneur business to the next level. Your computer has a single core CPU. State if the following processing techniques will be able to take place. Motivate your answers
    a. Multi-tasking
    b. Multi-processing

12. List TWO differences between multi-processing and multi-threading.

13. In need of more memory, you decided to make use of virtual memory.
    a. What is virtual memory?
    b. How does the computer make use of virtual memory?

NETWORKS

CHAPTER OVERVIEW	
Unit 3.1	Overview of physical aspects of a network
Unit 3.2	Overview of network innovation

Learning outcomes

At the end of this chapter you should be able to:
- list and describe network communication and data transmission
- list and describe the physical limitations of networks
- describe network innovations. including VOIP, VPNs and location-based computing
- define and provide examples of location-based services websites.

INTRODUCTION

In this chapter, you will learn more about networks, and specifically the way in which data is transferred over a network. To understand data transfer, you will look at the different network hardware required, the limitations of networks and how data is transferred on different network sizes. Finally, the chapter will conclude by looking at a few interesting network innovations.

NETWORKS

In Grade 10, you learned that networks are incredibly powerful tools that most modern people and businesses depend on daily. Networks have thousands of different uses, including:
- sharing resources
- organising information
- connecting people
- providing access to entertainment.

However, it can also expose people to network crimes, advertising, spam, cyberbullying and abuse. Networks in general, and the internet, can also be addictive and make it difficult for people to disconnect from technology, which can result in more social isolation and depression.

Did you know

In 2016, Amazon Web Services used a sneakernet to transfer 50 petabytes (that is, 50 million gigabytes) of data by loading a truck full of storage devices and driving the data to a data centre. To download the same amount of data from the internet using a 100 MB fibre connection would take 250 years!

Revision activity

3.1.1 You are considering setting up a Wi-Fi network to connect the devices in your office and have decided on the above layout.

A friend suggests setting up a wired network.

a. Define a network.

b. Give TWO reasons why you need a network.

c. State TWO disadvantages of having a computer network.

d. Which network is more suitable for home, give reasons.

3.1 Overview of physical aspects of a network

A computer network refers to a group of two or more computing devices that are connected by a communication medium allowing the computers to communicate electronically. A computing device on a network is usually referred to as a node, being connected to one another, it allows nodes to exchange data with one another using a connection media between them. The links can be established either over cable media such as wires or via a wireless media such as Wi-Fi.

Table 3.1: *Summary of different types of wireless media*

NETWORK	USES
Wi-Fi	Wi-Fi refers to wireless LANs connecting computers and devices using radio signals communicating through wireless access points over a short range (20 m).
WiMAX	Worldwide Interoperability for Microwave Access is a technology standard for long-range wireless networking for both mobile and fixed connections. The speed gets slower as the distance to the transmitter gets longer. WiMAX is flexible and low in cost. It can be installed quicker than other internet technologies because it can use shorter towers and less cabling.
4G/LTE	4G/ Long Term Evolution (LTE) is a wireless broadband technology designed to support roaming internet access by cellphones and other handheld devices.
5G	5G (the G represents the generation) is the fifth generation of mobile networking technology. The 5G is not a replacement for 4G, so you will find LTE/4G and 5G technology working together. 5G has improved speed over LTE.

Data transmission is supported by various pieces of hardware, media and devices, set up in a specific layout.

DATA TRANSMISSION

MEDIA
There are two types of networks, and three types of media to support them. These are:

WIRED NETWORKS
A wired network is a network that uses a physical media to transfer data between two or more nodes. The transmission medium for wired networks are Unshielded Twisted Pair (UTP) and Fibre optic cables.

WIRELESS NETWORKS
A wireless network consists of transmitters and receivers. Nodes connect wirelessly to these transmitters and receivers to complete the network. Home Area Networks are often Wireless Local Area Networks (WLAN).

The media needed to support these networks are:
- Radio waves (wireless network)
- Infrared

Figure 3.1: *UTP*
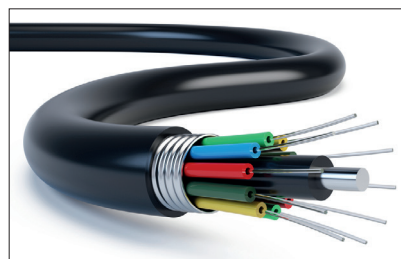
Figure 3.2: *Fibre optic cables*

PHYSICAL LAYOUT (TOPOLOGY – STAR)

Every LAN has a topology, this is the way that the devices on a network are arranged and how they communicate with each other. The physical topology is the physical structure of the network in which workstations are connected to the network through the actual cables that transmit data. There are many different layouts but we will look at the star topology:

In a star network, the devices are connected to a central node, called a switch. Nodes communicate across the network by passing data through the hub. Two of the biggest advantages of a star topology is that new devices can easily be added to the network, and if any connected device breaks, it does not affect the rest of the network. The main disadvantage is if the switch fails then the entire network becomes unusable.
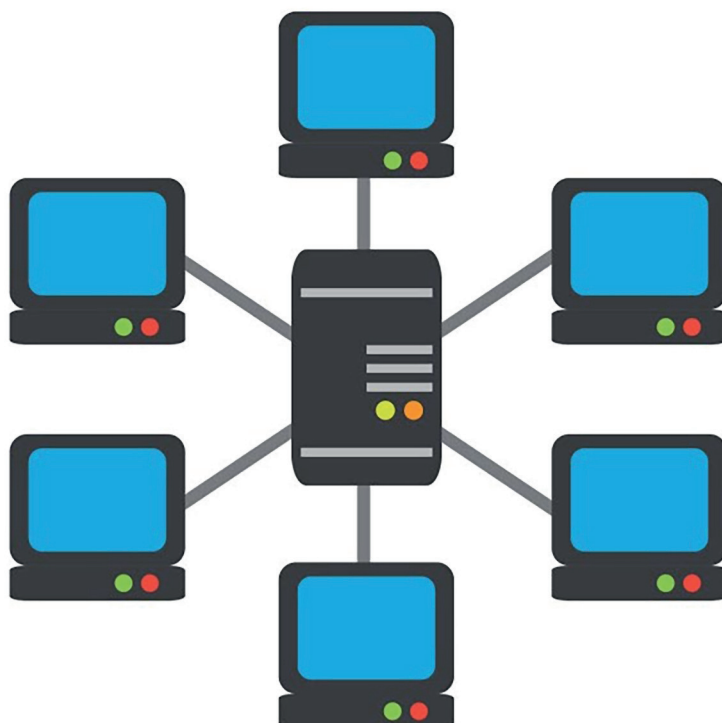
Figure 3.3: *A star topology*

PHYSICAL LIMITATIONS (ACCESS AND BANDWIDTH)

Bandwidth refers to the amount of data that can be sent over a network in a specific amount of time. For example, an internet connection with high bandwidth (such as 100 Mb/s) allows you to download a large amount file quickly, while an internet connection with lower bandwidth (such as 512 Kb/s) will take a much longer time to download the same file.

A user's account can have limitations restricting the user access to the network. Examples include time, bandwidth and storage access.

CONNECTION DEVICES

A few examples of connection devices include:

Network Interface Card (NIC): Most desktop computers have a built-in ethernet card, which would enable it to connect to a cabled network. Your laptop or smartphone would most likely have a built-in wireless NIC.
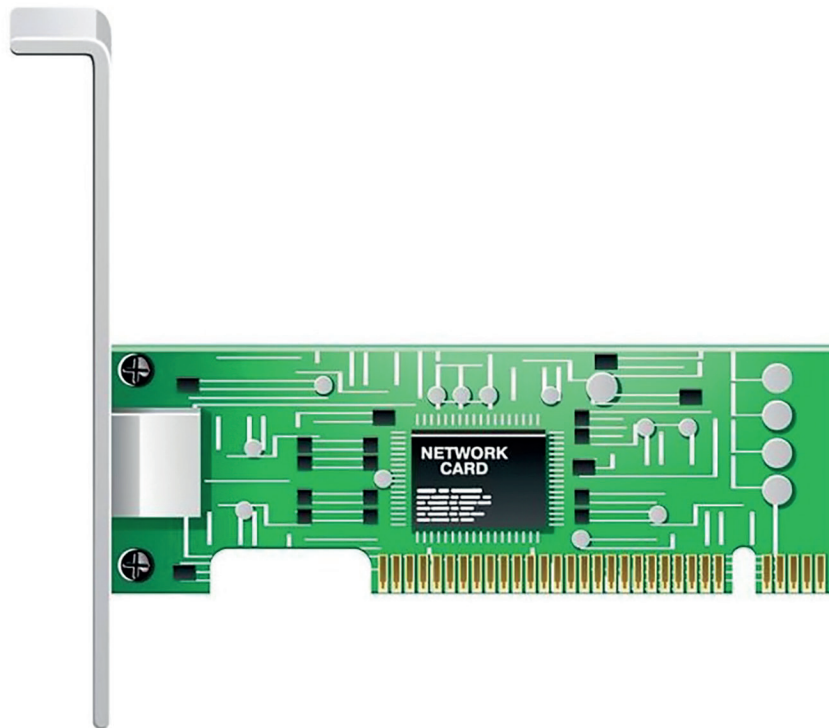
Figure 3.4: *A network interface controller expansion card*

Modem: The purpose of a modem is to connect a computer or network to the internet.

Switch: The purpose of a switch is to connect many computers on the same, wired internal network and has the ability to direct network traffic to the correct port.

Router/bridge: The purpose of a router is to connect different types of networks using one device. This can include combining wired and wireless networks or connecting a LAN network to a WAN network. Many routers may contain a modem to connect to a telephone line.

3.2.1 In small groups populate the table to compare the composition, media and capacity of the different networks.

	PAN	HAN	LAN	WAN
Composition (Topology, how is everything connected)				
Media hardware				
Capacity (how many people or devices can be connected)				

3.2.2 Study the following representation of a network (from Google images) and answer the questions.
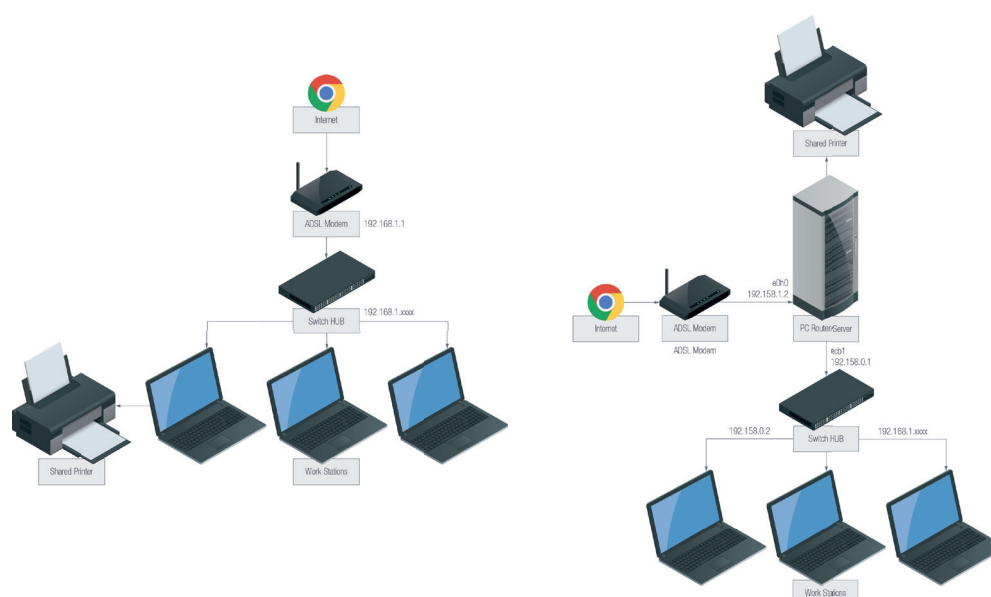
In the image it is shown that the network is used to share a printer (hardware) and Internet. List THREE other reasons for having a network.

3.2.3 A star topology is used in this representation of a network.

  a. Define the term topology.

  b. Explain why the star topology is overall a popular choice.

  c. List ONE disadvantage of a star network.

3.2.4 Your next work-shadowing experience is to meet with management of the local Nestle factory who outsource their IT requirements to your friend's IT business. They want to set up a network in their canteen for staff access. A network card is an example of an important hardware component in a network.

  a. List TWO other hardware components that are needed for a network.

  b. What is a network card used for?

3.2.5 Differentiate between a router and a switch.

3.2.6 Max has decided to use Wi-Max technology to connect to the Internet.

  a. State TWO other technologies you could have used to connect to the Internet.

  b. Justify your reason for choosing Wi-Max instead of any of the TWO ways mentioned in the above question.

  c. Name the device that you will need to link your local network to the Internet.

3.2 Overview of network innovation

Network technologies are constantly changing, with new technologies being invented each year. Whether it is lightbulbs that connect to your Wi-Fi network and change colour based on your smartphone settings (like the Phillips Hue), mesh wireless routers that instantly create a great wireless network (like Google WiFi), or car-to-car communication networks that allow *driverless* cars from driving into any other cars, new technologies will continue to change the way we live.

In this unit, you will learn about three network innovations that have proven their staying-power. These are:
- voice over internet protocol (VOIP)
- virtual private networks (VPN)
- location-based computing.

VOICE OVER INTERNET PROTOCOL (VOIP)

Voice over internet protocol (VOIP) is a technology that allows phone calls or video calls to be made over the internet. There are two main types of VOIP calls:
- VOIP to VOIP calls
- VOIP to phone calls

VOIP to VOIP calls can usually be made for free. To make these calls, both the person making the VOIP call and the person receiving the call must have an account with the same VOIP service (such as Skype, WhatsApp, Facetime or Discord). If you have access to a fast internet connection, this is a great way to contact someone for free.

VOIP to VOIP calls can even include multiple people in a chat room or conference call. For example, the application Discord allows you to open a permanent chat room and voice chat with your friends. Once created, you can join the room from your phone or computer and anything you say over your microphone will be broadcast to any friends connected to the same room.

The second type of VOIP calls are made between VOIP and a phone. These services usually cost money but are often significantly cheaper than making a normal phone call. You are also able to make these phone calls directly from your computer, which can be more convenient for some people. The application Skype allows you to make VOIP to phone calls, but there are also many private VOIP-to-phone service providers like Vox Telecom and InterExcel.

When talking about different types of networks, it is easy to get the words internet, intranet and extranet confused.

The internet is a global network that allows computers from around the world to communicate and share information (such videos or webpages). There is only one internet in the world and that is the internet that all computers share.

New words

mesh – a type of network in which a device (node) transmits its own data as well as serves as a relay for other devices (nodes)

virtual private network (VPN) – an encrypted connection over the internet from a device to a network
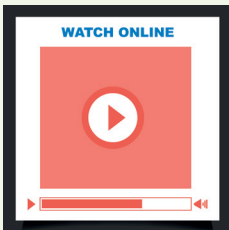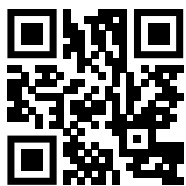
INTERNET VS. INTRANET VS. EXTRANET

In contrast to the internet, the intranet is a locked private network used to share information on a private network. Many businesses create intranets that give employees access to shared files and network resources. These network resources can include:

- Network printers
- Shared folders
- Network applications

Finally, the word extranet is used to refer to any network that combines an intranet with the internet. Many companies build extranets so that their employees can get the benefit of the intranet when they are not in the same physical space as the local network. For example, employees can use an extranet from home to access documents shared on their company's intranet.

https://www.hyperoffice.com/blog/2018/06/20/intranet-examples/

VIRTUAL PRIVATE NETWORK (VPN)

A virtual private network (VPN) is a computer connected to a VPN can access all the private network resources shared on the network (including printers and file servers), without physically being in the same area.

In the past, VPNs were mostly used by companies to allow employees to connect to their internal networks from anywhere in the country. This was useful for employees working from home, visiting clients, or working from a different office, and VPNs are still often used in this way.

VPNs allow people to access the internet anonymously and securely, no matter your geographical location in relation to the server. For example, if you log onto the American VPN server, internet companies would assume that you are in the USA.

LOCATION-BASED COMPUTING

Location-based computing refers to several different technologies that make use of geographical position to customise a user's experience.

The six components required include:
1. Positioning system e.g. **GPS** (Global Positioning System)
2. Communication network for data transfer
3. Service and application provider e.g. Maps or Uber
4. Data and content provider
5. Mobile devices
6. User

This is simply one of the many ways in which location-based computing is used to improve our lives. Other uses include:
- Weather applications that tell you what the weather in your specific area will be, based on your location.
- Food ordering applications that use your location to deliver food directly to you.
- Car sharing services like Uber that use your phone's location to find the nearest Uber driver, who will then pick you up and drop you off at the correct location.

All these technologies use a combination of GPS and mobile internet connections to improve the service they offer you.

Activity 3.3

Complete the following tables comparing network innovations.

	VOIP	VPN	LOCATION-BASED COMPUTING
Definition			
Advantages			
Disadvantages			
Examples			

	INTERNET	INTRANET	EXTRANET
Use			
Advantage			
Disadvantage			

1. Choose the correct answer.

    a. VPN stands for…

        A. Very Private Network

        B. Virtual Protocol Network

        C. Very Powerful Network

        D. Virtual Private Network

    b. The following types of network in ascending order with regards to their size:

        A. LAN, PAN, WAN, HAN

        B. PAN, HAN, LAN, WAN

        C. WAN, PAN, HAN, LAN

        D. HAN, PAN, WAN, LAN

    c. A device that converts the data or signal from a computer to format that can be transmitted over a communication channel:

        A. Router

        B. Modem

        C. Switch

        D. Mouse

2. Choose the answer and write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. Change the underlined word(s) to make the statement TRUE. (You may not simply use the word 'NOT' to change the statement.)

    a. A <u>LAN</u> is a small network that is usually limited to a single building.

    b. The <u>internet</u> is a global network that allows computers from around the world to communicate and share information (such videos or webpages).

3. Briefly explain the difference between a router and a switch.

4. What is the function of a modem in data communication?

5. Explain what a VPN is. Do not just expand on the acronym.

6. All the devices including the Satellite TV decoder, gaming console, mobile phones and tablets in the household will be connected in this setting by a multipurpose LTE router/modem.

    a. What is the term used to describe this kind of network?

    b. Give TWO advantages and TWO disadvantages of having a network.

    c. What are the FOUR main functions of the multipurpose router/modem in this network?

    d. Identify the topology that is employed in this environment.

7. You are offered the position of ICT manager of a new shopping mall. No ICT infrastructure has been put in place. You are tasked to help with implementation of ICT in the mall.

    a. Explain to her FIVE main advantages of having a network for the mall.

    b. Explain what is necessary for each machine to be connected to a network.

    c. One of the buildings is set a bit back from the others in the mall. The owner of this shop is worried about connectivity.

        i. The building is 150 m away from the mall. Name TWO connection methods which could be used to connect this building to the rest of the network.

        ii. Should speed be a factor in the above question, which ONE of the connection methods would you suggest? Motivate your answer.

        iii. The mall covers an area of 200 m by 350 m, all on one street block. What type of network is this considered to be? LAN or WAN?

SOCIAL IMPLICATIONS

CHAPTER OVERVIEW	
Unit 4.1	The social implications of location-based computing
Unit 4.2	Ethical and legal issues of network use policies and practices
Unit 4.3	Capabilities and limitations of ICTs

Learning outcomes

At the end of this chapter you should be able to:
- discuss the social implications of location-based computing
- explain the ethical and legal issues of network use policies and practices
- understand the capabilities and limitations of ICTs.
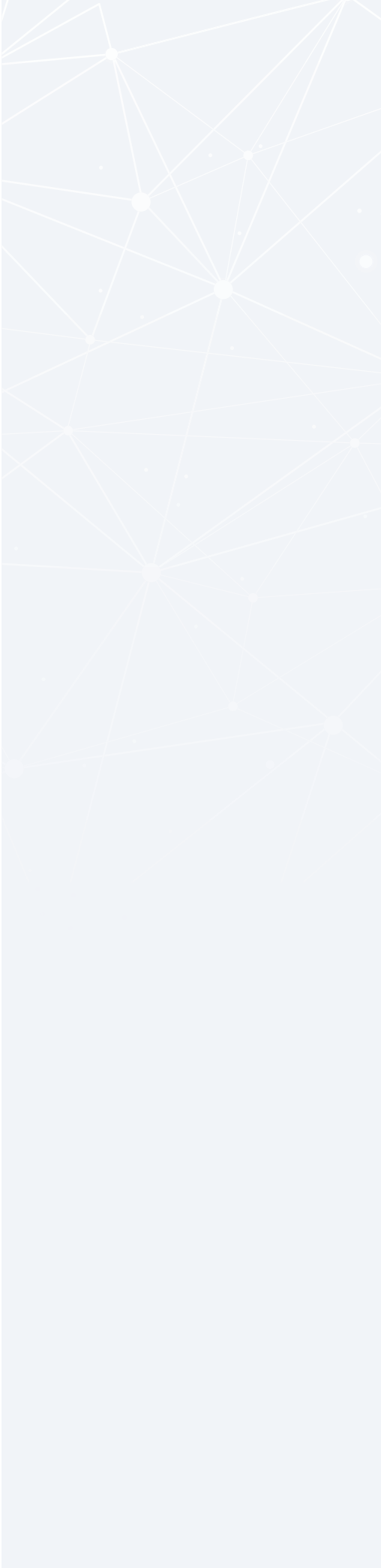
INTRODUCTION

The introduction of computers in our daily lives has created various issues in our society. These include, legal, ethical, economical issues as well as issues with regard to the digital divide. In this unit, we will be looking at the social issues applicable to all content that we have covered thus far in Term 1.

SOCIAL IMPLICATIONS IN A NUTSHELL

For the first time in history, it is possible for a person to live their entire life without ever leaving home. They can buy everything they need using online shopping services, go to school on the internet, attend an online university or teach themselves how to programme from the internet, find a remote or internet-based job, and even build friendships and relationships on the internet.

In fact, in Japan, so many people (mostly men) have started doing this that they have a name: *Hikikomori*. According to the Japanese psychiatrist, Tamaki Saito, hikikomori refers to 'cooping oneself up in one's own home and not participating in society for six months or longer …[without] another psychological problem as its principal source.' A 2010 study found that more than 700 000 people in Japan were living as *hikikomori*.

Just because it is possible does not mean it is a good idea! Studies have shown that *hikikomori* tend to be more unhappy, insecure and have fewer friends than the average person. However, it does show how dramatically computers and the internet have changed the world. Computers have become integrated in every part of society, from entertainment to work. Computers have even become integrated with love, with a 2018 study finding that 40% of Americans use online dating and 20% of new long-term relationships start with online dating!

Location-based computing (LBC) services are applications that use the position of a device and its user in the provision of a value-added service. Examples of these applications include services such as Tinder, Meetup or Windy, which use the geographic location of their users to provide or augment an activity. These applications monitor a user's location either willingly or covertly (by others).

Because users often carry their mobile devices with them, location data may be collected everywhere and at any time, often without user interaction. The mobile device may keep track of what a person is doing and their location. It can reveal visits to potentially sensitive destinations, like medical clinics, courts, political rallies, and union meetings.

LBCs introduce a set of challenges from a social perspective. Although these applications have benefits such as an increased sense of community, connectivity and access to information and place knowledge, they bring with them many negatives as well. These negatives are loss of personal privacy, objective access to knowledge, and the application's influence on our relationship to physical places.

The extent of location information has also increased the risks of stalking and domestic violence because perpetrators are able to use or abuse location-based services to gain access to location information about their victims. LBCs make it easy for predators to locate potential victims, and they give the criminal more than enough information to manipulate their target. Additionally, because an increasing number of minors carry location-enabled cell phones and devices, location privacy will also become a child safety issue.

⚙ Case Study   Location-based computing

A few years ago, some soldiers posted a picture of helicopters arriving in Iraq on a social network. The geotag attached to the photo gave insurgents the location of where the picture was taken, and they launched a mortar attack that destroyed four of the newly-arrived helicopters.

👤   Activity 4.1

4.1.1   Read the below article, then debate the use of location-based computing.

8 realities about location-based apps: Use your common sense before buying into the hype of location-based apps

By IRA WINKLE

The desire to be cool and embrace new technologies definitely overtook the desire to be safe with the very buzzy mobile, location-based apps. You've got to love a smartphone app that broadcasts all sorts of information about you – your likes, your age, your job – to everyone within sight who has the same app. Because it reduces friction, right? It makes it easier to meet that good-looking guy or girl *right over there* who shares your love of kiteboarding and Gorillaz. You can cut down lame conversations about things you have no interest in at all. Cool. Right?

The hype says these apps are all about possibility. But when reality sets in, you start to think about probability. For example, the probability that a certain percentage of the people who look appealing to you when apps like Glancee or Highlight bring them to your attention are going to be, well, creeps – or worse. The probability that apps like these are putting out more information about you than you're really comfortable with. The probability that your privacy, once compromised, will never be whole again.

I have put together a list of eight things everyone should know about location-based services and social networks in general.

No. 1 – Stalkers and paedophiles will like these apps

Location-based services are a dream for sexual predators and other criminals. They make it easy for predators to locate potential victims, and then they give the criminal more than enough information to manipulate his target.

No. 2 – If it is anywhere on the internet, consider it public

If you think you can put something on the internet, mark it as private, and then not worry about it becoming public, you are wrong. There really is no such thing as private data. Let's say you post something on a social network. Your privacy settings make you feel confident that the post is going to be seen by no one but your friends. There is really nothing to keep that social network from changing its privacy policy so that such friends-only restrictions just disappear.

No. 3 – Your circle of friends is much bigger than you think

Do you really know all of the people you have friended on Facebook? Many people have hundreds of 'friends' on Facebook, and not a few have thousands. That means the friends of your friends could number in the hundreds of thousands.

Considering that you likely are not true friends with your Facebook friends, it's safe to assume that at least some of them are less than trustworthy. And when you consider 'friends' of 'friends,' the chances that some are reprobates, sickos or perverts are much larger.

No. 4 – We all make mistakes

You might decide to give these apps a try and just be careful with them. You'll turn them on only when you are surrounded by friends and actively seeking to contact people. Inevitably, though, because we all make mistakes, you will forget to turn the service off from time to time, or you will set the parameters incorrectly.

No. 5 – People lie

Some lies might be considered harmless enough, but the thing that worries me about location-based social apps is that they can expose you to sociopaths and criminals. A sociopath who wants to meet you would have no qualms about checking out your interests and then going to Facebook to revise his own to bring them in line with yours. Then he's back in your vicinity with a profile that Highlight or Glancee is all excited about. Hey, nice to meet you!

No. 6 – Small pieces of information add up

Cisco Systems' Lance Hayden, who is a part-time faculty member at the University of Texas and a former CIA operative, told me about an exercise he conducts with his students – most of whom tend to have that same idea that they control the information about them on the internet. He asks them to put together an intelligence dossier on themselves, using information available only on public internet sites. Invariably, he said, as soon as the students start their projects, they show up early for the next class to ask him how they can get all of the information about them off of the internet. So who's in control?

No. 7 – No, you can't have separate online and offline lives

Another comment from those SXSW attendees was that they protect their lives by having separate personas – one for online one and one for offline. They believe that what they do on social media can be kept completely separate from what they do in the workplace and other venues. Sorry to break it to them, but social network monitoring is a thriving business. Companies use such services to screen potential employees.

Similarly, it's foolish to believe that you're protected because you've shut down location-based apps. If you have had them turned on, you have sent out information about yourself. If you have a stalker, he could well know where you live and might be waiting for you there.

No. 8 – You can't predict all the ways these things can work against you

Suppose you go into a car dealership today with your smartphone in your pocket. The salesperson could use Highlight or Glancee to find out your marital status and how many kids you have. He can discover where you work and your job title. He can see whether you have checked in at other dealerships via Foursquare. He might be able to learn that you have asked your Facebook friends for car recommendations. In short, he can arm himself with a lot of information that will be useful in any negotiation. I think I would rather have them just pull my credit report.

The price of ignorance

The interesting thing about that car-buying example is that the advantage seems to go not to the person broadcasting the information, but to the one receiving it. Like so many other things on the internet, these new location-based apps are 'free' services. The big problem with location-based services is that they can place you at the whim of anyone who chooses to abuse you. Criminals are early adopters, and they never miss an opening. Is your need to be cool worth the risk of being a crime victim?

[To read the full article: Source: www.computerworld.com/article/2503019/8-realities-about-location-based-apps.html, accessed 13 June 2019]

4.1.2   Read the below article about a location-based app that is used to locate missing persons.

How to Locate a Missing Person by Tracking Their Cell Phone

Tracking a cell phone can help to obtain a lost or stolen device, but it can also be used to find a person of interest or someone who is missing. Today there are two primary ways with which traces can be performed.

The first is the most common used by law enforcement and that is a call trace. A call trace functions by waiting for a call to be placed from the phone in question. If someone uses their cell phone to call 911, emergency call centers now have the ability to pinpoint the call within a 25–100 meter radius. Law enforcement authorities are able to use the same technology to 'ping' a cell phone and find its position. This is how authorities are able to find children who are victims of kidnappings or those who have run away. However, a different set of circumstances arise when the phone belongs to an adult. In this case, the tracer should expect an array of red tape and jurisdictional issues.

Privacy, consumer protection and wireless protection acts that are put in place disallow any indiscriminate tracing. In certain cases, however, a simple signing of a waiver will allow either the cell phone service provider or the authorities to track the phone in this manner. In other instances it is not so easy. Law enforcement and investigators have to entertain the idea that the person in question wanted to disappear. It is within their rights to do so.

The second way, which is easier and used by non-law enforcement, taps into a phone's GPS chip or SIM Card. In nearly all cases, the phone in question will need to have a GPS chip already installed before any type of tracking can be accomplished. Many phones on the market today are already sold with this technology. If the phone does not have GPS capabilities, the chip can be bought through a service provider or online. Order according to phone model and install according to the manufacturer's instructions.

Once a chip has been discovered or installed, the tracking can commence. Software downloaded to a computer can then trace the phone at all times. Many people are not comfortable with having their whereabouts tracked on a daily basis in the off chance that they might get lost or abducted. Still, signals sent from a phone to a tower can aid in finding the person's location. Overlapping signals work to triangulate the location via global positioning system (GPS) coordinates.

If no access to a constant tracing program is possible. There are companies out like I.C.U. Inc., uLocate.com, and AccuTracking that will charge a fee to perform this type of search for you, but you may want to try using Google Latitude or the My iPhone app (if they have an iPhone) to find them first.

If the cell number you are trying to track is one belonging to a family member that is on a plan with you as the administrator, a new set of options are open to you. There are also services that can be purchased through your service provider to locate devices using certain SIM cards. AT&T offers what they call FamilyMap, and Sprint and Verizon both call their service Family Locator. Both of these come with a monthly fee but can be used to trace the whereabouts of a cell phone.

[Source: http://cellphonenumber.phonebooks.com/tracking-cell-phones.html, accessed on 13 June 2019]

a.   Think about all the adults and children who are being reported as going missing in South Africa. How do you think an app like this could help police to locate these missing adults and children?

b.   Do you think there are any negatives to this app. Think about what could happen if this app was hacked.

Individuals are going to great lengths to locate unsecured wireless access points either for their own benefit or the benefit of others.

Activity 4.2

In a recent case, an individual found an unsecured wireless network at a Lowe's home improvement store. After documenting the location, he went back with a friend. Together, they hacked into the Lowe's system with the goal of stealing credit card numbers of the store's customers. The men were caught after they had managed to get six credit card numbers, but the damage could have been far worse.

When an individual accesses another person's network and uses their resources without their permission, it can be considered stealing. It is illegal to use someone else's bandwidth. In addition, the owner can lose their network access if the provider finds any unauthorised actions via their connection, illegal or in excess of allotments.

The use of wireless networks to conduct confidential business is now standard practice. Highly confidential work like legal matters are often done on unsecured networks using mobile devices. Anyone can hack the devices that are connected to an unsecured network and take information from these devices. These networks range from coffee shops to public spaces, such as airports, to home networks that are often not password-protected and can be connected to free Wi-Fi.

With these scenarios in mind, discuss the following questions in small groups.

4.2.1   Should the average person be concerned about privacy?

4.2.2   By entering your interests on a search engine, do you give a company the right to sell that information?

4.2.3   By entering your private information on a social network, does that give the company the right to sell your information?

4.2.4   What about the information entered on a smartphone?

4.2.5   Should companies be allowed to sell this information if they inform you?

4.2.6   Is it good or bad that you receive advertisements that match your browser history?

4.2.7   Would you allow data collection if it allowed complex services (such as Google Maps) to remain free?

4.3 Capabilities and limitations of ICTs

In the previous chapters we discussed information and communications technology (ICT) and the role it plays in our everyday life. We also discussed some of the limitations of ICT.

Work through the table below to revise the capabilities and limitations of ICTs.

CAPABILITIES	LIMITATIONS
Computers perform tasks very fast. Some CPUs can execute literally 'billions' of instructions per second.	Portable device such as laptops, PDAs and mobile phones are limited by their battery life. These devices only remain charged for so long before they need to be plugged into the mains.
If programmed properly, computers are capable of performing the same tasks 100% accurately every time.	Some devices have small screens and keyboards making it difficult to read large amounts of text.
Computers are able to perform many tasks at the same time.	Some portable devices are heavy (especially laptops). This does not make them ideal for carrying around.
Computers will carry out boring and repetitive tasks accurately.	Low bandwidth means that large files will take a long time to transfer.
Computers can be joined together (either as a LAN or a WAN) and this allows them to easily share resources such as printers and data.	The ability of an ICT system can be affected by a number of factors including: hardware, software, suitability of the operating systems, communication and input.
Computer databases can store enormous amounts of data including text, numbers, images and video.	Necessary hardware and software can be expensive.
Computers can search for stored data extremely fast.	
Data can be secured with passwords or encryption.	

Activity 4.3

For each factor explain why it is a limitation of ICT and how it could affect a business:
- hardware
- software
- suitability of the operating systems
- communication
- input.

Read the following information about location-based social networking sites and answer the questions that follows for each app.

- **Plazes** allows its users to create a calendar of what's going to happen and where it is going to happen in their current area. Users can then notify their friends by hitting the 'spread it' button. This is a great way for friends to connect.
- **Citysense** displays a map of where people are transmitting a cell signal from so you can see where your friends are and get up to date information of local events.
- **Whrrl** lets friends share reviews, photos, the latest specials, deals, and so on,of restaurants, hotels, bars, clubs, malls, movie theaters with one another. This app uses Google maps so you can specify a location to read reviews of businesses in a particular area and what they all have to offer in order to choose which one is best suited to what you are looking for.
- **Brightkite** is similar to Twitter and has a Facebook-like friend feed so that users can comment, upload and share pictures on the location of where they are.
- **Loopt** turns your mobile device into a compass that allows a map to be populated showing the locations of your friends and where they've visited. Comments and suggestions are easily left for others to see and the application also has built-in support for instant messaging services.

1. What are the social implications for the location-based app?

2. What ethical and legal issues could happen due to the policies of the app?

3. What is the advantage and disadvantage of the app?

COMPUTER MANAGEMENT

CHAPTER OVERVIEW	
Unit 5.1	Safety and security
Unit 5.2	Threats
Unit 5.3	Remedies

Learning outcomes

At the end of this chapter you should be able to:
- discuss computer management issues regarding safeguarding against threats
- provide remedies for safety and security issues.

INTRODUCTION

When talking about computer criminals, it is easy to call all computer criminals hackers. This is an oversimplification, with the word hacker referring to a specific type of computer criminal who uses his or her computer skills to gain unauthorised access to data. In fact, many security experts will argue that calling a hacker a criminal is also incorrect since many hackers do not use their computer skills for illegal purposes but are instead paid by companies to test their security systems. Hackers can also use their skills to expose or prevent criminal activities. This Chapter will look at the various cybercrimes and remedies for safety and security.

COMPUTER MANAGEMENT IN A NUTSHELL

In grade 10 we learned that computer users need to understand the basics of malicious software and know how to use computers and the internet safely because it is possible for computer criminals to infect your computer or gain access to your personal details and use them to steal from you.

A cyber gang, much like a gang in real life, is a group of people who work together to commit crimes. Just like in real life gangs, these gangs can be made up of many loosely organised members (like the group Anonymous) or they can be a small team of specialists.

5.1 Safety and security

In this unit, you will learn more about the different computer threats and how to best protect yourself from them. Where Grade 10 looked mostly at digital computer threats, this unit will look at computer threats more broadly, including problems caused by human error, hardware failure, physical computer threats (such as theft), and finally digital computer threats (such as viruses and malware).

For each threat, you will learn what the threat is and how you can prevent it from affecting you.

HUMAN ERROR

The biggest threat to your computer and your data is always you!

Common errors made by people include:
- Giving sensitive information to the wrong people
- Writing down your passwords
- Using the same password for all your accounts
- Choosing an insecure password
- Clicking on links provided in emails without first verifying them.

Another common error made by humans is capturing incorrect information. This is more commonly called GIGO, which stands for "Garbage In, Garbage Out". According to GIGO, if you capture inaccurate, unreliable or nonsense information on your computer then you can expect any program that uses this information to provide you with inaccurate, unreliable or nonsense information. For example, If you enter someone's email address or phone number incorrectly then you will not be able to contact that person.

You have got to be aware of accidentally exposing sensitive information due to lack of vigilance or negligence such as leaving your computer logged in or your cellphone unlocked. For example, if you store a scanned copy of your Identity document on an flash drive and then you leave it lying around, a person could gain access to this document and use it to steal your identity.

Activity 5.1

5.1.1 In small groups discuss when you made a human error, the consequences and how you can remedy it in the future.

5.1.2 Explain GIGO and human accidents in your own words.

5.1.3 Design the strongest password activity.

Write a sentence that is easy to remember. This might be a line from a song or movie, a story about a place you have been, or any other phrase you can remember. e.g Avengers

Take the first letter from each word to make your password (including capitalisation).
e.g. AveNgerS

Change the letters to numbers and symbols where possible.
e.g. Av3N93r5

Can also add a symbol on the end for extra length and complexity.
e.g. @v3N93r5!

Now try and make at least 3 diffrent passwords with varried complexity. Try and expore other creative ways to make strongest passphrase.

5.2 Threats

PHYSICAL ACCESS

One way in which data can be lost is through theft. This can be the theft of a smartphone, notebook or computer, or simply the theft of an external hard drive or flash disk.

- Do not leave your storage devices unattended in public spaces such as in school computers.
- Make regular backups of your data.

Never store critical information only on a portable storage device.

HARDWARE FAILURE

While most hardware can simply be replaced, losing a storage device means you also lose all the data stored on the device, which could represent the loss of many years of work.

Data loss like this occurs for two reasons:

- **mechanical damages of hard drive:** There are many moving parts inside hard drives that can break down easily.
- **power failures:** Sudden changes in voltage may damage hard drives and other parts which are very sensitive to changes in voltage and strong magnetic fields
- **spilling coffee, and other water damages:** Liquids cause short circuit of important electronic components and they are really hard to recover/repair afterwards.

NETWORK VULNERABILITY

The final threat you will learn about are network-based threats. Since you already know about viruses, spoofing and phishing, this section will look at these types of network threats. The table below describes each of these threats in greater detail.

Table 5.1: *Security threats*

TYPE	DESCRIPTION
Virus	A computer virus is malicious software that is loaded onto a user's computer without their knowledge, replicates itself and performs malicious actions.
Worm	A computer worm is a type of malware that spreads copies of itself from one computer to another. A worm can replicate itself without any action from the user and it does not need to attach itself to another program to cause damage. Worms will scan a network for open ports and use those openings to spread through the network.
Trojan	A Trojan is a type of malware that is often disguised as useful software. Trojans can be used to gain access to users' systems. Users are tricked by social engineering executing the Trojan on their system. Once activated, Trojans can enable cyber-criminals to gain backdoor access to your system. One of the most dangerous types of trojan horses is called a keylogger, which recordskeystrokes.
Rootkit	A third type of virus is called a rootkit. Rootkit is malware that is designed to infect a computer and allow an attacker to install a set of tools that grant him remote access to the computer. The rootkit is hidden within the operating system and will be designed to hide from anti-malware applications. Rootkits act as a backdoor that gives the attacker the ability to connect remotely to the infected machine whenever he chooses and remove or install specific components.

TYPE	DESCRIPTION
Spoofing	With spoofing, the attacker disguises an email to pretend that the email is sent from a known, trusted source. For example, the attacker might send emails that appear to come from you to your friends and family with an urgent request for money while providing their own banking details.
Phishing	Phishing attacks try to obtain sensitive information (such as usernames, passwords and banking details) by sending emails to users that look like official emails. This is often used with email spoofing to convince victims that they email is from a legitimate source.
Pharming	Pharming attacks create an official-looking website that requests sensitive information. A very common pharming attack allows users to "change" their passwords. Instead of changing their passwords, the user's username and password is recorded and their account is taken over.

Pharming involves malicious code being is installed on a computer or server, which misdirects users to a fraudulent website even when the type the correct address, that requests sensitive information such as passwords and banking details which are then stolen by the cyber-criminal. |
| Malware | Malicious software that is specifically designed to disrupt, damage, or gain unauthorised access to a computer system. |

Activity 5.2

5.2.1 In small groups, mind map the three types of threats, their definitions and examples.

5.2.2 For each threat try to list or research remedies.

5.2.3 Match the COLUMN A with the correct answer in COLUMN B. Write down only the question number (1.1 – 1.10) and the matching letter (A – H) in COLUMN B in your Theory writing book, for example 1.1 – M.

COLUMN A	COLUMN B
1. When sensitive information (such as usernames, passwords and banking details) is obtained by sending emails to users that look like official emails.	A. Phishing B. Ransomware
2. Refers to when a fake social media account is created to gain someone's trust.	C. Theft
3. A malicious virus that locks all a user's files and encrypts data on the computer.	D. Pharming
4. Malicious software that is loaded onto a user's computer without their knowledge, replicates itself and performs malicious actions.	E. Virus F. Hacking
5. This is an official-looking website that requests sensitive information	G. Spoofing
6.	H.
7.	

5.2.4 Study the following phishing example:

From: FNB <ir@gmail.com>
To:
Cc:
Subject: Payment Confirmation

Dear Client,

A payment has been made to your account. To view the details of the payment, please Login. to view details.

If you have any questions or would like more information, please contact our support centre

a. Describe TWO features in the e-mail that confirms the e-mail to be a phishing attempt.

b. Explain the main difference between phishing and pharming.

5.3   Remedies

For each threat that was discuss in the previous unit we will look at remedies so that your system can be secure.

CREATING A BACKUP

Creating a backup is the process of making copies of your computer's data to use in the event that the original data or are lost or destroyed.

A backup is a copy of your computer's data.

TYPES OF BACKUPS

FULL BACKUP

A full backup is when a copy is made of every single file and folder in the system. A full backup takes longer and uses more storage space than other types of backups but restoring data from the backup is faster.

DIFFERENTIAL BACKUP

Differential backups start with a full backup and after that copies those files that have been changed since the full backup took place. So if a full backup was done on Day 1, Day 2s differential will copy all of the files that have changed since Day 1s backup. Day 3s backup will also copy all of the files that have changed since Day 1.

Because a full backup was taken and the differentials copied everything that changed after that, only the full backup and the latest differential need to be restored.

The size of the differential copy increases each time a backup is taken until the next full version is made.

INCREMENTAL BACKUP

Incremental backups also start with a full backup. After that, a copy of the files that have changed since the last backup is made, whether it was a full or incremental copy. If a full backup was done on Day 1, Day 2s incremental will back up all the files that have changed since Day 1. Day 3s incremental backup will only copy those files that have changed since Day 2s incremental backup.

A disadvantage is that when you want to carry out a complete restore, the most recent full backup and all of the subsequent incremental copies must be restored. This can make the restore process a lengthier one than when using a full backup plus the most recent differential copies only.

BACKUP LOCATIONS

Backups can be stored in many different locations. These are discussed below.

LOCAL BACKUP

Local backups are made on a storage medium that is kept in the same location as the original data. It could be on an external hard drive or Network Attached Storage (NAS). Local backups can protect data from hard drive failures, accidental deletion and virus attacks.

OFFSITE BACKUP

When the backup storage media is kept at a different location from the source, this is known as an offsite backup. The backup can be done locally and then the storage medium is moved to another place. Offsite backups provide extra protection from theft, fire and natural disasters.

ONLINE/CLOUD BACKUP

Online backups are done frequently to a storage medium that is always connected to the source being backed up via an internet connection. Many commercial data centres offer this as a subscription service to customers. This offers the same protection as an offsite backup.

UNINTERRUPTIBLE POWER SOURCE (UPS)

An uninterruptible power supply (UPS) is a device that allows a computer to keep running for a short time when power is lost due to a power failure. UPS devices also provide protection from power surges.

A UPS contains a battery that takes over when the device detects a power failure. If a user is working on the computer when the power fails, they have enough time to save what they are working on and shut the computer down before the battery runs out. A UPS will also regulate any power surges so that the power surges do not damage the computer and you do not lose any data when a power failure occurs.

PASSWORDS

The following guidelines will help you to set a strong password. This will stop hackers from finding out your password and using your account illegally:
- Always use at least 8 characters in your password, at least two of which are numeric.
- Use a mixture of both uppercase and lowercase letters
- Includee a mixture of letters and numbers
- Include of at least one special character for example, ! @ # ? % *
- Do not use personal information in your password that someone else is likely to be able to figure out.
- Never use a password that is the same as your account number.
- Do not use passwords that are easy to spot while you're typing them in. Passwords like 12345, qwerty (i.e., all keys right next to each other), or nnnnnn should be avoided.

ACCESS RIGHTS

This was discussed in the Chapter on Networks. Most networks are set up with 'access rights'. This means the administrator has created accounts for all users, with the right to access certain files and folders. For instance, you may have a personal folder in which you have the right to open, read, write, create and delete files. This will restrict unauthorised access to certain files and folders.

FIREWALLS AND ANTI-VIRUS

FIREWALL

A firewall is hardware, software or a combination of both, that monitors incoming and outgoing traffic on a network. The firewall decides whether to stop the traffic based on a set of predefined security rules. Its purpose is to create a barrier between an internal network and incoming traffic from external sources to block potentially malicious traffic.

ANTI-VIRUS

Antivirus software is system software designed to prevent, detect and remove malware infections on computing devices.

Antivirus software can protect against a wide variety of threats including keyloggers, Trojan horses, worms, rootkits, spyware and ransomware.

All antivirus programs perform some important tasks:
- Scan specific files for malware or known malicious patterns
- Allow you to schedule scans to automatically run for you
- Allow you to initiate a scan of a particular file or your entire computer, or an external storage device at any time.
- Remove any malicious code that it detects. Depending on the settings, you will be notified of an infection and asked if you want to clean the file, or the program will automatically do this.

VALIDATION

To prevent theft of data and personal details, computer systems must be programmed to validate whether the user that is logging into the computer is an authentic user or not.

Activity 5.3

5.3.1 In small groups, add to your mind map, from the previous activity, the remedies for each threat you identified.

1. Choose the correct answer.

   a. A collection of programs designed to infiltrate a computer and gain the highest level of privileges:

      A. Rootkit

      B. Trojan horse

      C. Worm

      D. Virus

   b. Attempt from people using an e-mail to try to convince someone to provide security-related information is called …

      A. Phishing

      B. Pharming

      C. Scamming

      D. Snooping

   c. Social engineering is associated with

      i) Designing social networks

      ii) Maintaining social media records for clients

      iii) Manipulating individuals to give personal information

         A. (i) and (ii) are correct

         B. (ii) and (iii) are correct

         C. Only (ii) is correct

         D. Only (iii) is correct

   d. Shop owners are making good use of the Internet and all its services. Viruses are always a problem.

      i) List THREE ways in which a user's actions could result in a virus getting onto their computer system via a network.

   e. One of the shop owners has been advised that once he is connected to the internet, his chances of receiving unsolicited mail increases. He also plans to be doing online banking.

      i) What is this unsolicited mail called?

      ii) Is it possible to stop unsolicited mail from getting into your mailbox? Motivate your answer.

      iii) Give THREE measures he can take to protect himself from someone trying to get his banking details.

ELECTRONIC COMMUNICATIONS

CHAPTER OVERVIEW	
Unit 6.1	Mobile/wireless e-communication
Unit 6.2	Use of mobile technology
Unit 6.3	Use of wireless technologies
Unit 6.4	Data security

Learning outcomes

At the end of this chapter you should be able to:
- explain the purpose, writing style and audience for e-communication
- list and describe uses of mobile technology
- describe the uses of wireless technologies
- describe how communication protocols are used to control data
- provide methods of practising data security.

INTRODUCTION

Today, young people from around the world have realised that money can be made if you have a large enough online following.

Many brands are working with internet personalities and **influencers** to market their products. YouTubers, streamers and social media celebrities are becoming more professional every day, and what used to be something that anyone with a webcam and microphone could do, has suddenly turned into big business.

In this chapter, you will learn more about modern electronic communications, specifically, mobile communications. This will include classic forms of communication like email and SMS, as well as modern forms like **vlogging**, **podcasting** and **streaming**. You will also learn more about mobile devices and the protocols used to transfer data between these devices.

Did you know

Becoming an online celebrity sounds like a great idea. As a result, there are millions of people around the world hoping to make easy money as a *professional gamer* or social media celebrity. Only a very, very, very small percentage of these people can survive, much less get rich, from their online income.

New words

social media – a form of electronic communication through which users create online communities to share information, ideas, personal messages, and other content

influencers – people who have built a reputation for their knowledge and expertise on a particular topic

vlogging – a blog in which the postings are mostly in video form

podcasting – a digital recording of music, news or other media that can be downloaded from the internet to a portable media player

streaming – when a multimedia file can be viewed without being completely downloaded

ELECTRONIC COMMUNICATIONS IN A NUTSHELL

Electronic communication refers to any data, information, words, photos or symbols that are sent electronically to communicate with one or more people. Thanks to computers and the internet, there are thousands of different ways to communicate today – from uploading videos on YouTube to posting a 140-character tweet on Twitter.

Some of the most popular forms of electronic communication include:
- emails
- websites
- File transfer protocol
- Instant messages
- VOIP
- Video calls
- Vlogs
- Blogs
- Webinars

Whenever you communicate on the internet, whether it is via e-mail, instant messaging or by posting a blog, it is important that you follow proper netiquette. This will not only make the internet a more pleasant place for everyone else, it will also save you from potential embarrassment in the future!

The following are some guidelines you can follow when communicating on the internet:
- Show people on the internet the same respect you would show to them in person.
- Do not say things to people you would not say to them in person.
- Do not post things on the internet that you would not want your mother or future boss to see.
- Things posted on the internet often last forever. This means that things you post as a teenager or young adult can negatively affect the rest of your life.
- Make sure your messages are clearly written and easy to understand.
- When joining an existing conversation, speak about subjects relevant to the topic.
- Try to make useful contributions and help people out on the internet.
- If you need help from the internet, do not expect other people to do all the work for you. Do as much work as you can before asking your question.
- See if there are existing conversations about your topic before starting new conversations.
- Do not spam people! Do not post the same advertisement repeatedly.

While the tips covered in this section are generally good guidelines, it is important to note that netiquette differs from site to site and changes over time. When joining a new website, spend some time figuring out what acceptable behaviour is for that website before sending your own messages.

1. Define the followiDefine the following terms:

   a. Electronic communication

   b. Blog

   c. VOIP

2. A friend of yours visits many download sites and starts receiving lots of unwanted mail.

   a. What is this unwanted mail called?

   b. Is it right to send out mail to people you do not know? Motivate your answer.

3. Study the following words that Jenny usually uses in an email to her colleagues at work.

TTYL	OMW
LOL	OMG
BRB	

   a. Consider the context of the words she uses in her email messages and list TWO e-mail etiquette (netiquette) rules that have been violated.

   b. Which other e-communication medium are these words best used for?

   c. Briefly explain to Jenny how she is supposed to send emails to colleagues at work.

In this unit, you will learn more about different communication methods and how they can be applied using wireless technology. For each technology, you will look at what it is, how it is used, what its advantages and disadvantages are, and a few popular examples of the tool. Let's start with the most commonly used technology: E-mail.

E-MAIL

Email is short for "electronic mail," and is one of the most popular uses of the Internet. It allows you to send and receive messages containing text, images, or other attachments to and from anyone with an email address, anywhere in the world.

Email allows us to:
- Contact people all over the world for free
- Share files with one or more people at a time
- Communicate with more than one person at a time
- Keep documented evidence of our communication with someone
- Send messages any time of day without disturbing people
- Advertise to multiple people

When typing an email message, it is vital that you use good netiquette. You should always include a subject that summarizes the topic of the email. Begin each message with the recipient's name and end the message with your name or "signature".
- communication
- sending files
- marketing

As one of the first internet services, there are millions of different email providers today with most large web services offering a free email service. Some examples common include::
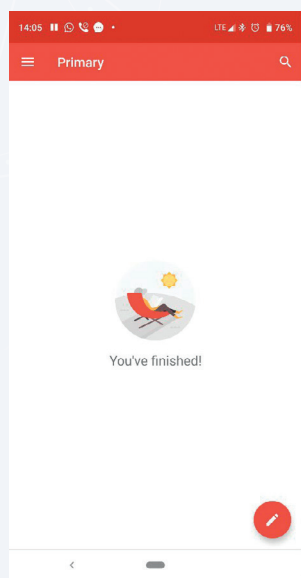- Gmail
- Yahoo Mail
- Outlook.com

Figure 6.1: *Gmail is the most popular free email provider*

BLOGGING

The first form of one-way conversation is blogging, in which a website creator **posts** short, informal stories or articles on their website. It is a discussion or informational website published on world wide web consisting of discrete, often informal diary style text entries.

The Audience is generally people who are interested in the content of that specific blog.

Whenever a new story is posted, it is automatically moved to the top of the website where it will be seen first while all the older stories move down one position. For example, in the screenshot from the blog *Kotaku*, the newest story is about a professional *Magic* player, and this is followed by three older stories

related to gaming. Clicking on any of these stories will open an informally written article about the topic.
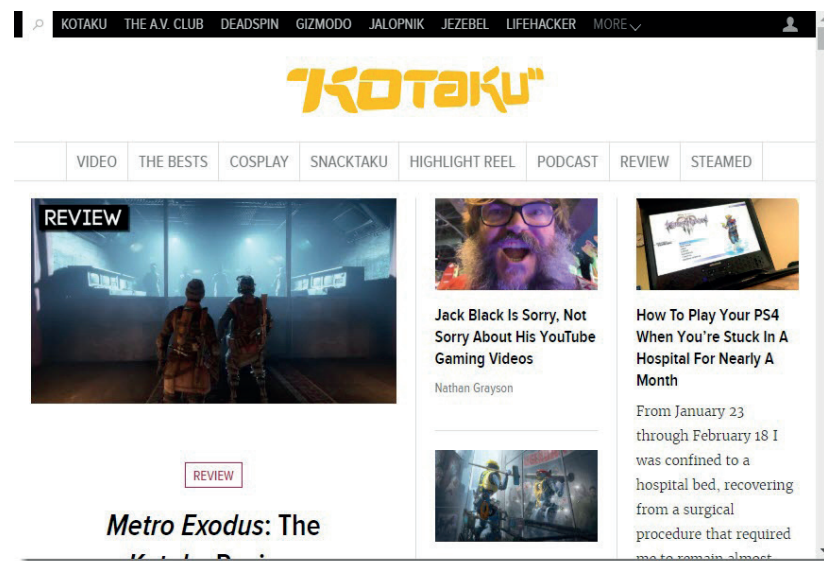
Figure 6.2: *An example of a blog*

MICROBLOG

Microblogging is a combination of blogging and instant messaging that allows users of social platforms such as Twitter to conveniently create short messages to be posted and shared with an audience online. Microblogs are usually limited to 280 characters, so messages must be short and to the point.
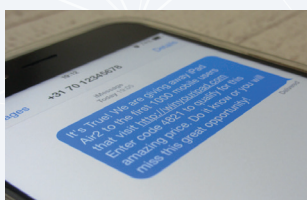
Microblogs come in a variety of content formats including text, images, video, audio, and hyperlinks. They can be seen as short conversations where people can share ideas with their followers.

SMS

The second oldest form of electronic communication is SMS (or short message service). The first SMS was sent in 1992. Since the early 90s, any mobile phone could send a short message (or SMS) to another mobile phone. These messages had a maximum length of 140 characters (including spaces), cost a small amount per message and were asynchronous. This made them an excellent tool for sending small amounts of information to someone or for having short conversations.

Today, SMSs are rarely used for personal communication since instant messaging and social media applications can send the same short messages for free. Instead, the only situations in which SMSs are commonly used are:
- the sender does not know the message receiver
- the sender does not have internet access needed for instant messaging applications
- the sender does not have a phone capable of using instant messaging applications.
- Some banks also use SMSs to notify customers of transactions on their bank accounts.
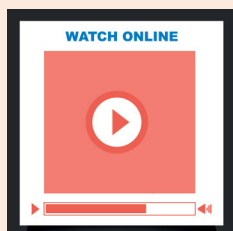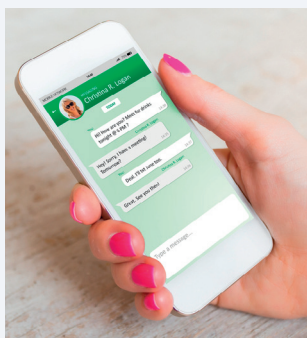
The table below summarises the advantages and disadvantages of SMS.

Table 6.1: *Advantages and disadvantages of SMS*

ADVANTAGES	DISADVANTAGES
Quick and easy to send	More expensive than instant messaging
Available on all mobile phones	Limited number of characters per message
Asynchronous communication	Cannot send photos, videos or emojis
Can be sent without internet access	Often used for marketing or spam
More affordable than a phone call	

The picture in the margin shows a typical example of a spam SMS.

INSTANT MESSAGING

Instant messaging is a service, like SMS, that allows people to send short messages using their mobiles phones (or computers). However, unlike SMSs, instant messages are sent for free over the internet and can contain multimedia items like emojis, pictures, videos and voice recordings. In 2018, the most popular instant messaging applications are WhatsApp, Facebook Messenger and WeChat, although newer instant messaging applications like Snapchat and Telegram have gained many users very quickly.

Together with voice calls, instant messaging is the most popular method for people to have electronic conversations in 2018. It is used to communicate with friends and acquaintances, have group conversations, organise events and share multimedia with people. In fact, it has become so popular that many businesses are using instant messaging applications to communicate directly with customers such as Absa's *ChatBanking* and Afrihost's *WhatsApp Assistant*.

The table below summarises the advantages and disadvantages of instant messaging.

Table 6.2: *Advantages and disadvantages of instant messaging (IM)*

ADVANTAGES	DISADVANTAGES
Messages are free to send	Messages are not permanently saved and backed-up
Possible to see when messages are received and read	Too informal for some settings (such as business communication)
Asynchronous communication	Message recipients are under pressure to respond to all messages.
Messages are shorter and more conversational	Can be a distraction
Can create group conversations	
Can share multimedia like emojis, pictures, videos and voice recordings	

The picture in the margin shows a typical example of a WhatsApp conversation.


Figure 6.3: *A spam SMS*

Animation

Animation from Grade 10 showing how a message is converted to data and sent to another person's phone.

WATCH ONLINE

Did you know

In 2017, more than 29 million WhatsApp messages were sent per minute. This is equal to more than 40 billion WhatsApp messages per day!

Figure 6.4: *A WhatsApp conversation*

VIDEOCASTING

Videocasting refers to a form of communication where videos are broadcast over the internet. Videos can first be created and then uploaded to a website (like YouTube), or they can be streamed live, allowing people to watch the video as it is created. One very popular form of videocasting is vlogging. The word vlogging is a combination of two words: Video and blogging. Vlogging (or a vlog) is like blogging but with videos. As with blogs, vlogs show several informal, conversational videos with the most popular video appearing first. These videos can be on any topic and are generally not professionally made. Most channels you will find on YouTube are examples of vlogs.

The advantages and disadvantages of video casting are shown in the table below.

Table 6.3: *Advantages and disadvantages of video casting*

ADVANTAGES	DISADVANTAGES
Easy to connect with an audience	Requires basic recording equipment
Do not have to create your own website	Requires basic video editing knowledge
Does not need to be professional	Can be very time consuming

PODCASTING

The final type of electronic communication discussed in this chapter is podcasting. Podcasting (or a podcast) refers to an audio only broadcast released on the internet. It is a free service that allows Internet users to download audio files from a podcasting Web site to listen to on their computers or personal digital audio players. As with blogging and vlogging, there are thousands of different types of podcasts, from novels and dramas, to news and talk show podcasts to popular culture and documentary podcasts, which means that there is a podcast for every type of audience.

The advantages and disadvantages of podcasting are listed in the table below.

There is a really common misconception that starndard audio files available on the internet are postcasts. Anyone can just take a recording of themselves or someone on a dictaphone or on their mobile phone and then that audio file can then be uploaded on a website and then most people think that it's a podcast. One thing that separetes a podcast from simple audio file is the act of allowing subscriptions as soon as you upload an audio file to a podcast hosting site then that podcast hosting website produces a RSS feed and its the fact that the RSS feed allows peolple to subscribe to the podcast. That is what turns into from an audio file to a podcast.

As soon as people start subscribing to that audio file or your CDs of Audio files through RSS feeds, that is what turns it into a Podcast or episodes of a podcast. When you have podcasts that talk about a certain topic then you would have a podcast series.

Table 6.4: *Advantages and disadvantages of podcasting*

ADVANTAGES	DISADVANTAGES
Good to listen to while travelling	Can be time consuming and difficult to make, especially scripted podcasts
Good way to get a daily update	Needs a good reader, good information and good writing to be interesting
Can be professional or relaxed	Audience for podcasts is smaller
Can be very informative	
Can be downloaded to your device and listened to without an internet connection	

VOICE OVER INTERNET PROTOCOL (VOIP)

VOIP is a service to make telephone calls over the internet rather than through the traditional telephone or cell phone networks. It allows voice and mutimedia data to be transferred across a data network.To use VOIP, the signal from an old, analogue phone system can either be converted to a digital signal or a digital phone system must be installed.

Although VOIP is much cheaper than analogue phones, VOIP systems initially suffered from many technical problems. These days VOIP is widely used and, together with cell phones, has caused the analogue phone system to shrink to a fraction of its original size. As you will see in the next section, VOIP is often combined with video conferencing tools and included in smartphone applications. This gives users the convenience of making a call from their phone, without the cost normally associated with a call.

VIDEO CONFERENCING

Video conferencing refers to a set of technologies that allow a person to make a video call to one or more people at the same time. These calls are like phone calls but can also include a video broadcast of the people in the call. Popular examples of video call applications include Skype, FaceTime and Discord.

Video calls are mostly used by people who want to have a comfortable conversation. Since more than half of what people say is nonverbal (that is, body language), being able to see the person you are speaking to helps to avoid confusion and misunderstandings.

However, video calls and video conferences also have different uses. For example, video calls are sometimes used to broadcast a live event to people (such as a sporting event, childbirth or home viewing). Video conferences are also often used in business environments, where they allow people from across the world to attend a meeting or view a presentation.

Figure 6.5: *A video call made in Skype*

The table below summarises the advantages and disadvantages of video conferences.

Table 6.5: *Advantages and disadvantages of video conferencing*

ADVANTAGES	DISADVANTAGES
Calls are free to make	Requires a fast internet connection
Can contain sound and visuals	Uses a significant amount of data, so can be expensive
Allows non-verbal communication	Can experience delays (or lag) on slow internet connections
Can easily transfer visual information	Requires both sender and receiver to be available at the same time
Conversation is synchronous, which means a direct conversation can take place	
Video broadcast can be disabled to decrease the amount of data used	

Activity 6.2

6.2.1 Match the COLUMN A (1.1 – 1.12) with the correct answer in COLUMN B. Write down only the question number and the matching letter in COLUMN B (A – L).

COLUMN A	COLUMN B
1. Instant messaging	**A.** Internet service provider
2. SMS	**B.** Social networking
3. Blog	**C.** Website creator posts short, informal stories or articles on their website
4. e-mail	
5.	**D.** Calls made using the internet
6. VOIP	**E.**
7. Video calls	**F.** Limited number of characters per message
8. Podcast	**G.** Too informal for some settings (such as business communication)
9. Vlog	**H.** Audio only broadcast released on the internet.
10. Very short stories (or "status updates") are posted	**I.** Show several informal, conversational videos with the most popular video appearing first
	J. Microblog
	K. Sometimes used to broadcast a live event to people
	L. Electronic version of mail

6.2.2 Briefly describe how e-mail is a form of e-communication.

    a. List TWO uses e-mails have.

    b. List THREE advantages to sending mail over the internet compared to sending it via the postal service.

6.2.3 The second oldest form of electronic communication is SMS (or short message service). The first SMS was sent in 1992. Today, SMSs are rarely used for personal communication.

    a. List TWO situations where SMSs are still used.

    b. List TWO advantages of SMSs.

    c. List TWO disadvantages of SMSs.

6.2.4 Instant messaging is a service, like SMS, that allows people to send short messages using their mobiles phones (or computers).

    a. Give THREE advantages of instant messaging.

    b. Give TWO disadvantages of instant messaging.

6.2.5 **a.** What is podcasting?

    b. Give ONE difference between podcasting and blogging.

6.2 Use of mobile technology

In this unit, you will learn more about the use of mobile technology. The section will look specifically at mobile phones, feature phones and smartphones.

MOBILE PHONES

Mobile phones were designed specifically to make calls and send SMSs. Occasionally, the phones had a few additional features like a calculator or timer, but these features were not as important as the phone's ability to make calls and send SMSs.

FEATURE PHONES

Feature phones could send multimedia messages, play music, take photos, read emails and browse the internet. While these features are like smartphone features, they differ in two important ways:
- feature phones had a very weak processor, low quality screen and poor camera
- applications had to be designed specifically for each feature phone and there was no App store.

Because of these limitations, feature phones were more like "dumb phones" with a few extra features, while smartphones are more like computers that can run any program designed for the operating system.

SMARTPHONES

A smartphone has advanced features, including a high-resolution touch screen display, WiFi connectivity, web browsing, software applications and a mobile Operating System.

One of the most important features of a smartphone is its connection to an app store. An app store is a centralized portal where users can search for and download software applications to run on their phones.

MOBILE BROWSERS

One of the biggest advantages of smartphones is that they provide access to high speed internet and the world-wide web. To access the internet through a smartphone, you need to use a mobile browser app such as Chrome (for Android) or Safari (for iOS). Like a web browser on your computer, mobile browsers allow you to visit webpages and browse the internet.

While visiting websites from your smartphone, you may notice that they look slightly different from what you are used to. This is because mobile websites are changed to make them easier to read from a mobile device. In general, mobile web pages differ from their desktop pages in the following ways:
- Mobile phones are smaller, so less information can be shown per screen.
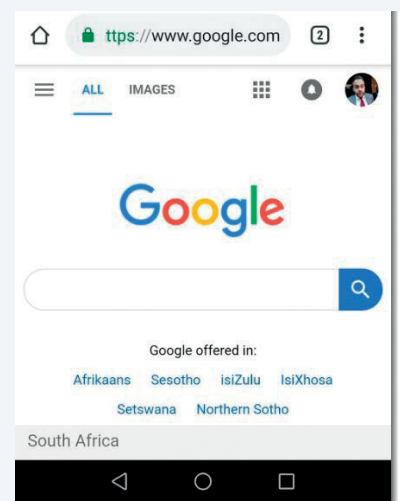- Mobile phones can be rotated, so pages need to automatically adapt to the width of the screen.

Figure 6.6: *The Nokia 3310 is one of the most popular cell phones ever made*

Figure 6.7: *The Motorola Razr was one of the most popular feature phones*

Figure 6.8: *The Blackberry Curve (photo by Death by Hammer)*

Figure 6.9: *A mobile browser*

- Mobile phones are slower, so mobile pages can be less interactive.
- Mobile data is expensive, so images and videos are compressed to use less data.
- Mobile phones use touch input (which is less accurate), so interactive elements need to be larger and easier to click.

The purposes of these apps range from productivity and navigation to entertainment, sports, fitness, and communication. Social media is one of the most popular fields of mobile app development.

MOBILE DEVICES

Tablets: One of the fast-growing segments of mobile devices is tablets. These tablets are usually running an iOS or Android system.	- Single-screen touch computers: - iOs, Android, Windows, etc. - Larger than 7 inches diagonal. - Designed for touch input. - virtual keyboards, drawing interfaces. - Application Support - Productivity applications like games - specialised applications - Media - Take pictures, watch movies - Audio and Video media
Smart phones: Smart phones have turned into the ultimate communication device. We can send email messages, we can perform voixe communication,very good media viewer etc.	- Mobile Communication - Voice, email,text,instant message,pictures,video 3,5 inches to 5.5 inches diagonal. - Media Viewer - music,movies,videos - Mobile Applications - maps ,travel information - Other Apps - Productivity, games, specialised apps, etc
Wearable Technology	- Smart watches - An extension of your phone and body - Fitness monitors - Track heart rate,steps,sleep patterns and more - Glasses and Headsets - easily access data, overlay virtual with reality
Phablets: Fills a niche for larget screens with somewhat less mobility, The right size can be subjective.	- all in one 5,5 inches to 7 inches diagonal size - not super compact - not tablet sized

eReaders	• Specialised device • Book reading • some music,some apps • black and white screen • performs well in direct light. • Exceptionally long battery life • Network access (WiFI and Cellular)
Smart Camera	• traditional digital cameras • video recoders • powerful operating systems (Android, etc) • image processing on the camera • touch screen • capture on camera, save on phone • wireless network connectivity. • face recognition
GPS	• In car navigation (and non- car) ○ Requires a view of the sky (needs to receive GPS signal) • Periodic updates required (over the air or Memory Card)

Activity 6.3

6.3.1 Give ONE word/term for each of the following descriptions:

a. This type of mobile technology was small, affordable and had a battery life that could last for weeks.

b. This type of phone could send multimedia messages, play music, take photos, read emails and browse the internet.

c. This type of mobile technology can do the tasks most desktop computers can do.

d. This allows you to visit web pages and access the internet.

e. This is a service to make telephone calls over the internet rather than through the traditional telephone or cell phone networks.

6.3.2 Give ONE difference between a cell phone and a feature phone.

6.3.3 You have also decided to use a smartphone and a web browser to conduct business in the shop that you own.

a. Discuss TWO main hardware differences between a smartphone and a conventional phone.

b. List THREE commonly used smartphone operating systems.

c. Give TWO advantages of using a smartphone in your business.

d. Define a web browser.

e. Explain TWO differences between web pages on a desktop and mobile web pages.

f. Describe ONE type of threat you could be exposed to when using a smartphone.

In this unit, you will learn more about the different wireless network technologies, as well as a few of the most common protocols used to send and receive data over these wireless networks.

WIRELESS TECHNOLOGIES

- **Access points:** a networking hardware device that allows other Wi-Fi devices to connect to a wired network
- **Difference in range and bandwidth:** range refers to the measurement of how far data or a signal can be transmitted and received, while bandwidth refers to how much data you can send through the network
- **Connection speed (shaping and throttling):** refers to the speed that data is transferred between a device and the internet. Throttling occurs when your ISP intentionally slows down your internet speed, while shaping is the lowering of available bandwidth by your ISP once you have exceeded your monthly limit
- **Blockchain:** refers to a growing list of records, called blocks, that are linked using cryptography.

Wireless networks do not require cables or wires. Instead, wireless network connections send data across a specific wireless frequency. They form wireless local-area networks (WLANs).

Wireless access points (WAPs) are networking devices that allow Wi-Fi devices to connect to a wired network. An access point acts as a central transmitter and receiver of wireless radio signals. If you use a tablet or laptop to get online, you are going through an access point, either hardware or built in, to access the internet without connecting to it using a cable. Due to differences in the wireless frequencies, range, bandwidth as well as technological differences, different wireless technologies have different uses. For example, bandwidth throttling is an intentional slowing of available bandwidth, lowering of the "speed" that's typically available over an internet connection. Bandwidth throttling can happen at various places between your device (like your computer or smartphone) and the website or service that you're using over the internet. Another example is Internet shaping, this is the lowering of available bandwidth by the Internet Service Provider (ISP) to a customer when that customer has exceeded their monthly limit.

The table below summarises the most commonly used wireless network technologies:

NETWORK	SPEED	DESCRIPTION	NETWORK
GPS	–	Global Positioning System (GPS) captures the signals from three or more satellites to triangulate data and pinpoint your location.	App specific network

NETWORK	SPEED	DESCRIPTION	NETWORK
4G/5G	100 MB/s – 1 000 MB/s	4G ("fourth generation") gives improved speed and stability over 3G and its application may therefore also include options such as HD TV and internet gaming.	Internet
Bluetooth	1 MB/s – 24 MB/s	Bluetooth connects devices over short distances using radio waves. It finds most of its application in cell phone to device (such as earphones) connectivity, remote controls and limited data transfer.	Device-specific network

Another type of network is blockchain, see the image below:
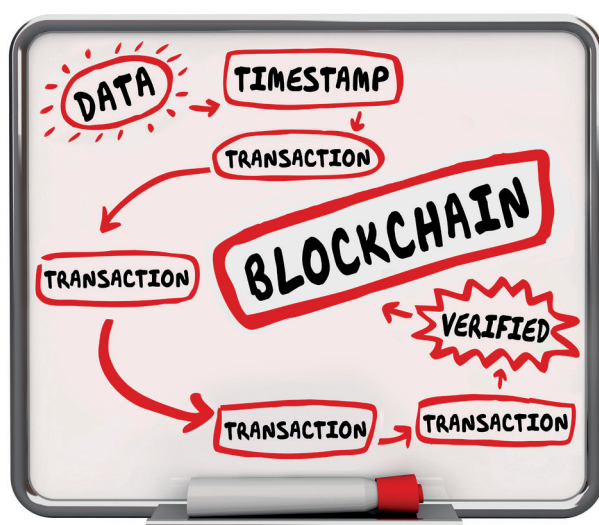
By the end of 2018, 99% of all people in South Africa live in areas with access to 3G and more than 90% of people live in areas with access to 4G.

PROTOCOLS

In Grade 10 you learned that a protocol is a set of rules that describe how data is sent between two computers. For two computers to understand the information that is being sent between them, they need to use the same protocol. This tells the computer that is sending the data how to package the data while also telling the computer that receives the data how to understand and interpret the data it receives.

To see how protocols are used, you can look at four different protocols: POP3, SMTP, IMAP and VoIP.
- **POP3**: POP3 (Post Office Protocol version 3) is one of the protocols that is used to retrieve emails from your mail server. POP3 tells your email application how to communicate with this server, find out if any emails were sent to your address and download the emails to your computer.

- **SMTP**: SMTP (short for Simple Mail Transfer Protocol) is a protocol that is used to send emails. This means that the SMTP protocol tells your email application what information is needed to successfully send an email. This includes your own email address, the email address you are sending the message to, and the message itself. Once you send an email, SMTP makes sure that the email is sent to the correct mail server on the internet where it waits for the email recipient to download their emails.
- **IMAP**: IMAP allows you to access your email messages wherever you are if you have data or wireless connection to the Internet. IMAP allows you to access, organise, read and sort your email messages without having to download them first, so it is very fast and efficient.
- **VoIP**: VoIP (or Voice over Internet Protocol) is a protocol that is used to make voice calls over the internet. With VoIP, a phone call is made from a VoIP-enabled telephone or computer. This call is connected to a VoIP service provider, who then connects you to either another VoIP user or to a traditional telephone. Popular services like WhatsApp voice calls and Skype make use of VoIP to allow you to make voice calls to other WhatsApp or Skype users for free.

As these examples show, the different network protocols determine how computers communicate with each other over the internet. Other popular network protocols include HTTP and HTTPS (which determines how web pages are viewed), FTP (which allows files to be transferred over the internet), and IMAP (which also allows emails to be downloaded).

Activity 6.4

6.4.1 Indicate whether the following statements are TRUE or FALSE. Correct the statement if it is FALSE. Change the underlined word(s) to make the statement TRUE. (You may not simply use the word 'NOT' to change the statement.)

   a. <u>SMTP</u> is the protocol used to receive emails.

   b. Services like WhatsApp or Skype use <u>VoIP</u> to allow users to make free voice calls to other WhatsApp or Skype users.

   c. SMTP stands for <u>Short Message Transfer Protocol</u> and is used to send emails.

   d. POP3 is <u>the only protocol</u> that can be used to receive email messages.

   e. HTTP and HTTPS are used to<u> transfer files over the internet.</u>

6.4.2 You have decided to place 3G connectivity instead of ADSL connectivity in your living room. A wireless router will be used to connect all your mobile devices and computers to the internet

   a. What is wireless technology?

   b. 3G/LTE connectivity is becoming popular in many homes. Explain what 3G is.

   c. What type of network category does 3G fall in?

   d. List ONE advantage 4G/LTE has over 3G.

   e. What medium of data transmission is used in 3G/LTE?

6.4.3 Protocols are necessary to enable transmission across a network or the Internet. Briefly describe where each of the following will be used.

   a. VOIP

   b. POP3

To keep users' computers and data safe, computers include several security features. In this unit, you will learn about three safety and security features, namely:

PASSWORDS

The first security feature on most computers and online services is a password. By adding a password to a computer, only people who know the password can access the computer and its files.. If you create a secure password that you do not share with other people, you should be the only person who is able to access your computer.

For online services, anyone from anywhere in the world can try to login to your account, the only thing stopping them is your password. To make sure your password is as secure as possible, you should use the following guidelines:
- Choose a password that is long (at least 8 characters).
- Include uppercase and lowercase letters, as well as numbers, in your password.
- Never use personal information such as a birthdate or the name of your favourite sports team as a password.
- Create different passwords for different websites. In this way, if someone hacks your social media account, they cannot use the same password for your online banking.
- Do not share your passwords with other people and do not write your passwords down.

ENCRYPTION

The final security tool used on computers is encryption. With encryption, any data sent between two computers is changed from something that is useful to encrypted data that is difficult to decrypt and use by unauthorised people. The only way to turn the encrypted data back into useful data is to know the encryption key, which is only known by the receiving computer.

Today, most websites use the HTTPS (HyperText Transfer Protocol Secure) protocol which ensures that all data sent to and from the website is encrypted. Most online services today also encrypt personal user information in their databases, which means that, even if a hacker gets access to the database, they cannot just read all the user's usernames and passwords.
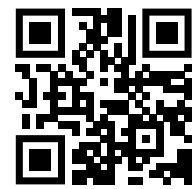
MULTI-LAYER VERIFICATION

Multi-layer authentication is an authentication method, much like a password, in which a computer user is granted access only after successfully giving two or more pieces of evidence to an authentication mechanism:
- knowledge (something the user and only the user knows) e.g. your ID number or mother's middle name
- possession (something the user and only the user has) e.g. accept verification on another device
- and inherence (something the user and only the user is) e.g. voice or fingerprint verification

QR CODE

https://informationisbeautiful.net/visualizations/worlds-biggest-data-breaches-hacks/

https://qrs.ly/vca5qel

Activity 6.5

6.5.1 Match the COLUMN A (1.1 – 1.12) with the correct answer in COLUMN B. Write down only the question number and the matching letter in COLUMN B (A – L).

COLUMN A	COLUMN B
1. Firewall **2.** Password **3.** Encryption **4.** Protocol **5.** VOIP **6.** Wi-Fi **7.** POP3 **8.** Software firewall **9.** HTTPS **10.** SMTP **11.** Hardware firewall **12.** Bluetooth	**A.** This protocol tells your email application what information is needed to successfully send an email
	B. Wireless LANs connecting computers and devices using radio signals communicating through wireless access points over a short range
	C. These are installed on the user's computer and protects a single computer.
	D. A security feature on most computers and online services
	E. A set of rules that describe how data is sent between two computers
	F. Determines how the voice data should be sent and received
	G. This works by allowing any data you request or send to go through while blocking any unrequested information
	H. Any data sent between two computers is changed from something that is useful to encrypted data that looks like nonsense.
	I. This one of the protocols that is used to retrieve emails from your mail server.
	J. This protocol ensures that all data sent to and from the website is encrypted
	K. Connects devices over short distances using radio waves.
	L. This is installed between a local network and the internet and protects all the computers on the network.

6.5.2 A password is used to protect your computer from others accessing it. Answer the following questions regarding security of a computer.

a. Explain how using a password for online services can protect you.

b. List THREE ways to make your password secure.

c. What is encryption?

d. What do most websites use to enable encryption?

1. Choose the correct answer.

   a. Which one of the following best describes a blog?

      A. A website creator posts short, informal stories or articles on their website

      B. A website where the creator posts informal video stories on their website

      C. A website where the creator posts photos on their website

      D. None of the above

   b. Which one of the following is NOT an advantage of a podcast.

      A. Can be very informative

      B. Conversation is synchronous, which means a direct conversation can take place

      C. Can be professional or relaxed

      D. Good way to get a daily update

2. Match the COLUMN A with the correct answer in COLUMN B. Write down only the question number (1.1−1.10) and the matching letter (A–L) in COLUMN B, for example 1.11 K.

COLUMN A	COLUMN B
1. SMTP	A. Skype
2. Social Networking	B. Audio only broadcast released on the internet.
3. VOIP	C. Instant messaging
4. Asynchronous communication	D. Very weak processor, low quality screen and poor camera
5. Cell phone	E. Installed on a server or router that protects all the computers on the network.
6. Podcast	F. Virtual community that communicates and interacts via the internet
7. Feature phone	G. Like Wi-Fi, but has a much bigger range of up to 50 km
8. POP3	H. Protocol responsible for delivery of mail
9. HTTP	I. These phones were designed specifically to make calls and send SMSs
10. WiMAX	J. One of the protocols that is used to retrieve emails from your mail server.
11. Software firewall	K. Determines how web pages are viewed

3. Define electronic communication.

4. What is email used for?

5. List TWO netiquette rules that you should apply when sending an email.

6. What is blogging? List TWO disadvantages of blogging.

7. Give TWO differences between a smartphone and a feature phone.

8. An important part of a network is a firewall.

    A. What is a firewall?

    B. Name TWO ways that a firewall protects your computer.

    C. Briefly explain how a firewall works.

9. Your uncle is considering publicising his business on the internet and has heard that he can use either a microblog or a vlog service.

    a. Differentiate between a microblog AND a vlog service

    b. Provide an example of a microblog AND a vlog service.

10. Briefly explain what encryption is.

11. Give an example of how a bank uses encryption.

12. List TWO advantages of vlogging.

13. List TWO disadvantages of video conferencing.

14. To be able to buy tickets for transport online, a user must complete the online form shown below.

When purchasing tickets online, users need to provide personal information.

    a. State TWO precautions to prevent identity theft, which could take place during this process.

        The following error message appears when the 'Confirm Registration' button is clicked:

        Password is not strong!

    b. Suggest TWO ways to ensure that a password is strong.

15. Your brother knows that one of the biggest advantages of smartphones is that they provide access to high speed internet and the world-wide web.

    a. List TWO disadvantages of smartphones.

    b. Give TWO threats your brother's phone can be exposed to.

    c. Discuss THREE ways mobile web pages differ from their desktop pages.

SOCIAL IMPLICATIONS

CHAPTER OVERVIEW	
Unit 7.1	Effects of digitalisation
Unit 7.2	Protecting your online identity

Learning outcomes

At the end of this chapter you should be able to:
- describe the effect of digitalisation on future careers
- explain the effect of digitalisation on the workplace and employment practices
- describe ways to protect your online identity.

INTRODUCTION

Combined the computer, mobile phone, internet and the World Wide Web now affect most Western people's lives on an everyday basis. More than half of the world's population is connected to the internet in one form or another. Technology has provided an interconnectedness in society and paved the way for digitalisation.

SOCIAL IMPLICATIONS IN A NUTSHELL

Since the start of the industrial revolution in 1760, machines have been taking over human jobs. At the start, machines could only do simple manual tasks like weave a fabric or create basic hand tools. However, as time went by, machines became more and more complicated and could do more and more complicated tasks.

Figure 7.1: *In the industrial revolution, machines did simple, repetitive tasks*

In previous years the only way a person could access any kind of entertainment was to go to a movie or sit in front of the television and watch what a broadcaster chose for you to watch. Today you can not only choose what you would like to watch when with Video on Demand, you can also be a producer of your own content by uploading Vlogs, Blogs or podcasts for others with similar intersts to view and listen to.

Activity 7.1

In small groups conduct some research and discuss the following:
- How has the internet changed over the last 15 years?
- How has the internet changed society and a person's everyday life?
- How are robots used in businesses?
- What is the future for robots? How will this change society?

7.1 Effects of digitalisation

Digitalisation is the integration of digital technologies into everyday life and the computerisation of systems and jobs for better ease and accessibility. We see this mainly in the rise and effect of social media on society, businesses use of cell phones to keep up to date with their customers, and entrepreneurs starting companies. Let's look at the future of careers due to digitalisation to see how digitalisation has affected the workforce.

SOCIAL IMPLICATIONS

There are ethical and social issues with information systems to show how it has impacted society.

Our current society is very dependent on information systems which has become a part of our daily life in almost every aspect, the workplace, our private life's, the government and even to individuals with no access to these systems are affected in some way.

WHAT IS AN INFORMATION SYSTEM?

An information system (IS) is any organised system for the collection, organisation, storage and communication of information.

Impact on society:
- Sharing of Information
- Education
- Enviroment
- Political

ETHICS

Ethics is referring to the right and wrong of an individual acting on free will using choicechoice to determine their behaviour.

Not all ethical choices are the right ones and some behaviour creates social issues. This issues are related to privacy and security.

Figure 7.2: *Not all ethical choices are the right ones*

FUTURE CAREER

Many jobs face a high probability of being replaced in the forseeable future.. Automation has already replaced various jobs in manufacturing, agriculture and mining.

The table below lists and describes a few of the ICT careers.

Table 7.1: *ICT careers*

TITLE	DESCRIPTION
Digital forensic investigator	Digital forensics is the analysis of computer and electronic equipment to find evidence to be used in a legal trial or internal investigation.
3D architects and 3D printing operators (prostatic limbs)	3D architects are designers who use 3D software to create models of buildings and other structures. The process of 3D printing involves utilising computer-aided design (CAD) information to print products in layers. A 3D printing operator oversees the printing process. Examples include prostatic limbs, plastic models and cameras.
Privacy consultant	Is exactly that, a consultant who deals with the online privacy of a corporation. They assess and define system specifications in relation to compliance with data protection and privacy regulations. They follow proper data management systems and build positive relationships with a variety of stakeholders.
Medical nanobot technician	Nanorobotics is a technology field that creates machines or robots with components that are at or near the scale of a nanometre. Nanotechnology in medicine involves applications of nanoparticles currently under development research that involves the use of manufactured nano-robots to make repairs at the cellular level, this can cure cancer cells in the future.

EFFECT ON WORKPLACE AND EMPLOYMENT PRACTICES

The growth of computers and digitisation in the workplace have had a significant effect on companies, employers and employees around the world. In this section, you will learn more about the effects of artificial intelligence, robotics and automation on the workplace, as well as learn how remote and flexible workspaces are changing the way companies work.

MOBILE AND VIRTUAL OFFICES

Mobile offices are temporary offices that are designed to be transported or moved easily. These offices would be used by anyone who only needs a laptop and internet in their office. A mobile office can significantly improve the productivity of remote workers who need to travel regularly.

New companies are now specialising in providing *shared working spaces* for remote workers. These are either open-plan or closed offices that offer features you would find in a workplace such as a receptionist and boardroom, which can be rented for one or more days a week.

QR CODE

https://www.youtube.com/watch?v=HYlwYjRPbPo

https://qrs.ly/cza5qes

Virtual offices that businesses can rent are like shared working spaces. Once rented, the business gains access to a business address, conference rooms, printing and faxing services, a phone number and a receptionist. However employees will still work remotely.

DECENTRALISATION OF LABOUR

Decentralising labour means that people no longer have to be together in an office to perform many different types of jobs. This means that they can work from home and avoid drains on their time such as sitting in rush hour traffic every day. The fact that internet speeds have vastly increased in recent years means that people can still attend meetings when necessary, using video conferencing.
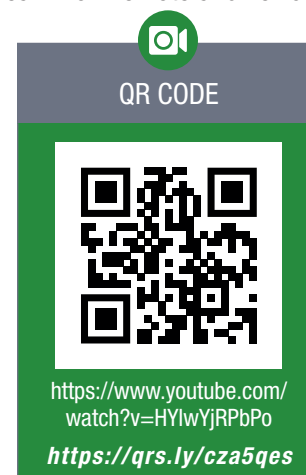
This does of course require more self discipline from staff to ensure that they do actually work, as there will not be a boss ensuring that they are working on any given day. The reverse could also become a problem as people may tend to work longer hours at home than they would in the office because they never really leave their work behind.

OFFICE AUTOMATION

Office automation is the collective hardware, software and processes that allow automation of the information processing and communication tasks in an organisation. Computer technology and software are used to digitise, store, process and communicate most routine tasks and processes in a standard office. This allows office workers to have more time for other tasks.

Automating tasks in the office can have both positive and negative effects on workers. Certain tasks can be performed more quickly and accurately using a computer, which would allow the workers to spend more time on other aspects of their jobs. Workers may be resistant to the fact that they would have to learn how to work with computing devices in order to complete these tasks and they may feel that their jobs are threatened by the devices.

ARTIFICIAL INTELLIGENCE

Artificial intelligence (or AI) refers to a field of computer studies in which programmers try to create or simulate human intelligence in machines. In the workplace, the goal of AI is to allow computers to do tasks that typically require human intelligence. This can be anything from analysing data to directing phone calls to the correct employee.
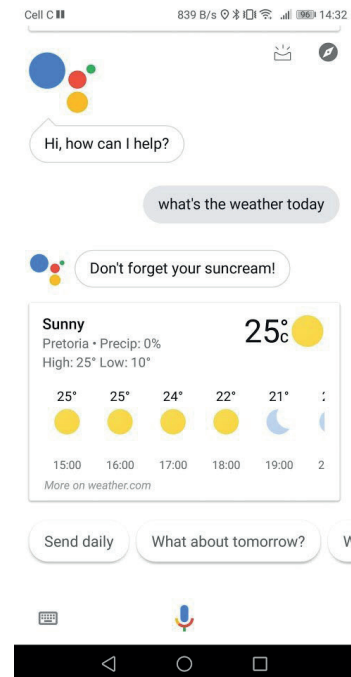

Figure 7.3: *Google Assistant can understand natural language questions*

One popular use of AI is to create chatbots that complete tasks by speaking to people in natural language. These chatbots can process questions such as, 'What's the weather today?' and give natural sounding answers like 'In Pretoria, the current weather is 25 degrees Celsius and sunny, with a forecasted high of 28 degrees and a low of 10.'

Not all AI programs have to talk like humans. Instead, some AI programs can see the world and act according to what they see. For example. self-driving cars need to constantly analyse the world around them to drive safely. At the end of 2018, Google's self-driving cars (called Waymo) have driven more than 15 million kilometres on public roads without causing a single accident. They have, however, been involved in a few accidents where humans drive into them!

Figure 7.4: *Google's self-driving cars are much safer than human drivers*

Most modern accounting packages use similar technology to automatically classify receipts and expenses. This is one example of office automation, where AI helps to automatically complete tasks that used to be done manually. Other office automation examples include:
- ordering new stock before it runs out
- paying employee salaries automatically
- giving voice directions on phones
- receiving and processing payments.

Collectively, these tasks have dramatically reduced the number of administrative staff that is needed in most offices.

Many workers are wary of Artificial Intelligence and are reluctant to embrace the technology. They justifiably fear that they will lose their jobs to a computer. People must be aware that Artificial Intelligence has not just replaced jobs, it has also created new ones such as a need for programmers to write code and devise new uses for this technology. People could find their jobs are actually made easier if some of the tasks are done by a computer.

ROBOTICS

Robots can effectively be used to perform tasks that would be too dangerous for a human to perform or that require a large degree of repetiton. They could also be used to perform tasks that require strength beyond what a human being would have.

With the combination of Artificial Intelligence and robotics, society will start to see the automation of certain tasks.

Once again, these advances will create new jobs such as the research and designing of these systems.

While AI and automation might sound bad for employees, especially in a country like South Africa with a high rate of unemployment, these changes are good for most people. As automation decreases the cost of labour, the price of goods and services go down. When people save money on these goods and services, they can spend more money on other items that then require more human labour.

An important thing to remember is that human qualities such as social, emotional, and higher cognitive skills, involving creativity, critical thinking, and complex information processing, will also become more valuable.

Activity 7.2

7.2.1 Complete the table, explain how digitalisation has affected either positively or negatively, these areas:

AREA	EFFECT OF DIGITALISATION
safety	
productivity	
accessibility	
sustainability	
privacy	

7.2.2 Read the below case studies and give your opinion about whether digitalisation has positively or negatively affected our lives. Support your choice with facts.

Case Study 1

Everyday objects such as watches, home appliances and cars are being connected to communications networks – the 'internet of Things' (IoT) – to provide a range of services and applications, such as personal healthcare, smart electricity grids, surveillance, home automation and intelligent transport

Case Study 2

Digitalisation can help in providing electricity to the 1.1 billion people who still lack access to it. In certain countries in sub-Saharan Africa, mobile phones are more dominant in homes than electricity. Mobile phones and their network cell towers, may be able to help provide access to a large type of energy services. New digital tools can also promote sustainability, including satellites to verify greenhouse gas emissions and technologies to track air pollution at the neighbourhood level.

7.2 Protecting your online identity

Privacy is defined as a person's ability to control how information about them is shared with other people or institutions. Most people intuitively understand privacy and the importance of privacy. In South Africa, the privacy of all individuals is protected in the constitution. Furthermore, the Protection of Personal Information Act (or POPI Act) ensures that citizens' personal information (such as ID numbers, addresses and telephone numbers) may only be used in very specific circumstances.

Let's look at different ways to protect your online identity:
- Exclude personal information from your social media profiles, like your phone number, address, family information or school.
- Look at your social media privacy settings
- Protect your online passwords and strengthen them.
- Use multiple passwords
- Check your phone's privacy settings,.
- Be aware of 'phishing' emails
- Check for any suspicious transactions that you didn't authorise.

Activity 7.3

Read the case studies and answer the questions.

Case Study 1

Frank Abagnale, whose life story inspired Steven Spielberg's 2002 movie Catch Me if You Can, was a professional identity thief. He netted $6 million by forging personal checks and impersonating a Pan Am pilot before being arrested in 1969.

Case Study 2

Back in 2011, former Alaska governor Sarah Palin Palin's official Twitter account at the time, AKGovSarahPalin (now@SarahPalinUSA), found itself lost in a sea of fake accounts.

In one incident, a Palin impersonator tweeted out an open invite to Sarah Palin's family home for a barbecue. As a result, Palin's security staff had to be dispatched to her Alaska residence to deter would-be partygoers.

Many public figures and politicians, like the 2016 presidential candidate Donald Trump, have a host of fake accounts assuming their identity.

7.3.1 Why is online privacy becoming more difficult to achieve?

7.3.2 In your own words, explain anonymity.

7.3.3 What were the reasons for the identity theft in each case study?

7.3.4 What measures have you put into place to protect your identity? If you haven't, explain why.

1. Explain how digitalisation is reducing the amount of staff needed for the below careers.

FARMER	
SECRETARY	
MECHANIC	
MEDICAL FIELD	

2. Provide the job description for the below careers. Explain if you would you like to work in this career.

CAREER	JOB DESCRIPTION	EXPLAIN IF YOU WOULD YOU LIKE TO WORK IN THIS CAREER
3D architect		
Privacy consultant		
Medical nanobot technician		

3. List five ways to protect your online identity.
4. Do you think companies need to protect the identities of their staff? Explain.

DATABASE MANAGEMENT

CHAPTER OVERVIEW	
Unit 8.1	Database software
Unit 8.2	Database types
Unit 8.3	Database-related careers

Learning outcomes

At the end of this chapter you should be able to:
- describe examples of database management software (DBMS)
- explain how database management decisions are made
- list and describe different database careers

INTRODUCTION

A database is an organised collection of data regarding a specific topic. More specifically, a database is an electronic system that allows data to be easily stored, organised, processed and changed.

Modern databases are managed using a database management system (DBMS). The DBMS provides users and programmers with an organised way to create, retrieve, update and manage data in a database. The DBMS basically serves as an interface between the database and end users or application programs, ensuring that data is consistently organized and is easily accessible.

An example of a database could be a database that is used to store all of the information about the books in the school library. The title, author and subject, amongst others, could be some of the details that would be kept in the database. This would allow learners to search the database for all the books written by a particular author to see if those books are in the school library.

In this chapter you will learn about different types of database management software, how to make database management decisions, and about database management careers.

Using the information learned in this chapter, you will be ready to design and create databases.

If you want to learn a bit more about how and why databases are used, you can watch the video in the QR link.

QR CODE
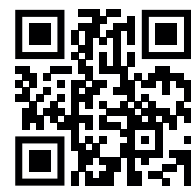
https://www.youtube.com/
watch?v=Ls_LzOZ7x0c
TRO –SHORT LINK

Database management software (DBMS) is software used to create and manage databases. DBMS software enables you to:

- create databases
- create database tables
- add new data to databases
- delete information from databases
- retrieve data from databases
- make data available to users
- make data available to applications
- create, manage and monitor users using the database.

The DBMS therefore manages the databases, the tables in the database, the data stored in the tables and the users who have access to the database.

New words

database – a collection of interrelated data. In practice, these applications do the same basic tasks, but they may do them in different ways with different levels of complexity.

A Database Management System – is a collection of programs that eneables us to create and maintain a Database. It is general-purpose software system that facilitates the process of defining, constructing and manipulating database for various applications. A database system consists of the combination of a DBMS and a database.

ADVANTAGES OF DBMS

The advantages of a DBMS are listed below:

- Data sharing
- Data Independence
- Better data integrity
- Controlled Redundancy
- Data consistency

- Data security
- Faster Application Development
- Concurrency control
- Recovery and Backup

The table below describes six examples of popular DBMS applications.

Table 8.1: *Popular DBMS software*

SOFTWARE	BRIEF DESCRIPTION
Microsoft SQL Server	A relational database management system developed by Microsoft
Oracle	A proprietary multi-model database management system produced and marketed by Oracle Corporation
Microsoft Access	A database management system from Microsoft that combines the relational database engine with a graphical user interface and software-development tools
BlackFish	A high-performance, small-footprint, SQL-92 compliant transactional database, which runs on both the .NET framework and on the Java platform
PostgreSQL	A free and open-source relational database management system emphasising extensibility and technical standards compliance
MySQL	An open source relational Database Management System

Activity 8.1

8.1.1   What is a database?

8.1.2   Explain the purpose of a database.

8.1.3   List THREE things DBMS software allows you to do.

8.1.4   Briefly describe the following DBMS software:

    a. Microsoft SQL Server   **b.** MySQL   **c.** BlackFish SQL

8.2 Database types

You can be assured that your school has some form of database that stores all of your information such as your marks, subjects, teachers and probably your address details. This database can be accessed and searched at any time to check your marks. Your teachers will also enter your marks on this system and will be able to go back to marks from previous terms to monitor your progress throughout the year.
If there is data that needs to be stored, programmers prefer to store it in a database.

This unit will briefly look at three different database decisions that should be made. These are:
- Should the database be installed on a desktop or a server?
- Should a distributed database be used?
- What software should be used?

DESKTOP OR SERVER

When planning a database, the first thing you need to consider is whether you will need a desktop or server based database. This will be determined by the following two factors:
- **Size:** How much data will be stored in the database.
- **Accessibility:** How that database will be accessed by users. Will it be accessed on the same computer every time or will it need to be accessed by many users from different locations.

A desktop database will be used for a small database that is only being accessed by a single user on a single computer. An example could be if you decided to keep a database of your movie collection.
A server database is stored on a dedicated server that is connected to the internet so that multiple users from multiple locations can access the database. A server would be required if the database held a large number of records such as the details of the customers of a cellphone company.

SINGLE USER DATABASE/DESKTOP

Its a standalone application that runs on your computer and only supports one user at a time. It runs on your local machine and all the resources are fully used by one user. e.g Microsoft Access.
- Runs locally computer
- All resources are always for the user to work.
- One or two Tier architecture
- Supports one user at a time
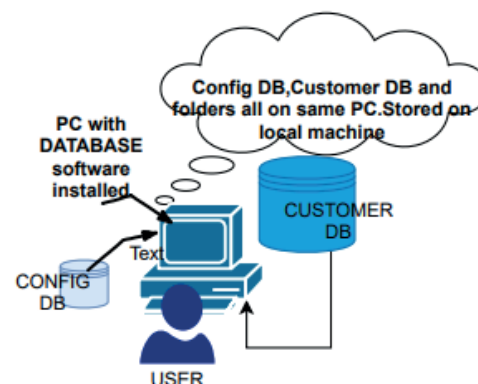
DISTRIBUTED DATABASE

It is a database that runs on a server first so all multiple users can connect to it.It can be stored locally at your organisation premises or anywhere online/cloud. All the resources that are allocated to this Database are being shared amongst all the users that are connected to it at any instatnce. It supports multi-user.
- Runs on a server locally or online
- All resources are always shared
- Supports multiple users at a time
- the two types include Workgroup and Enterprise database
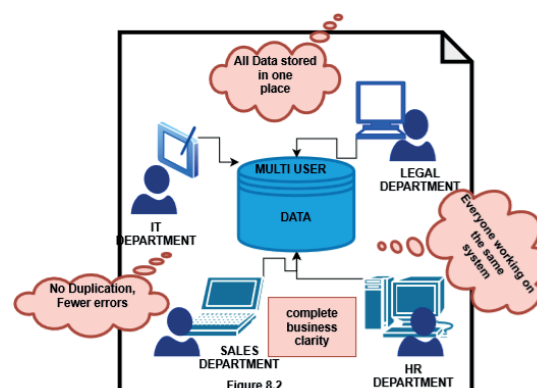
Figure 8.2

DISTRIBUTED DATABASE

A **distributed database** (like Amazon Web Services or Google Firebase) are databases that are not stored and run from a single computer (or server), but instead are stored on multiple computers at the same time. The most common examples of distributed databases are database that run on the **cloud**. Distributed databases, especially cloud-based distributed databases, are incredibly powerful since they can be expanded easily and make use of the power and bandwidth provided by multiple computers. Distributed databases are also more reliable, since the database will continue working as long as a single computer running the database stays active.

Case Study — School database

You want to create a database for your school to keep records of all the learner's marks, subjects and attendance statistics. For this application, you will need to create a database that will store a list of all the subjects offered at your school and all the learner's names. You need to decide how large the database will be, how many users will be accessing the database, how frequently the database will be updated and whether different users need to access the same database.

This database will contain a large amount of data if it contains the subjects, marks and teachers of every learner in your school.

Looking at the accessibility of the application, multiple users, being your teachers will need to access the database. This means that the database will need to be stored on a server so that all the teachers can capture the marks.

Case Study — Amazon Web Services

Amazon is known as the world's largest online shopping website, a few years ago, Amazon Web Services (AWS) was responsible for almost all of Amazon's profit for the year. Many of the world's most successful websites and web applications are hosted on AWS, including Airbnb, Netflix, Reddit and Pinterest.

Figure 8.1: *Many websites are hosted using Amazon Web Services*

Case Study   **Amazon Web Services** *continued*

This does not mean everything always goes well for Amazon! An Amazon employee one day made a typing error when running an SQL command and accidentally disabled many AWS servers. As a result, thousands of websites went offline including incredibly popular websites like Slack, Medium and Expedia. These websites stayed offline for hours while Amazon restarted the servers.

Or as a writer from USA Today described the situation: 'When Amazon sneezes, the Internet catches a cold.'

Activity 8.2

Compare the three types of databases.

	DEFINITION	SIZE	ACCESSIBILITY
Desktop/personal database			
Server/centralised database			
Distributed database			

The table below lists and describes a few of the most popular ICT careers. This includes a few careers you learned about previously, but also adds new careers.

TITLE	DESCRIPTION
Database administrator	A database administrator is the primary person involved in managing the data of a company or program. Database administrators are responsible for: • designing and building databases • providing access to the data • defining and creating users • securing the data and limiting database access as required • setting up an appropriate database backup • creating and enforcing database policies • monitoring and maintaining the database.
Database programmer	A database programmer is any employee whose primary job is to create database and database queries. Database programmers are responsible for: • create database and database structures • develop database queries • optimise database performance • responsible for data integrity in a database • maintain data security in a database.
Database analyst	A database analyst is responsible for working with companies to identify opportunities to set up and improve their data systems. Database analysts have the following responsibilities: • plan and design databases • add and remove fields from existing database • design the technical requirements of the databases • plan how the information will flow through this database.
Database project manager	A database project manager is the person who must make sure that any database projects are completed on time, at the right cost and at the right quality level. To do this, they take responsibility for: • developing project schedules • defining project goals • monitoring project schedules • monitoring and managing project quality • enforcing company standards within the project • selecting, managing, training and leading team members • developing database plans, policies and procedures for the company • managing, monitoring and forecasting the project's finances.

8.3.1 What are the main roles of the following careers, that is, what do people in those careers do?

    a. Database administrator

    b. Database programmer

    c. Database analyst

    d. Database project manager

8.3.2 If you could choose one of these careers, which would it be? Give reasons for your answers.

CONSOLIDATION ACTIVITY   Chapter 8: Database management

1. Match the COLUMN A with the correct answer in COLUMN B. Write down only the question number (1.1–1.6) and the matching letter (A–F) in COLUMN B, for example 1.6–F.

COLUMN A	COLUMN B
1. Size **2.** Desktop software **3.**	**A.** Powerful since they can be expanded easily and make use of the power and bandwidth provided by multiple computers
4. Distributed database	**B.** Amount of data that will be stored on the database.
5. Database programmer	**C.**
	D. Designed to work on a user's personal computer.
6. Database analyst	**E.** Working with companies to identify opportunities to set up and improve their data systems.
	F. Creates database and database structures

2. The database will be designed on one computer and will run on one standalone computer.

    a. What is the name given to this type of database?

    b. Give an example of a program that can be used to design the database mentioned in the previous question

    c. What is the name given to a database that is shared on the internet?

    d. Give TWO examples of programs that can be used to design the database described in the previous question.

3. While discussing the database, it is suggested that you set up a distributed database for your small office.

   a. What is a distributed database?

   b. Justify why this may not be a good idea.

   c. Suggest a more appropriate type of database for your office.

   d. Give an example of a program that can be used to design a distributed database.

   e. Will it be possible for many staff members to work on the distributed database at the same time? Justify your answer.

   f. You realise you might need the help of a database programmer. List THREE responsibilities a database programmer has.

4. Choose the correct answer.

   a. Which one is NOT a function or duty of a database administrator

      A. Managing and maintaining the database via a DBMS.

      B. Capturing and entering data in a database.

      C. Setting up and maintaining users of the database and their access rights.

      D. Performing routine maintenance on the database.

   b. Which one of the following is an example of a distributed database?

      A. Amazon web services

      B. Google

      C. Wikipedia

      D. Superbalist

5. Match the COLUMN A with the correct answer in COLUMN B. Write down only the question number (1.1–1.6) and the matching letter (A–F) in COLUMN B, for example 1.2–A.

COLUMN A	COLUMN B
1. Distributed database	A. Create database tables
	B. An example of a typical desktop database
2. Spotify	C. One example of how a DBMS is used
3. Database	
4. DBMS software	D. Responsible with working with companies to identify opportunities to set up and improve their data systems
5. Database analyst	
6. Microsoft Access	E. Databases that are not stored and run from a single computer (or server), but instead are stored on multiple computers at the same time
	F. Used to store data

6. What is a database used for?

7. List TWO factors that determine how databases are used.

8. Give ONE difference between a database on a desktop and database on a server.

9. Give THREE factors to consider when choosing a DBMS to use for the database.

10. List TWO open-source DBMS applications.

11. Give a description of a Microsoft SQL Server.

12. Look at the following DBMS systems. Indicate which type of DBMS you would use for the following situations. Motivate your answer.

    a. Sign-in and sign-out information of a company of 100 employees.

    b. An online programming course website.

    c. An online hotel booking service.

13. Discuss TWO reasons why businesses make use of the distributed database.

14. You have been appointed as a Database Analyst for the planned database of your brother's Primary School. More than 1 000 learners attend the school, you must make several presentations to the school management, teachers and governing body.

    a. One of the governing body members has suggested that you plan for a distributed DBMS instead of a server DBMS.

       A. What is a DBMS?

       B. List THREE activities that a DBMS allows you to do.

       C. Give TWO reasons when it becomes necessary for an organisation to have a distributed database.

    b. A Database Administrator will have to be appointed. List TWO tasks of a database administrator.

15. a. You want to create a database for a new online messaging app to store both the users' settings and the messages sent between users. In terms of the amount of data that will be used, it is difficult to say. Since it is a new application, you do not expect there to be millions of messages sent. However, even with just a few thousand users, you can easily see a hundred thousand messages being sent a day. The database should therefore be designed to handle large amounts of data.

    b. Describe the difference between a local database and an online database.

    c. Based on this scenario, which database would you use. Motivate your answer.

16. You need to create a database used to store the text and images for a large website. The website will need to be very reliable and be able to expand quickly as it becomes more popular.

    a. Which type of database would you choose for this scenario? Motivate your answer.

17. The following screenshot is an example of a possible database that can be used. It is created in Microsoft Access. A database analyst was asked to help with this.

Name	Surname	Age	M/F	Team	Free50m	Breast 50m	Back 50m	Fly 50m
ADRIAAN	VAN NIEKERK	19	M	Sticks	☑	☑	☐	☑
BAREND	TAUTE	19	M	Sticks	☑	☐	☐	☐
RUAAN	VD BERG	19	M	Sticks	☑	☑	☑	☑
Frederik	Engelbrecht	16	M	Anchors	☑	☑	☑	☑
ELOUISE	ROUSSEAU	16	F	Sticks	☑	☐	☑	☐
LIZ-ANGELA	ROMYLOS	16	F	Sticks	☑	☑	☑	☑
JOHAN	VISAGIE	19	M	Sticks	☑	☐	☐	☐
ELBE	VD WALT	19	F	Sticks	☑	☑	☑	☑
ANIKA	PRETORIUS	15	F	Shovels	☑	☑	☑	☑
Marco	Grond	16	M	Anchors	☑	☑	☑	☑
KRISTEN	RAUTENBACH	16	F	Sticks	☑	☑	☑	☑
CHRISTINE	ROMYLOS	14	F	Sticks	☑	☑	☑	☑

a. List TWO tasks of a database analyst.

b. Under which Database Management System (DBMS) software does Microsoft Access fall?

c. Give ONE advantage of the database described in question b).

DATABASE DESIGN

CHAPTER OUTCOMES	
Unit 9.1	Characteristics of quality data
Unit 9.2	Creating a simple database
Unit 9.3	Working with data
Unit 9.4	Setting up relationships

Learning outcomes

At the end of this chapter you should be able to:
- describe the characteristics of quality data
- describe how data should be organised in a database
- describe the characteristics that make information valuable
- design and create a simple database with a single table
- add, edit and delete data to and from the database
- process, sort and query data from the database

INTRODUCTION

In the previous chapter, you learned a bit more about databases and database management software (or DBMS). In this chapter, you will learn how to design your own databases. This includes making decisions such as:
- deciding which data to record
- deciding how to group the data
- deciding which fields to use in your tables
- deciding what type of valuable information should be stored in these fields
- deciding how to maintain data.

In fact, for every database you design, you will be faced with hundreds of choices, layouts and decisions. These decisions can often make it feel overwhelming to start working on a database. The goal of this chapter is to not only give you guidelines that will help you to create the best possible database, it will also show you how to complete each step along the way. By the end of the chapter, you will have created a database that can be used, as it is, in an instant messaging application.

DATABASES

Data is unprocessed numbers, signals or facts and in order for humans to use it and for computers to share it, the data needs to be processed and organised into meaningful information. One way in which data is shared amongst people is by the use of letters and characters.

Once data has been processed into information, this information can be interpreted to provide knowledge, which allows yoou to make decisions based on that knowledge.

A database is designed to store data (facts), these facts are organised within the database so that they can be sorted or extracted in response to a user's requirements which will allow them to make a decision.

For example, your school probably has a database containing the details all of the books in your school library, with data such as author, subject, title, ISBN number, and so on.

If you were given a History project to research the history of your city, you would be able to search the database for books on written about this subject. With a list of the available books the database provides, you would be able to decide which of them to use for your research to get the information you required for your project.

| Activity 9.1	Revision activity

9.1.1 Define data.

9.1.2 Your school has a database that records your marks throughout the year. Explain how this data could be used to extract information that could allow her to make decisions regarding your achievements at school.

Let's first clarify the different terms that will be used and how they relate to each other:

- Data is raw material; and information is when data is organised and presented by someone. For example, if I take individual pictures of all the learners in your school, the collection of photographs is data. When the photographs are re-organised into each class unit, then the photographs become information.
- Knowledge is information read, heard, or seen, and understood.

These three elements help a person to make beneficial decisions.
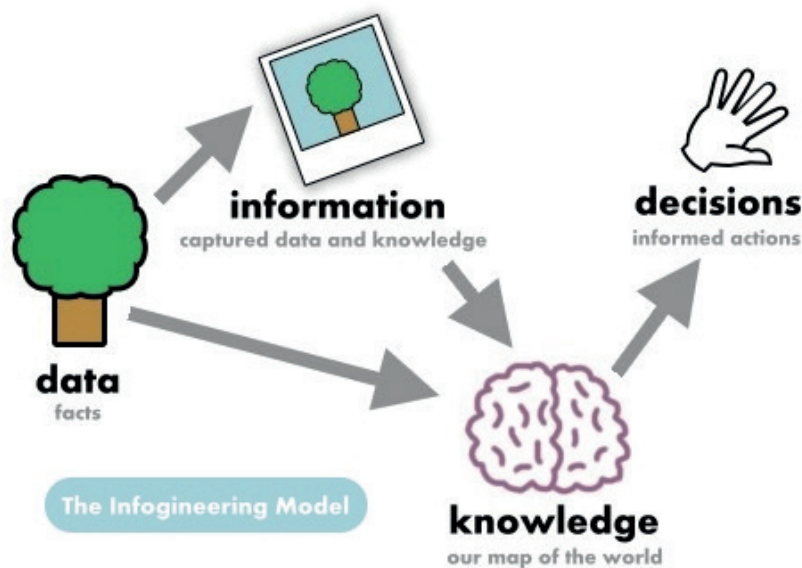
In order for the computer to use the data to produce accurate results that allow decision making, the data has to be of a good quality.

The table below summarises the characteristics of quality data.

Table 9.1: *Characteristics of quality data*

CHARACTERISTIC	DESCRIPTION
Accurate	It is important that the data in your database is accurate, which means both error-free and precise. If you created a weather database, then recording the wrong prediction for the wrong day may result in people expecting sunshine instead of rain. Similarly, recording a comma inaccurately is the difference between a weather prediction of 27,2 °C (a nice warm day) and 2,72 °C (a very cold day)! High quality data must be accurate.
Correctness	Inaccurate data is the downfall of a database, you might as well not have any data. This is the basis of decision making, incorrect data will lead to incorrect decisions.

CHARACTERISTIC	DESCRIPTION
Current	For the data to be of high-quality, it is important that it is up-to-date. If you fail to keep your data current, then you run the risk that it will no longer be relevant or accurate. For example, if the data in your weather database is a few weeks old, no-one will use your weather application because the data is not current!
Complete	In a database, incomplete data is almost as bad as inaccurate data. Gaps in the data can cause the data to be difficult to use, outdated and misleading. If, for example, your weather database has gaps and misses a few days, people will stop using it. Even worse, if your weather database is used for research on droughts, and it failed to record a few days in which it rained, researchers will get an inaccurate understanding of the weather!
Relevant	Good quality data is relevant to the people who are using it. If you are making a South African weather app, then your database should contain South African weather data. Filling the database with the weather data for the world's 100 largest cities is not useful if there are only four South African cities on the list.
Consistent	The data in your database should be consistent, which means the data in one part of your database should not contradict or differ from the data in another part of your database. For example, your weather database might collect the weather prediction from many different websites. In this case, your data will be inconsistent if some websites give the temperature in degrees Celsius while others give the temperature in degrees Fahrenheit, since the same physical temperature will be recorded with different values.

VALIDATE YOUR DATA

Data validation refers to the process in which you check whether the data is accurate, in the correct format or of the correct type before recording it in your database. This ensures that the data in your database is consistent and accurate. Since data validation is usually created by a programmer, there are thousands of different types of data validation that can be done. However, the following are some of the easiest and most useful ways to validate data:

- **format check:** A format check ensures that the data is in the correct format. This can be used to ensure that an email address contains an @ sign and ends with a country code.
- **data type check:** A data type check ensures that the data is of the correct data type (e.g. string, integer, double or datetime).
- **range check:** A range check ensures that the data falls within a specific range. For example, if a range check can be used to ensure a student's grade is set between 1 and 12.
- **check digit:** A digit check ensures that the data is a specific number of characters long before it is recorded. This is useful for data like phone numbers or ID numbers.

DATABASE DESIGN TIPS

Using the information, you learned in the previous two sections, you should be equipped to determine what you need to create a database. In this section, you will learn how to do this by following these simple rules:

1. Accessing data
2. Validate your data
3. Standardise your data
4. Use effective names
5. Manipulating and grouping data
6. Be careful with calculated fields
7. Have one source of truth

ACCESSING AND MANIPULATING DATA

In general, there are two ways to obtain data for a database:

- With manual data collection, the data is collected and entered into the database by hand. This can be very time consuming, but is often the only way to capture data, especially if you are the first person to create the data. For example, when Blizzard created *World of Warcraft*, they had a team of video game writers who wrote millions of lines of dialogue for the game. These lines were then manually captured in one of the games databases.
- With the electronic collection of data, data is automatically obtained from an electronic source and added to a database. For example, Facebook automatically records every status update, comment and like on their website and stores it in a database. With more than 1,2 billion status updates and comments per day, recording these updates manually would be impossible. The disadvantage of electronic data collection is that it usually requires significant programming to set up and mistakes can easily be introduced in the data. However, once it is set up it allows incredible amounts of data to be collected quickly.

For the rest of the chapter, you will work towards building a database for a new messaging app called *Secret Messaging Service* (or SMS for short).

While it would be awesome to build a database capable of handling 1,2 billion messages per day, the goal of the chapter is to build a proof of concept database that can be used to work with a prototype of your application. At the most basic level, the database will need to store the details of different users, as well as the messages sent between the users.

QUALITIES OF VALUABLE INFORMATION

A second important aspect to consider is what data is valuable to record. When designing a database, it is easy to go overboard with the information you collect, so you start asking users additional questions (like age, phone number and address) just so that you can add the information into your database. Once in your database, the data lies there, increasing the size of your database without ever being used.

This problem suggests three important questions to ask yourself when creating a database:
- Will I ever use the data in this field?
- What fields do I need specifically for my application?
- What fields would I need for my application in the future?

Based on these three questions, you can determine whether certain types of information are valuable to the application and should be recorded and stored in the database.

HOW TO GET TO INFORMATION

HAVE ONE SOURCE OF TRUTH
This links to redundancy and consistency issues discussed in the previous sections, but a database should only have one source of truth. This means that both consumers and database users should never be confused about where the data comes from or which data is real. This has a few implications for you as a designer:
- the same data should not be recorded in more than one place
- unused tables and fields that can be confusing (such as "song_id_old", or "song_id_2") should be removed
- tables that are automatically created by combining other tables should be labelled clearly
- numbered tables (like "users_1" and "users_2") should either be combined into one table ("users") or renamed more clearly ("users_south_africa" and "users_rest_of_africa").

STANDARDISE YOUR DATA
As you learned earlier in this chapter, the data in a database should be consistent. One way to achieve consistency is by standardising your data so that certain fields always look and work in the same way. For example, imagine that you are building a database for the school and you need to capture the grade a student is in. If multiple people enter the values, you may end up with non-standard data, like:
- "5th Grade"
- "5"
- "Grade 5"
- "5th"

If you would like all the data to use a format like "5th Grade", you could enforce this using data validation. You could also set the field to only accept numbers or integers (like 1, 2 and 3) and then link this field to a different table where 1 is equal to "1st Grade" and 2 is equal to "2nd Grade".

There are many ways of standardising your database, so it is up to you to choose a method that works.

USE EFFECTIVE NAMES

Your tables and fields should use effective names that make sense and are easy to understand. Working with a database where all the tables are called "Table 1", "Table 2" and so forth is not best practice.

When choosing names:
- choose descriptive names
- choose simple names
- avoid abbreviations
- do not use numbers in the name
- do not use spaces in the name
- do not use strange characters in the name (other than underscores)
- use a consistent naming pattern

Field names and table names are also usually written in lowercase (so user_name rather than UserName).

MANIPULATING AND GROUPING DATA

Data, and especially complex data, should be broken into smaller logical pieces and grouped according to the chosen categories. This allows you to work with the data more easily. For example, it is usually better to store people's first name, middle name and last name separately, rather than as one long string in a single field. This allows you to use those items individually.

A database table (datasheet) is composed of records and fields that hold data. Each table in a database holds data about a different, but related, subject.

Data is stored in records. A record is composed of fields and contains all the data about one particular person, company, or item in a database.

A field is part of a record and contains a single piece of data for the subject of the record.

The primary key of a table is a field that is used to uniquely identify each record in a table. Microsoft Access automatically creates a primary key field called "ID" for each table. This field type is set to *AutoNumber*, which means it will automatically increment a unique number for each record. In general, it is a good idea to keep this field. However, ID is not a good, descriptive name so it should be changed.

Since the "username" is also a unique field, it is a good alternate key for your users table. An alternate key is a field that also uniquely identifies each record but is not the primary key.

STUDENT NAMES
James Bertus Jones
Mandisa Mpho Khoza
Chantel Jantjies
Linda Lerato Radebe

FIRST_NAME	MIDDLE_NAME	SURNAME
James	Bertus	Jones
Mandisa	Mpho	Khoza
Chantel		Jantjies
Linda	Lerato	Radebe

Figure 9.1: *Data should be broken into smaller, logical pieces*

By breaking the data into logical pieces, you can send a customised greeting message like "Welcome, John!". If the data is grouped, you would need to create a string handling script to find the first name.

BE CAREFUL WITH CALCULATED FIELDS

Calculated fields are incredibly useful since they allow you to automate large parts of your database. For example, rather than entering a student's score on four tests and her average, you could create a field that automatically calculates the average. However, you need to be careful when doing this to ensure that the field will give the correct answer in all situations.

To understand the problem, look at the following set of marks and average:

TEST 1	TEST 2	TEST 3	TEST 4	AVERAGE
50%	75%	75%	100%	75%

In this example, the database correctly calculated an average of 75%. Now, imagine that instead of scoring 50% for the first test, the student failed to write the first test. Your database now looks as follows:

TEST 1	TEST 2	TEST 3	TEST 4	AVERAGE
	75%	75%	100%	?

What do you think the average should be? Depending on how you design the calculated field, the average could be 62.5%, it could be 83.3%, or you could receive an error. Since only one of these values will be correct based on the school's rules, you need to think carefully about how you program the field to ensure it always gives the correct answer.

Activity 9.2

9.2.1 For each question, select the correct answer.

  a. Which one is a characteristic of quality data?

    A. Accuracy

    B. Sensitivity

    C. Punctuality

    D. Readability

  b. Which characteristic to quality data does this statement refer to? The data in one part of your database should not contradict or differ from the data in another part of your database.

    A. A. Currency

    B. B. Accuracy

    C. C. Consistency

    D. D. Relevancy

  c. You are creating a database for a South African news website. If the database only contains news from Europe, the database will have poor …

    A. Currency

    B. Accuracy

    C. Consistency

    D. Relevancy

  d. After creating your news website database, you realise the database only updates once a week. Unless this problem is fixed, the database will have poor …

    A. Currency

    B. Accuracy

    C. Consistency

    D. Relevancy

  e. After the website has been running successfully for a few months, a friend asks you to go hiking with him in Lesotho. When you reach your destination, you find out that there is no Internet and you cannot update your website. Once you get back home, you need to add the missing data to ensure your database has a good …

    A. Currency and completeness

    B. Accuracy and currency

    C. Consistency and accuracy

    D. Relevancy and consistency

9.2.2 What are the five characteristics of a good database?

9.2.3 List the characteristic(s) of quality data that are missing in the following database examples.

  a. A database for currency exchange rates that is updated every month.

  b. An African weather app with weather details for Australia.

  c. A classroom list of attendance with the names of students' pets.

  d. An exercise application that takes your height.

9.2.4 What is data validation?

9.2.5 Suggest one form of data validation for each of the four fields. Give reasons for your answers.

Look at the "movies" table from the previous unit.

ID	TITLE	INCOME_BILLION	GENRE	STUDIO_NAME	STUDIO_LOCATION
1	Avatar	R39.0	Science fiction	Fox	Los Angeles, United States
2	Titanic	R30.6	Historical drama	Paramount	Los Angeles, United States
3	Star Wars: The Force Awakens	R29.0	Science fiction	Disney	Hollywood, United States
4	Avengers: Infinity War	R28.7	Superhero	Disney	Hollywood, United States
5	Jurassic World	R23.4	Action	Universal	Los Angeles, United States
6	Marvel's The Avengers	R21.3	Superhero	Disney	Hollywood, United States
7	Furious 7	R21.2	Action	Universal	Los Angeles, United States
8	Avengers: Age of Ultron	R19.7	Superhero	Disney	Hollywood, United States
9	Black Panther	R18.9	Superhero	Disney	Hollywood, United States
10	Harry Potter and the Deathly Hallows Part 2	R18.8	Fantasy	Warner Brothers	Hollywood, United States

9.2.6 What is the difference between data, information and knowledge? Provide your own example.

9.2.7 What is the aim of grouping data?

9.2 Creating a simple database

The first step to building the SMS database is to create the database. To do this, you need to:

1. install database software
2. create the SMS database
3. create the first table.

Since this database will be used for **rapid-application development** (RAD), we will use Microsoft Access to create it. Microsoft Access is an easy to use DBMS with a *what you see is what you get* (abbreviated as **WYSIWYG**) user interface. This means you can create the database visually and you can see the changes to the database as you make it.

However, as a programmer you will be working with databases for the rest of your life, which means you will be using SQL for the rest of your life. This database is an excellent opportunity to start using SQL, so the SQL command for each still will be shown. At the end of the chapter, the same database used throughout the chapter will be recreated quickly in SQL, with each line of code explained.

AS YOU BEGIN WORKING WITH DATABASES, YOU WILL NEED TO KNOW THE FOLLOWING KEY TERMINOLOGY:

Field: A field is part of a record and contains a single piece of data for the subject of the record.

Primary Key: A field that uniquely identifies each record in the table.

Composite/Combined Primary Key: Is a set of more than one key that, together, uniquely identifies each record.

Foreign Key: A foreign key is a primary key in one table that appears as a field in another table.

Data-types of fields: The fields within a database often require a specific type of data to be input. Data-type that each field stores has to be declared/set. Common datatypes are: text, number, data, time Yes/No,etc.

Record: A record is composed of fields and contains all the data about one particular person, company, or item in a database

Table: A database table is composed of records and fields that hold data. Each table in a database holds data about a different, but related, subject.

Relationship: Is a situation that exists between two relational database tables when one table has a foreign key that references the primary key of the other table. Relationships allow relational databases to split and store data in different tables, while linking disparate data items.
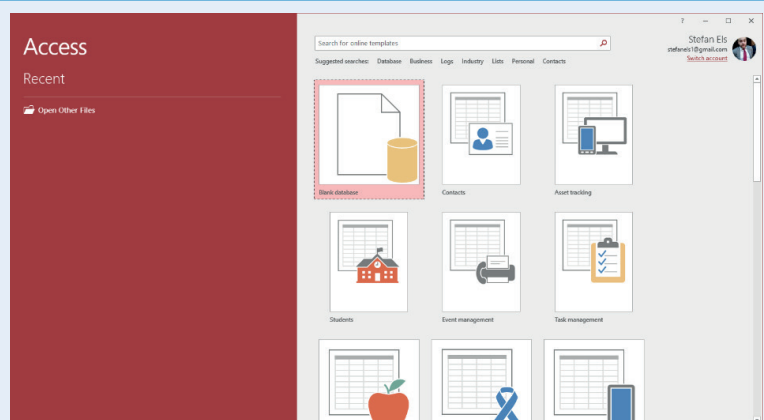
CREATING A DATABASE

Now you are ready to create your first database.

Example 9.2.1   Creating a database in Access
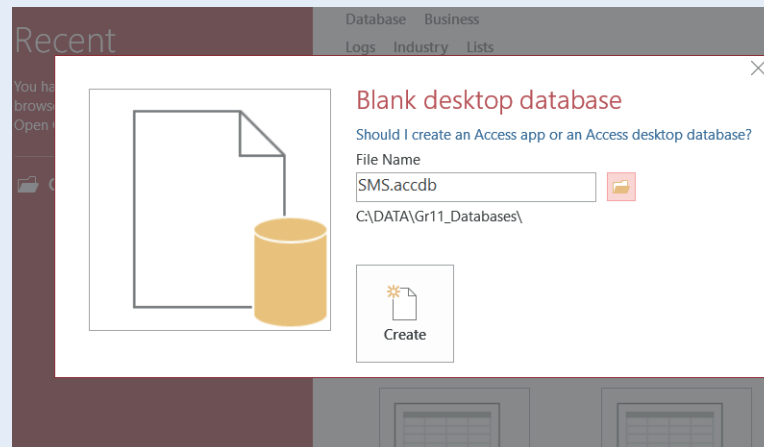
To create a database in Microsoft Access:

1. Open the Start Menu and search for "Access".

2. Click on the *Access* item to open the application.

Example 9.2.2   Creating a database in Access *continued*

3. Once *Access* is open, double click on the *Blank database* option in the main window.

4. Enter the name "SMS.accdb" in the *File name* text box at the bottom of the *File New Database* window.

5. In the window that opens, click on the Open icon next to the *File Name* text box.

6. In the *File New Database* window that opens, select an appropriate folder to save your database and click *OK*.
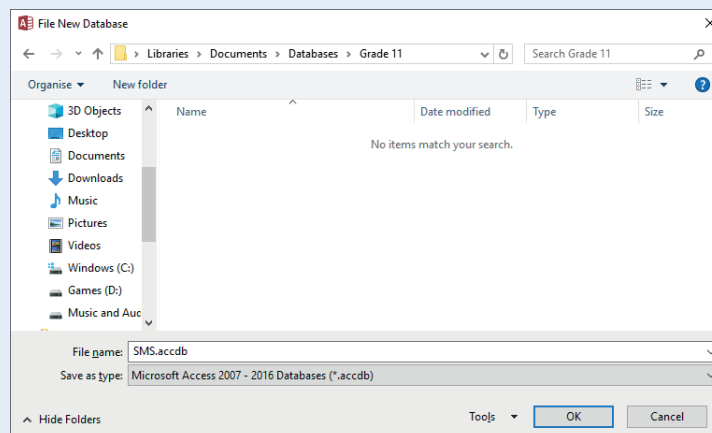
7. Click OK to close the window, then click on the *Create* button to create the database.

    The SMS database should now open in Access.

    Congratulations, you have just created your first empty database!

DESIGN THE TABLE(S)

Now that your database has been created, you can start thinking about your first table. However, before you can create it you need to answer these four questions:

- What table are you creating?
- Which fields will you include in your table?
- What data type will each of these fields be?
- Which column will be the primary key for your table?

Let's work through these questions and the practical steps one-by-one.

TABLE

You must choose which of two tables to create first: "users" or "messages". The "users" table will contain all the users' information, while the "messages" table will contain the messages sent between users.

There are two possible approaches:

- Create the central table of your database first, because this is the most important table in your database. In the SMS database, the "messages" table contains the most important data in your table, so it would be the central table of your database.
- Create the table that is not dependent on any other tables first, because this table can be created without relying on any other tables. In the SMS database, the "users" table is independent of the other tables, since you can know who the users are without having any messages, but you cannot have messages without knowing which users sent them.

For this example, we will follow the second, more common, approach and create the users table first.

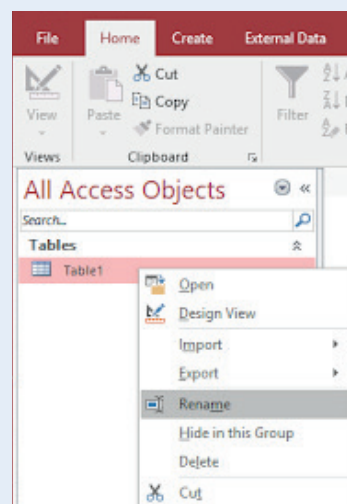| Example 9.2.3 | Renaming an existing table in Access |

If Access automatically created an empty table for your database. This default table is called "Table1" and can be found in the *All Access Objects* panel on the left side of Access.

To rename the "Table1" table to "users":

1. Open *Access.*

2. Inside *Access*, open the "SMS.accdb" file. You should see the file in the *Recent* panel on the left of the *Access* window. If not, click on the *Open Other Files* button and open it from the folder where you saved the database previously.
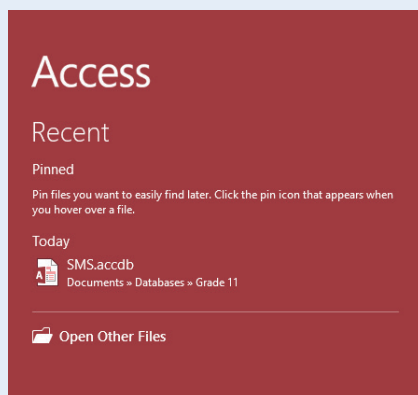
3. Find the "Table1" table in the *All Access Objects* panel on the left side of Access.

4. Right click on this table and select the *Rename* option. Note, you could also use the F2 hotkey to rename the table.
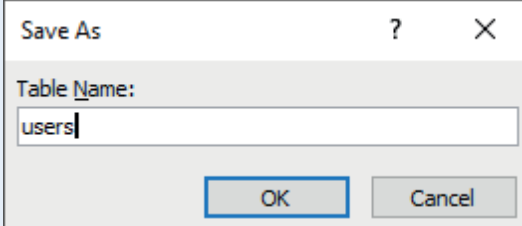
Example 9.2.3   Renaming an existing table in Access *continued*

5. Enter the name "users" for the table and press Enter.
6. Click on the *Save* icon 🔲 to save your database.

Take note, when creating a new table, you may be unable to rename it immediately. However, by pressing on the *Save* icon, Access will ask you to enter a name for your database. You can use this opportunity to rename it.
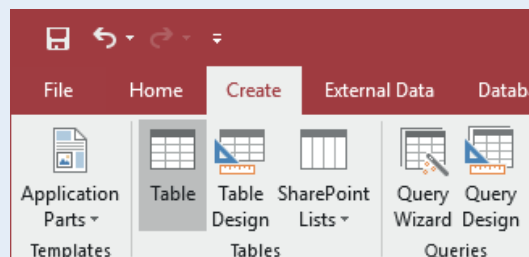
Save As	?	×
Table Name:		
users		
	OK	Cancel

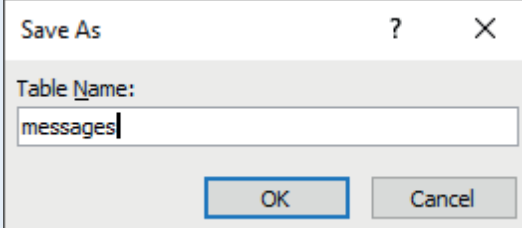Congratulations you have just renamed the existing default table "table1" to "users"!

Example 9.2.4   Creating a new table in Access

You may not always have an existing table to rename. To create a new table in Access:

1. Open Access and the "SMS" database.
2. Open the *Create* ribbon at the top of the Access window.
3. Click on the *Table* option.

File	Home	Create	External Data	Databa
Application Parts ▾	Table	Table Design	SharePoint Lists ▾	Query Wizard	Query Design
Templates		Tables		Queries

4. Save the database using the CTRL + S hotkey.
5. In the dialogue box that opens, enter the name "messages" for the table and press the *OK* button.

Save As	?	×
Table Name:		
messages		
	OK	Cancel

Congratulations you have just created a new table!

FIELDS

The next decision you need to make is about the fields to include in the "users" table. Since your application is called *Secret Messaging Service*, you should probably not collect too much information about your users. Instead, you should ask yourself what the least amount of information is that you need to make your application work.

For your application to work, the only fields that you require are:
- username
- password.

It is possible that, in the future, you may want to use email to authenticate user accounts (like Facebook) or link user accounts to phone numbers (like WhatsApp), but for now you do not need either of those fields.

However, before you can create your two fields you need to select a data type for them.

FIELD DATA TYPES

In the previous section, you decided that your table will have two fields: "username" and "password". Both fields will therefore potentially contain a combination of letters, numbers and symbols. This means that both the fields should be text fields. Since neither the username nor the password should be longer than 255 characters, both fields can be *Short Text* fields in Access.

| Example 9.2.5	Creating fields in Access

To create the two short text fields:
1. Open Access and the "SMS" database.
2. Inside the "SMS" database, click on the *users* option in the *All Access Objects* panel to open your *users* table.
   You should now see an empty table.
3. Click on the *Click to Add* option at the top of your table.
4. Select the *Short Text* option.
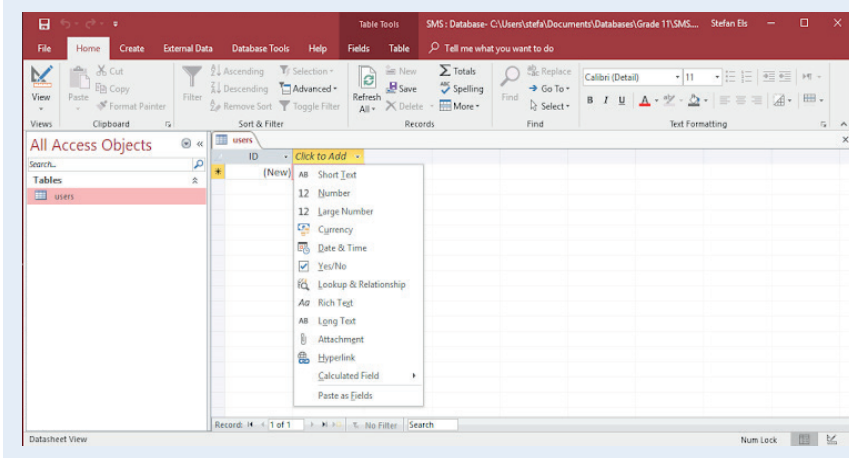
Example 9.2.5 — Creating fields in Access *continued*

5. Enter "username" to create the username field.

6. Select the field and click on the *Fields* button at the top of the *Access* ribbon (under *Table Tools*).

7. In the *Fields* ribbon, tick the *Required* and *Unique* buttons. This will make sure that each user has a username and that all usernames are unique.
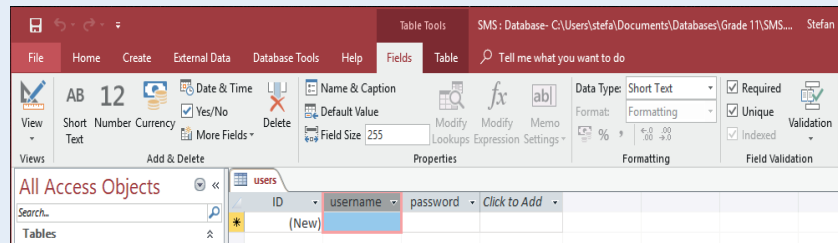
8. Using the *Fields* ribbon, change the *Field Size* of the "username" field to 30. This will limit the number of characters that can be entered into this field to 30.

9. Repeat the process for your second field and call it "password". The password field should not be unique, since users are allowed to have the same password.

10. Set the *Field Size* of the password field to 20.

11. Save your database using the CTRL + S hotkey.

Congratulations, you have just created your first two fields in Microsoft Access!

Example 9.2.6 — Changing the primary key field name

To change the "ID" field's name:

1. Open the "users" table of your "SMS" database.

2. Right click on the "ID" field and select the *Rename* option.

3. Enter the name "userid" and press Enter.

Congratulations, you have just renamed your primary ID field and finished creating your first table! To do this, you had to create the table, create two fields and select their data types. You also had to make sure that the entries in the username field were unique and required, and that passwords were required.

The database should now look like this:
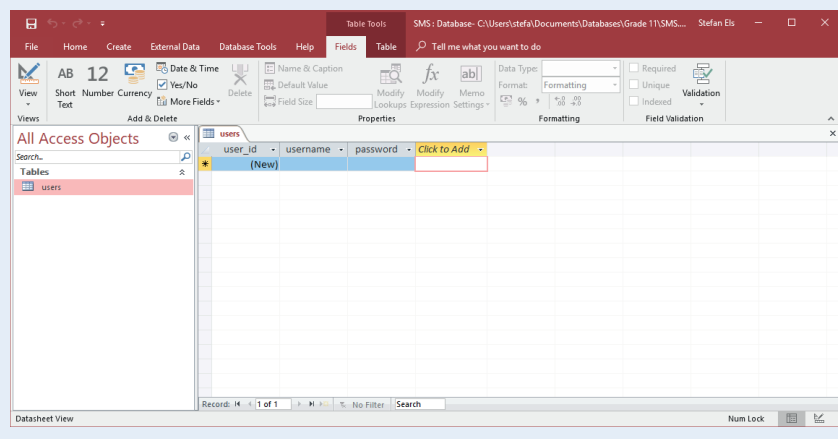
With your username and table created, you are ready to start adding data to it.

In the next unit, you will learn how to add data, edit data and delete data from your table.

Activity 9.3　Creating a database

9.3.1 You have been asked to create a book database for your local library. The database needs to store the following information:

Book name

Language

Release date

Publisher name

Copies in library

Author name and surname

Date of birth

Nationality

Based on this scenario, answer the following questions.

a. How many tables will you need to record this information?

b. What will the tables be called?

9.3.2 Your school is trying to build a database of all the students and their sports. You have been asked to update the school's database to record this information. This will consist of adding the following fields:

Student name and surname

Birthdate

Grade

Sport

Team

Team coach

Practice days and times

a. How many tables will you need to record this information.

b. What will the tables be called?

c. Do the fields include a primary key?

d. Can student name and surname be used as a primary key? Give reasons for your answer.

e. Which of the fields above are not atomic? How would you split these fields?

9.3.3 Complete the following tasks for both databases.

a. If required, install the database software on your computer.

b. Create the "books" and "sports" databases.

c. Add the required tables to the databases.

d. Add fields of the correct type to the tables.

Now that you have a database, you need to test whether it will work in your application. At this stage in the rapid application development cycle, you are not ready to give the application to your friends so that they can create their own usernames. This means that, to test the database, you will need to add your own **mock data**.

In this section you will learn how to add data, change data and modify data in your database.

ADDING DATA TO A TABLE

To test your database, you should add the following five users to your table.

USERNAME	PASSWORD
LovelyLethabo	P@ssw0rd
K!ll3r	Pupp!3s
Shadowzzz	password
stefan	SimpleDistantNear
JK	St@rt123

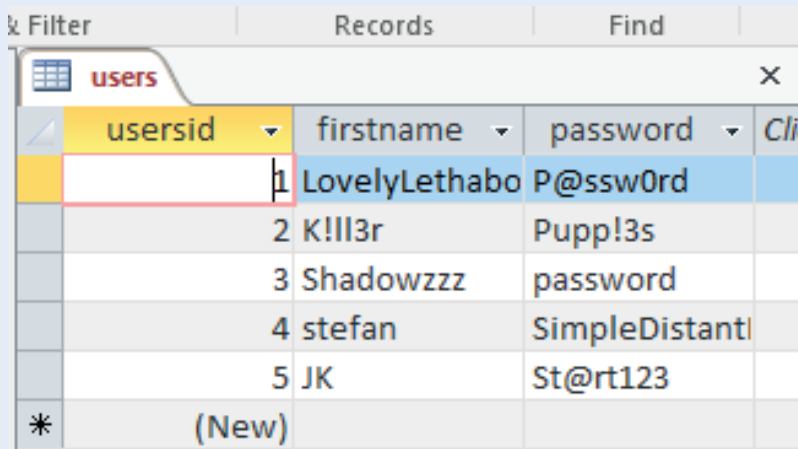**Example 9.3.7**   Adding data to your table in Access

Now that you have your data, you can add it to your table. To do this:

1. Open the "users" table of your "SMS" database.
2. In the first cell of the "username" column, enter "LovelyLethabo" (without the quotation marks) and press Enter.
3. In the first cell of the "password" column, enter "P@ssw0rd" and press Enter.

Adding data to your table in Access *continued*

4. You have just added your first record! Did you see that the userid incremented automatically?
   Repeat this process until you have added all five records to your table.

5. Click on the *Save* icon ⊟ (or press the CTRL + S hotkey) to save your table.
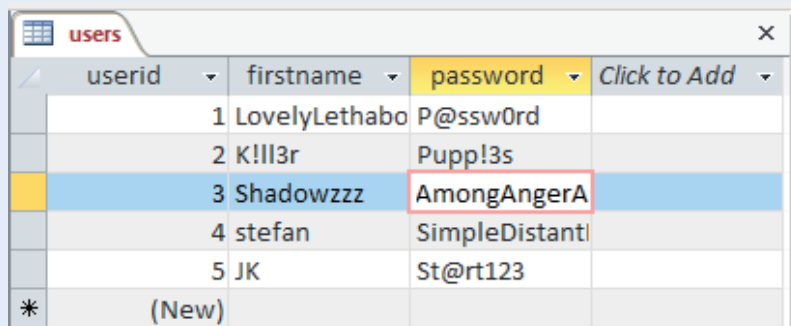
EDITING DATA ON A TABLE

After telling the user "Shadowzzz" that "password" is the least secure password in the world, he has asked you to change his password to "AmongAngerAgainst".

Example 9.3.8   **Modifying data in Access**

Fortunately, modifying data is incredibly easy in Microsoft Access. To change Shadowzzz's password:

1. Open the "users" table of your "SMS" database.

2. Find the record with the username "Shadowzzz" and click on its password.

3. Enter the new password: "AmongAngerAgainst"

4. Save the database by using the CTRL + S hotkey.

You can change any value in your table like this, as long as the new value meets the requirements of the field.

DELETING DATA FROM A TABLE

After using your SMS application for a while, the user LovelyLethaba asks to be removed from your database.

Example 9.3.9   Deleting records in Access

To delete LovelyLethaba's record from your database:
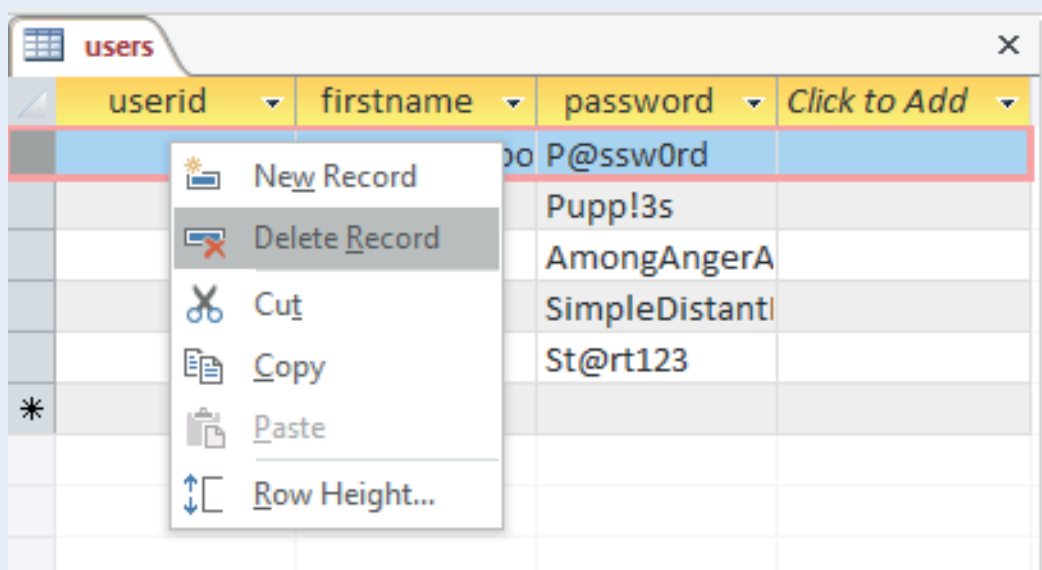
1. Open the "users" table of your "SMS" database in Microsoft Access.
2. Right click anywhere on LovelyLethaba's record.
3. Select the "Delete Record" option.

Congratulations, you have just removed a record from your database!

In general, you should think carefully before deleting any records. Since databases are relational, deleting a field on one record might cause errors on many other tables. In general, it might be better to add a **Boolean** field to your table that you can use to enable or disable users. You should also think carefully before deleting any tables from a database. Once a table has been deleted, it is gone forever! Unlike many other actions, you cannot use the Undo button to correct your mistake if you accidentally a table.

Activity 9.4   Working with data

9.4.1 Choose the answer and write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. Change the underlined word(s) to make the statement TRUE. (You may not simply use the word 'NOT' to change the statement.)

    a. You should think carefully before <u>deleting</u> any records. Since databases are flat, <u>deleting</u> a field on one record might cause errors on many other tables.

    b. It might be better to add a <u>Boolean</u> field to your table that you can use to enable or disable users.

    c. Once a table has been deleted, you <u>can</u> use the UNDO button to correct your mistake if the table was accidentally deleted.

9.4.2 **a.** Give a step-by-step procedure of how you would add someone with the username "Fahd_here" and password "MyKitt3n$f00D" to your messaging database.

    b. Let's say they want to change their username to I.am.Fahd, how will you do that in the database?

9.4.3   **a.**   Add the following data to your "books" database.

BOOK	LANGUAGE	RELEASE	PUBLISHER	COPIES	AUTHOR	BIRTH DATE	NATIONALITY
The Lord of the Rings	English	29/07/1954	Allen & Unwin	7	JRR Tolkien	01/03/1892	South African
Le Petit Prince	French	15/04/1943	Gallimard	2	Antoine de Saint-Exupéry	29/06/1900	French
Harry Potter and the Philosopher's Stone	English	26/06/1997	Bloomsbury	15	JK Rowling	31/07/1965	British
The Hobbit	English	21/09/1937	Allen & Unwin	5	JRR Tolkien	01/03/1892	South African
And Then There Were None	English	06/12/1939	Collins Crime Club	4	Agatha Christie	15/09/1890	British
Dream of the Red Chamber	Chinese	01/01/1791	Unknown	1	Cao Xueqin	31/12/1715	Chinese
The Lion, the Witch and the Wardrobe	English	16/10/1950	Geoffrey Bles	6	CS Lewis	29/12/1898	British
Harry Potter and the Chamber of Secrets	English	02/05/1998	Bloomsbury	11	JK Rowling	31/07/1965	British

Take note, the table above should not be added to your database as it is. Instead, the data should be placed in the correct fields and tables of your database.

b.   Add at least ten records based on your own school to the "sports" database. Make sure to include records for both tables.

9.4 Setting up relationships

Having successfully created your first table and added data to it, you are ready to create additional tables and set up the relationships between them. In this unit, you will therefore learn how to:

- plan the relationships between your tables
- create additional tables
- create the relationships.

DESIGNING RELATIONSHIPS

To plan the relationships between your tables, you can create an entity relationship diagram (ERD). These diagrams show the tables in your diagram, the fields in each table, and the relationships between the fields of different tables. This section will look at how an ERD can be drawn in two phases:

- first, the tables will be drawn
- second, the relationships between the tables will be drawn.

DRAWING THE TABLES

To see how to create a table in an ERD, you can start with the first table in your database.

Example 9.3.10 Creating an ERD for your first table

An ERD is used to map the relationships between your tables. To create an ERD for your first table:

1. On a piece of paper, draw a square with enough space to list all the fields of your table.
2. Inside the square, at the top, write down the name of your table ("users").
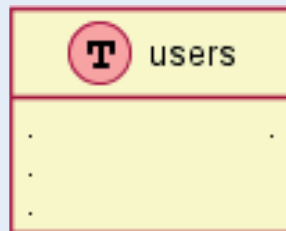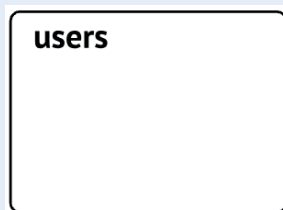
3. Underneath the table name, make a list of all the table's fields.
4. Draw a line between the table's name and the table's fields, as shown in the image below.
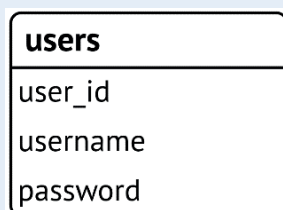
5. On the right-hand side of the square, write down the data type for each field.
6. Draw a line between the field names and their data types.

Congratulations, you have just created the first table for your entity diagram! In the next example, you will plan the remaining tables for your database using an ERD.

QR CODE

http://plantuml.com
TRO –SHORT LINK
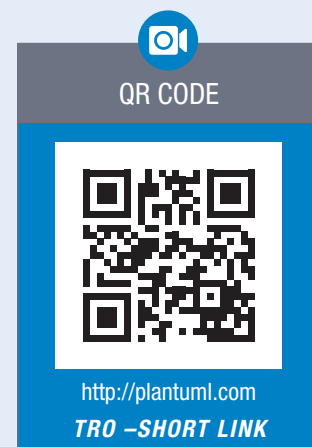
The second table of your ERD should be the "messages" table that will be used to capture and store all the messages sent between users of your application. Before you can draw the table on an ERD, you first need to decide which fields to create for this table. Based on the description of the table, the table requires at least three fields:

- message (text)
- senderid (integer)
- receiverid (integer)

Using information, you can link each message to a specific sender and receiver based on their unique user IDs. However, without recording when the message was sent, the messages may not appear in the correct order in your application. You should therefore add a fourth field (called **timestamp**) to your table. You should also add a "messageid" primary key to your table, to ensure that each message can be uniquely identified.
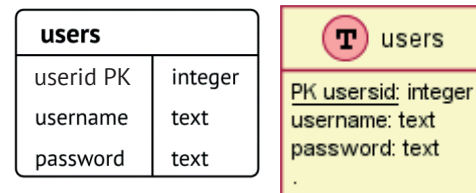

Example 9.3.11   Adding the "messages" table to the ERD

To add the "messages" table to your ERD:

1. Draw a second square on your piece of paper.
2. Add the table name ("messages") to the top of the square.
3. List the four fields on the left side of the square, and their data types on the right side of the square. Take note, the "timestamp" field's data type will be *datetime*.
4. Draw the lines between the table name, field names and data types.
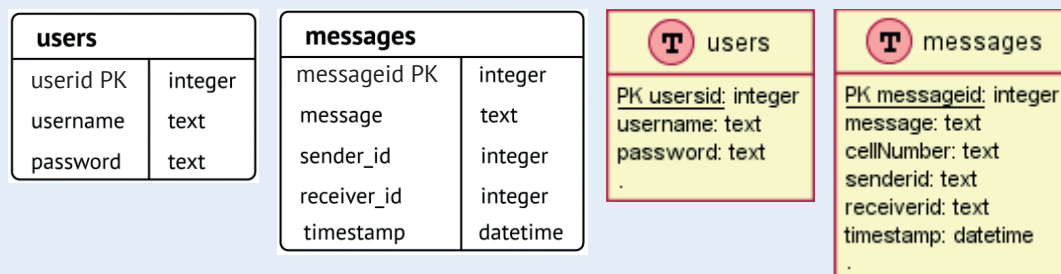
Your ERD should now have two tables on it (as is shown below).

DRAWING THE RELATIONSHIPS

Two tables can have three different types of relationships. They are:

- **one-to-one:** With a one-to-one relationship, one record on a table is related to one record on another table. For example, if you had a "user preferences" table, then each user would have a single set of preferences, and each set of preferences would be related to a single user.
- **one-to-many**: With a one-to-many relationship, one record on a table is related to many records on another table. For example, in your database, a single user on the "users" table might be the sender of more than one message on the "messages" table.
- **many-to-many:** With a many-to-many relationship, many records on one table are related to many records on another table. For example, if you had a "conversations" table in your application, then each user might be part of multiple conversations while each conversation might have multiple users.

> **Did you know**
>
> The exact positioning of your tables on an ERD does not matter, as long as they are logically organised and there is enough space between them.

To draw the relationships for your database, you need to carefully consider how the data is linked in your table. The best way to do this is to ask yourself what the minimum and maximum number of connections between your tables are. Once you know this, you can indicate these connections using one of the symbols from the table below.

CONNECTION	SYMBOL
One	
Zero or one	
One and only one	
Many	
Zero or many	
One or many	

Example 9.3.12 — Drawing the relationships

To draw the relationship between the "users" and "messages" table:

1. Ask yourself, which fields connect these tables? The answer is that the "userid" field in the "users" table is related to the "senderid" field in the "messages" table.
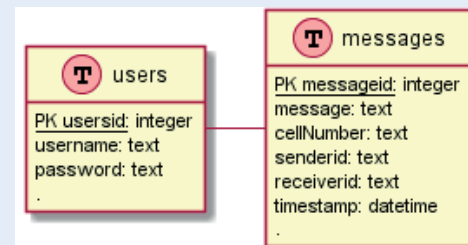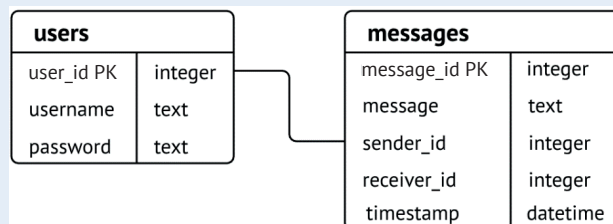
2. Draw a line connecting these fields.

3. Next, ask yourself, what is the minimum and the maximum number of users who can send a single message? Each message must have at least one sender, but also no more than one user. The minimum and maximum are both therefore one.

4. To indicate this relationship, draw the *one and only one* symbol ╫ at the point the line connects to the "users" table.
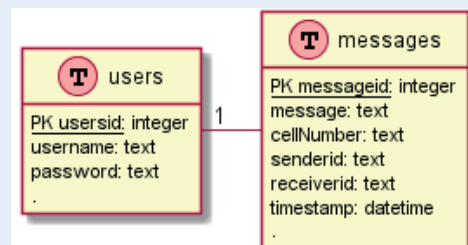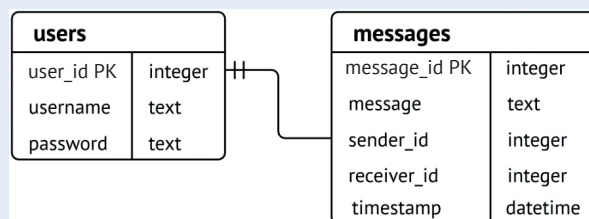
5. Next, ask yourself, what is the minimum and maximum number of messages a single user can send? Since a user can send no messages or many messages, the minimum is zero and the maximum is many.

6. To indicate this relationship, draw the *zero to many* symbol ○< at the connecting point of the line connects to the "messages" table.
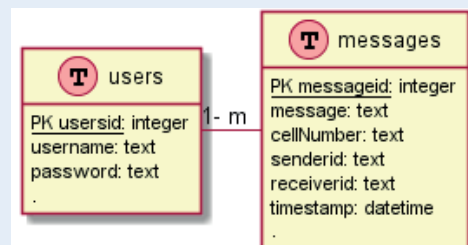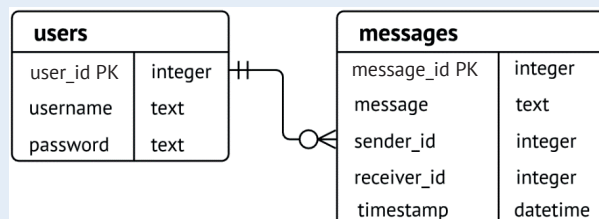
Example 9.3.12   Drawing the relationships *continued*

However, this is not the only relationship between the two tables. The "userid" is also related to the "receiverid" field. Since the app is just for direct communications between two users at this stage (and not for group chats), the relationship between the "userid" and "receiverid" is the same as the relationship between the "userid" and "senderid". Adding this relationship to the ERD you obtain your final diagram.
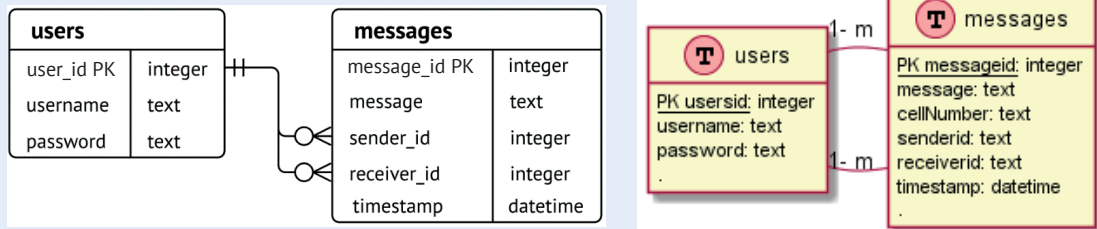
Congratulations, with these relationships drawn, any database administrator can look at your ERD and immediately understand that the two tables are related using two one-to-many relationships.

To see a second example of an ERD diagram being drawn, follow the QR codes in the margin to watch two short videos.

With your ERD diagram ready, you can now create the new table and set up the relationships between the tables.

QR CODE	QR CODE
https://www.youtube.com/watch?v=QpdhBUYk7Kk	https://www.youtube.com/watch?v=-CuY5ADwn24
TRO –SHORT LINK	*TRO –SHORT LINK*

SETTING UP RELATIONSHIPS BETWEEN TABLES

Once you have your ERD, your tables and some mock data in your tables, you are ready to set up the relationships between your tables.

Example 9.3.13   Adding tables to the Relationships view

To add tables to the *Relationships* view in Microsoft Access:

1. Open the "SMS" database.
2. Open the *Database Tools* ribbon and click on the *Relationships* button.
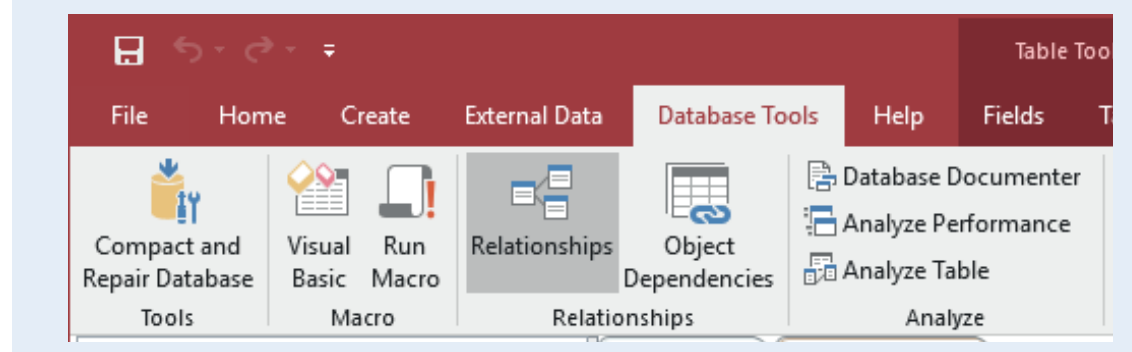
Example 9.3.13   Adding tables to the Relationships view *continued*

3.   If this is the first time you add relationships to your table, the *Show Table* window should open automatically. If it does not, click on the *Show Table* button from the ribbon.

4.   In the *Show Table* window, select each of the tables and click on the *Add* button.
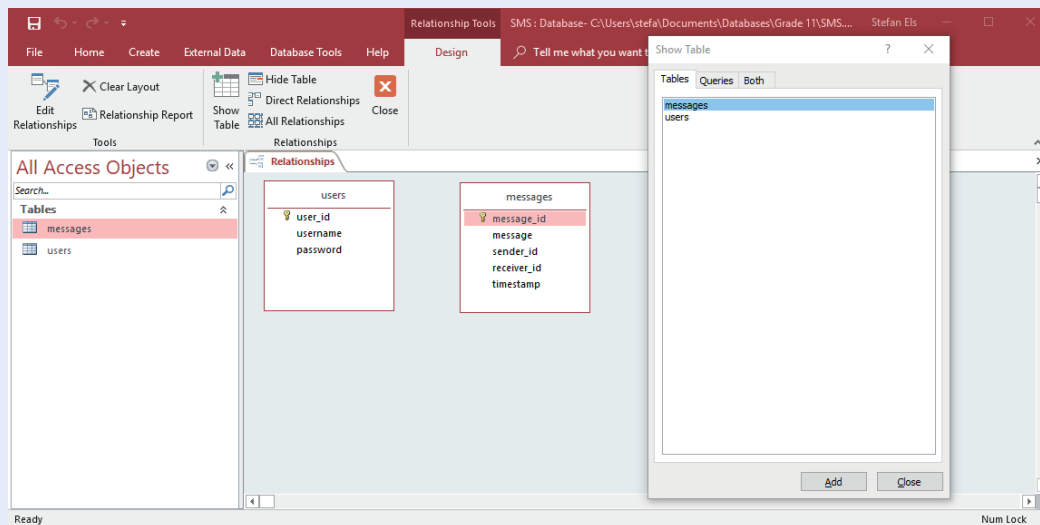
5.   Once all the tables have been added to the *Relationships* window in Access, click on the *Close* button.

6.   Use the CTRL + S hotkey to save your table.

The two tables have now been added to the *Relationships* view of Access, which is arranged just like an ERD!

Once the tables have been added to the *Relationships* view, you are ready to create the relationships.

Example 9.3.14   Setting up the relationships

To set up the relationships between the two tables.

1.   Open the "SMS" database and click on the *Relationships* button in the *Database Tools* ribbon.

2.   Drag the "userid" field (the primary key) and drop it on top of the "senderid" field (the foreign key). This will open the *Edit Relationships* window.

3.   Make sure the *Relationship Type* at the bottom of the window is set to *One-To-Many*.

4.   Click on the *Create* button to create the relationship. You should see a line connecting the two fields.
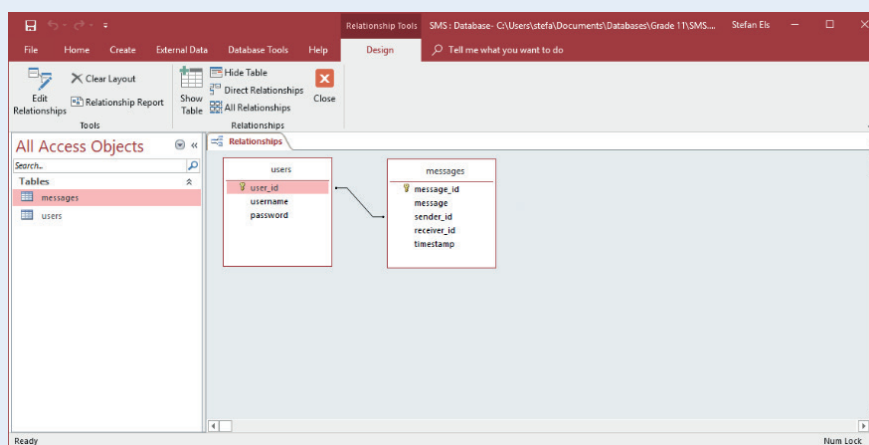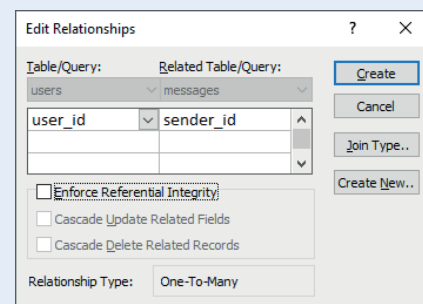
Example 9.3.14 | Setting up the relationships *continued*

5. Drag the "user_id" field onto the "receiver_id" field.

6. You will be informed that a relationship already exists and asked if you would like to edit the existing relationship. Click on the *No* button.

Microsoft Access	✕
⚠️ **A relationship already exists.** Do you want to edit the existing relationship? To create a new relationship, click No.	
[Yes] [No] [Cancel]	
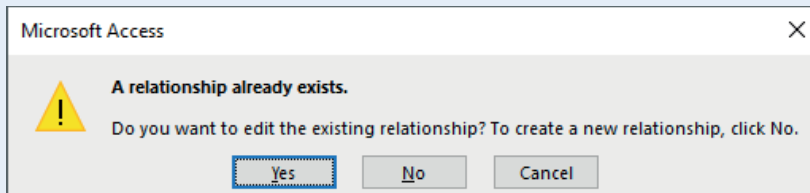
Activity 9.5 | Setting up relationships

9.5.1 An _____ shows the tables in your diagram, the fields in each table, and the relationships between the fields of different tables.

9.5.2 True or false? The exact positioning of your tables on an ERD does not matter, as long as they are logically organised and there is enough space between them.

9.5.3 Explain a many-to-many relationship in your own words.

9.5.4 Using the techniques learned in the previous sections, create the "messages" table designed above and add at least five records to it. While completing this activity, make sure that the:

   a. table and field names are entered correctly.

   b. primary key for the "messages" table is renamed correctly.

   c. data types are selected correctly. Take note, the "message" field should have the Long Text type, while the "timestamp" field should have the Date and Time type.

9.5.5 Once the "messages" table has been created, you should add the following data to it:

MESSAGE_ID	MESSAGE	SENDER_ID	RECEIVER_ID	TIMESTAMP
1	"Hey there! Are you guys getting this?"	2	5	04/10/2018
2	"Helllooooo … anyone here?"	2	5	04/10/2018
3	"Yep, I'm seeing your messages K!ll3r."	5	2	05/10/2018
4	"This is so cool!"	2	3	05/10/2018
5	"Except that my first message is from you …"	3	2	05/10/2018

If you get stuck with this activity, watch the video in the QR code to see how the tables are created and the data added.

9.5.6 Based on the "message" table above, answer the following questions.

   a. Which field is the primary key?

   b. How many foreign key fields are there? Give a reason for your answer.

   c. To which field (or fields) are the foreign key fields linked?

9.5.7 Based on the "books" database created in Activity 6.4, answer the following questions.

   a. Draw an entity relationship diagram.

   b. Based on the ERD, what are the primary key fields for the "books" and "authors" tables called?

   c. What is the relationship between the "books" and "authors" table?

   d. Based on the ERD, is it true that one author can have multiple books? If yes, give examples to support your answer.

Video

Show a video of how the table is created, the fields are created and set up, and the data is entered into the table.

WATCH ONLINE
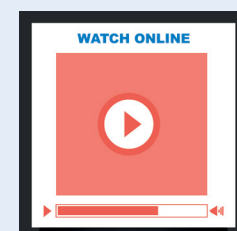
1. Your local library has asked you to write a program that will help them to keep track of which member has taken out which book. The following database tables have been designed to store data for the library.

TABLE: tblBooks

FieldName	Example of Data
BookID	001
BookName	Double Dexter
Author	Jeff Lindsay
Genre	Crime
BookReplacementCost	199.99
Available	Yes

TABLE: tblMembers

FieldName	Example of Data
MemberID	001
Name	Annie Black
Address	101 Wisteria Road, Durbanville
ContactNumber	082 121 5687
Blacklisted	No

Give the name of ONE field in each of the tables that can could be used as an acceptable primary key field.

a. There is currently no relationship between the two tables. Which fields will you use from each table to create a one to many relationship? Draw the relationship with the two tables in your workbook.

b. Describe a sensible way of relating the data in the two tables. You may add any fields or tables that you feel are necessary to achieve the goal.

c. The **tblMembers** table displays sample data, but the field data types have not been given. Suggest data types for each of the fields listed in the **tblMembers** table.

d. Differentiate between data validation and data verification, providing an example in each case to illustrate your answer.

e. Should the tables be renamed to Table 1 and Table 2? Justify the response to your answer with a suitable explanation.

2. The Water Department has designed a database to store information relating to South African Dams and the Towns that are fed by these Dams. Examine the layout of the database and answer the questions that follow:

	DamID ⏷	DamName ⏷	River ⏷	YearComplete ⏷	DamLevel ⏷	Capacity ⏷
⊞	1	Albasini Dam	Levubu River	05/05/1976	20053	28200
⊞	2	Albert Falls Dam	Umgeni River	29/05/1905	142339	288100
⊞	3	Allemanskraal Dam	Sand River	13/05/1969	128666	174500
⊞	4	Alphen Dam	Bonte River	12/06/1905	237	700
⊞	5	Armenia Dam	Leeu River	07/05/1976	7056	13000

TownID ⏷	TownName ⏷	Province ⏷	WaterRestrictions ⏷	Population ⏷	DamID ⏷
1	Willowmore	Eastern Cape	False	7100	6
2	Queenstown	Eastern Cape	False	55800	14
3	East London	Eastern Cape	False	423500	18
4	Kareedouw	Eastern Cape	False	3400	23
5	Tsomo	Eastern Cape	False	10600	107

3. Relationship between tblDams and tblTowns

a. In the **tblDams** table, the **DamID** field has been created as a primary key field.

A. What is a primary key field?

B. If this **DamID** field did not exist, suggest another possibility for having a primary key using only the existing data.

b. The database shown is a relational database.

A. Give TWO characteristics of a relational database.

B. Suggest another database model that can be used to store data.
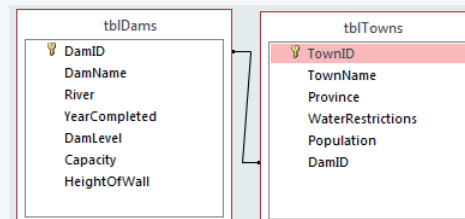
SOCIAL IMPLICATIONS

CHAPTER OVERVIEW
Unit 10.1 The effects of computer and human error
Unit 10.2 The effects of cybercrime

Learning outcomes

At the end of this chapter, you will be able to:
- discuss the effects of inaccurate and invalid – data input, unverified data, software bugs and incorrect hardware/software configurations
- discuss the effects of identity theft, business data theft and virus attacks to companies (ransomware and malware).

INTRODUCTION

Database design and management takes a team to ensure quality data and valuable information is used to make decisions in a company. In the previous chapters we discussed these concepts and what it takes to create a database. In this unit, we will look at the social issues applicable to databases content.

SOCIAL ISSUES IN A NUTSHELL

One type of computer threat is caused by human error. Below are some examples:
- weak password security and sharing of passwords
- careless handling of data or accidently deleting files
- inadequate software security and neglecting updates
- low security awareness
- ineffective data access management.

Activity 10.1 | Revision activity

10.1.1 Can you remember how to create a strong password? Discuss this with a partner and come up an example of a strong password.

10.1.2 a. In pairs, discuss how you can accidently delete files.

b. Is it a common occurrence for people to handle data carelessly? Explain why you say so.

10.1.3 Explain to your partner what a firewall is and how software security can make it stronger.

10.1.4 Explain phishing and how it can affect a security breach.

10.1.5 Controlling access to sensitive data is a basic part of any security. However, many organisations are granting complete access to all employees by default unless it is specifically restricted. Discuss how this can be dangerous to security within a company.

10.1 The effects of computer and human error

Sometimes the reported *computer problem* is not really a computer problem, but rather a human problem. The truth is that in many situations, a computer problem is not caused by a virus, a bug or a software problem, but rather by a user making a mistake.

The table below summarises four types of computer problems, two of which are caused by computer users.

Table 10.1: *Types of computer problems*

PROBLEM	DESCRIPTION
Inaccurate and invalid – data input	Information that is input by the user is erroneous. Human errors and poor auditing and control procedures of the data lead to inaccurate data capture. Causes for data to be inaccurate: missing data, wrong data, Inappropriate data, Non-conforming data, Duplicate data and Poor data entry.
Unverified data	When data entered into a computer is not verified, these data types can often be stored incorrectly, causing serious errors. Data verification is necessary to determine whether data was accurately captured from the source to the computer. A type of Data Verification is double entry and proofreading data.
Software bugs	Software bugs are errors, flaws or faults in a computer program that causes it to produce incorrect or unexpected results, or to behave in unintended ways. Software bugs change the user's experience of the program, or cause the program to crash.
Incorrect hardware/ software configurations	Computer software (including the operating system) has certain expectations about the system it will operate on. These expectations include minimum hardware requirements and specific hardware components. Installing software on an incorrect hardware configuration can cause instability and crashes.

Activity 10.2

10.2.1 At Cedar High School, safety, documentation and the international issues are considered and discussed at the school governing body meeting. The safety of the data in the school can be threatened, therefore taking away the trust that the parents have in the school management. Human errors, hardware and software issues may also damage the school's data.

    a. Explain hardware that can damage data on a computer.

    b. List THREE common human errors that contribute to loss of data.

    c. Explain the GIGO (Garbage In, Garbage Out) concept, which also contributes to messy data.

    d. Suggest THREE physical measures that can be taken by the school to protect the data on the computers

    e. Social networking poses a threat to data. Describe TWO ways in which social networking can become a threat to data.

Most people working online experienced cybercrime. Cybercrime not only affects individuals and organisations, but also society. Cybercrime can have long lasting effects on the people targeted. As a result, governments need to spend significant amounts of time and money fighting these criminals.

In this unit we will discuss the effects of identity theft, business data theft and virus attacks on a company.

IDENTITY THEFT

Identify theft is the collection of the victim's **personal information** by hackers to enable someone to masquerade as the victim. This could be the hacker or some other person he sold the information to.
Examples of stolen data and a possible effect on the victim:

- **Financial information** like credit card numbers, retail store account numbers will allow the cybercriminal to run up debt in the victim's name.
- **Medical insurance information** will allow the cybercriminal to get treatment in the victim's name and could use up all the medical cover due to the victim.
- **Driver's license information** will allow the cybercriminal to run up traffic fines in the victim's name.

The victim could end up with a criminal record, a poor credit rating and not being able to pay for medical treatment.

BUSINESS DATA THEFT

Many businesses are exposed to **email threats**, **malicious software**, or **spam bots**. Intellectual property and trade secrets are compromised.

- A business could lose their client information, trade secrets and data that could give their competitors.an edge when sold to their competitors.
- A business would have to spend on cleaning out its information system and securing it from further attacks.
- A business would not be able to function effectively whilst its information system is under reconstruction which in turn leads to time and money lost.
- A business may have to close down as a result of business data theft.
- KFC store its recipe in a vault to protect the trade secret from this kind of cybercrime

VIRUS ATTACK TO BUSINESS

MALWARE

Malware is malicious software written to destroy a computer system, to obtain business data theft or personal information.

Types of malware viruses, worms, Trojan viruses, spyware, and ransomware.

Malware viruses and worms usually spread and slow down the operation of the computer system. This decreases the efficiency of all aspects of the business that depends on the computer system.

Malware Trojans and spyware are usually use to obtain data and grant access. It is used for identity theft and business data theft.

RANSOMWARE

Ransomware is software that encrypts the business data. The business must then pay the ransom to have their data decrypted. All operation that needs this data comes to a halt. Business loses a lot time and money.

In all these cases the business has to spend to clean the system and protect it from more attacks. Good updated antivirus software would be required.

Activity 10.3

10.3.1 Explain three effects of cybercrime.

    a. Why do criminals hack into computers?

    b. Who are the most common targets?

10.3.2 Research examples of cybercrime. Choose at least TWO examples and create a poster in which you explain what the crime is, and what people can do to help prevent themselves from becoming victims.

10.3.3 Umlazi High School's computer server has been hacked and there is a virus on their system that has infected most of the files. Come up with a plan that the school administrator can use to get rid of the virus, and protect the school's data from any future cyber-attacks.

CONSOLIDATION ACTIVITY   Chapter 10: Social Implications

1. Read the case studies on human error and answer the following questions.

    a. What type of human error happened?

    b. How could it have been avoided?

    c. What is the effect of the error?

Case Study 1

Both government agencies and private companies keep vast databases containing very sensitive and very personal information about tens or hundreds of millions of subjects. For example, the FBI's National Crime Information Center (NCIC) keeps records on arrests, outstanding warrants, criminal histories, and other data that might be of use in investigating crime. It currently processes an average of 7.5 million transactions each day. When subjects are stopped by the police, their identities are often checked against the NCIC to see if they are currently wanted for a crime, on probation, or considered dangerous. In the private sector, large credit agencies such as TransUnion and Equifax, keep computerized credit histories on close to a hundred million people. These are searched hundreds of thousands of times each day by thousands of subscribers, whenever a customer requests credit of any kind, whether it is to apply for a loan or simply make a credit card payment.

⚙ Case Study 1   *continued*

These databases are used to make many critical decisions affecting peoples' lives. Someone can be arrested and detained or denied a mortgage or the use of a credit card based on the data stored in them. Yet the sheer size of these databases, as well as the procedures used to collect, process and maintain the data in them, ensure that they will contain many inaccuracies. A study done by Kenneth Laudon for the Office of Technology Assessment (OTA) found that only 25.7 percent of the records sent by the FBI's identification division were 'complete, accurate and unambiguous.' A higher percentage, about 46 percent, of the criminal history records in the NCIC met these standards. When Laudon checked a sample of open arrest warrants on file with the FBI against records in the local court houses where they originated, he found that over 15 percent of them were invalid, either because there was no record at all of them or they had already been cleared or vacated. Thus 15 percent of the warrants on record put their subjects at risk of being arrested for no justifiable reason.

⚙ Case Study 2

Michael DuCross was stopped for a routine traffic violation, when a check with the NCIC showed that he was AWOL from the Marine Corps. DuCross was arrested and held for five months before it was found that he had not been AWOL at all, but had been discharged legitimately.

In 1999, Phillip Cummings, a help desk worker at a software firm, took a spreadsheet of logins and passwords when he quit, granting him access to a number of credit reports. The criminals he sold the reports to stole $50 to $100 million – no small sum for the 33,000 people whose reports were stolen.

Malcolm Byrd was sitting at home in 2003 when police officers came to his home and arrested him on a warrant for cocaine possession. Though eventually his name was cleared, Byrd learned that a criminal had used his name when he was arrested. He spent some time in jail before finally being released.

2. Read the case studies on cybercrime and answer the following questions.
   a. What type of cybercrime happened?
   b. How could it have been avoided?
   c. What is the effect of the cybercrime?

⚙ Case Study 1

Alina got hit by a ransomware attack that encrypted and locked 5,726 files. The malware was so powerful that it was almost impossible to recover the information.

She contacted the attacker through the ransomware's communication feature. The ransomware creators, told her she can either pay to get her files back or lose them forever. Despite backing up her files 6 months ago, she decided that losing half a year's worth of photos, documents and other files was too much, and so decided to pay the ransom. The price to unlock her files was $500.

⚙ Case Study 2

Andy Greenberg, once took part in a ground-breaking experiment which tested how car hacking could be done. His car would be remotely hacked while he was behind the wheel. As Andy drove on the highway, the hackers started to take control of the car. First, they activated the air vents and windshield wipers. Next, the transmission was cut and finally, they remotely activated the breaks. Even though Andy tried to control his car, the hackers had more power. The experiment uncovered a massive flaw cars which was later fixed.

INTERNET AND WWW

CHAPTER OVERVIEW	
Unit 11.1	Evolution of the internet
Unit 11.2	Big data concepts
Unit 11.3	Multimedia as part of internet technologies
Unit 11.4	Compression technology

Learning outcomes

At the end of this chapter you should be able to:
- describe the evolution of the internet in terms of software and applications
- explain the differences between downloading, streaming and live streaming
- describe the role of multimedia on the internet
- explain how multimedia compression technology works

INTRODUCTION

The internet has not just changed the way we work or find information, it has also changed the way we are entertained. One of the clearest examples of this can be seen in the development and incredible growth of *eSports.* eSports is a general term that refers to computer games being played professionally. Thanks to the internet, eSports has become a massive spectator sport with thousands of professional eSports athletes and millions of viewers per day.

This incredible growth is only possible because of the internet and internet technologies, including:

- internet applications
- video streaming and live streaming
- multimedia compression.

In this chapter, you will learn more about these technologies and how they have changed the way people live.

| Activity 11.1 | Revision activity |

11.1.1 Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number.

   a. The composing, sending and receiving of messages electronically over a network, including the internet.

   b. The part of the internet where websites like Facebook and Google can be found.

   c. Each computer on the internet has a unique internet address.

   d. To make it easier to find a specific computer on a network, a person or company can purchase a this for themselves.

   e. A device that is used in a wired network to connect the LAN to the internet.

11.1.2 To make sure everything is covered for the gala, regular meetings with the committee is important. The best way for them to stay connected is through the internet.

   a. There is some confusion between the terms internet and World Wide Web (WWW). Distinguish between these two terms by describing both.

   b. Name the protocol used for sending e-mail via the internet.

   c. List ANY two devices required to connect to the internet using a 4G connection.

11.1 Evolution of the internet

In Grade 10, you learned that the **world-wide web** (or WWW) is the part of the internet where websites like Facebook and Google can be found, while the internet is the network connecting computers all over the world. Each computer on the internet has a unique internet (or IP) address. For example, if you have an IPv4 address, your computer's IP address might be: 102.250.56.11

Each number can range from 0 to 255 and can be represented by 1 byte (or 8 bits) of information. To make it easier to find a specific computer on a network, a person or company can purchase a **domain** for themselves that is linked to their IP address. Any person entering the name of their domain (for example, google. com) in a web browser will then automatically be taken to the linked IP address.

The world wide web changes almost as frequently as fashion changes. Every year, websites rush to be the first to adopt the newest web development trends, styles and best practices.
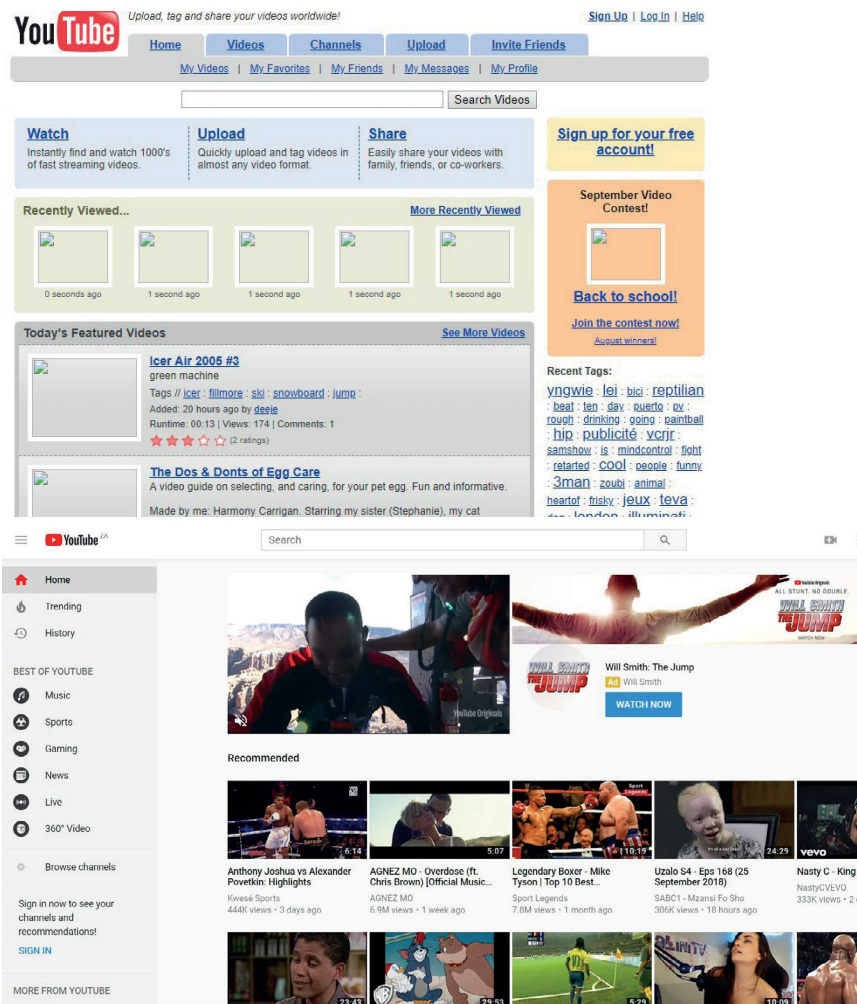
Figure 11.1: *YouTube in 2006 compared to YouTube in 2018*

More than simply the way the internet looks, the way we use the internet has changed dramatically in last 20 years. The most significant of these changes are captured using the names Web 1.0, Web 2.0 and Web 3.0

Did you know

If you want to see what a website looked like a long time ago, you can visit the Wayback Machine at https://archive.org/web/ and enter the name of your favourite website.

QR CODE

https://www.youtube.com/watch?v=HoVT7qIyarE

https://qrs.ly/8ja5qix
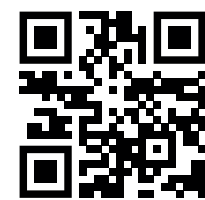
WEB 1.0

When the internet was first launched, websites were created specifically to provide information to users. As a result, the only information you could find on the internet was information that a web developer or content developer had specifically placed there.

Web pages from that era were static pages with all the information programmed directly onto the web page. As a result, these web pages stayed the same way until a web developer changed the web page's code. Web pages from that era were also not interactive, so once a user landed on a web page, the only thing they could do was read the information and look at the pictures.

The figure below shows an example of a Web 1.0 web page.

Figure 11.2: *Marshall Brain's personal web page is a Web 1.0 page*

WEB 2.0

Once sites like Google, MySpace and later YouTube, Twitter and Facebook started appearing, the internet had changed. Websites became interactive and dynamic. Instead of simply providing information, websites became applications that allowed users to search, send messages, post updates and watch videos.

With Web 2.0, users play a role in the development of content, whether through posting a status update on Facebook, uploading a video on YouTube, or writing an article for Wikipedia. Using this model, Wikipedia has become the world's largest encyclopaedia with articles on 6 million different topics in more than 100 languages. Every month, 120 000 Wikipedia visitors from around the world update existing articles or write new articles.
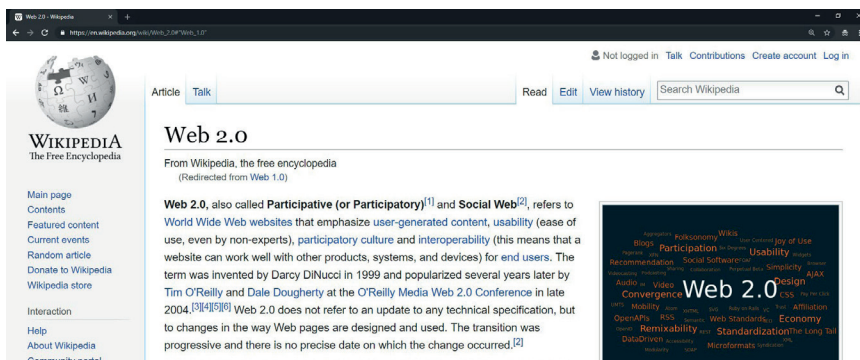
Figure 11.3: *Wikipedia is an example of a Web 2.0 website*

With Web 2.0, web developers have a different role. Rather than creating all the content, web developers are responsible for creating a platform (or application) that users can interact with. Users can then create and upload their own content.

WEB 3.0

Web 3.0 is like Web 2.0, but smarter! In the last 15 years, the internet has grown (and continues to grow) faster than anyone expected. While more information is usually a good thing, it also means that good or relevant information becomes more and more difficult to find. To solve this problem, internet services are creating increasingly smarter web applications to help find and recommend relevant information to visitors.

Web 3.0 will be able to get the context from the user; and then be able to provide the user with the most useful information. Web 3.0 can be likened to an artificial intelligence assistant that understands its user and personalizes everything.

For example, if someone is preparing for a vacation and needs to search for cheap flights and accommodations, they have to look through a lot of information on the web and compare different options and the search might take hours. Web 3.0 search engines or assistants will be able to gather all of this information and present it to the user in a very intelligent way and even make highly accurate and favorable suggestions.

INTERNET OF THINGS (IOT) (CHARACTERISTICS AND USES)

The Internet of Things is the network of physical devices that are embedded with electronics, software, sensors, actuators, and connectivity, which enables these devices to connect and exchange data. This creates opportunities for more direct integration of the physical world into computer-based systems. IoT results in efficiency improvements, economic benefits, and reduced human effort.

Examples include:
- **Connected security system** where you are able to turn on and off the lights in your house through a smartphone app. You can also open your electronic gate and watch video cameras placed around your property.
- **Household appliances**, can be operated, for example, by using an app on your smartphone. Here are some examples.

Figure 11.4: *Applications that can control different appliances in your home*

- **Connected cars** – a car that can communicate bi-directionally with other systems outside of the car (LAN). This allows the car to share internet access, and therefore data, with other devices both inside and outside the vehicle. In the near future cars will be able communicate with each other for safety-critical applications.

Case Study Internet applications

One of the biggest developments on the internet has been the rise of web applications. These are websites that, rather than providing information, work like desktop applications. Thanks to the growth of these applications, the distinction between websites, web applications and desktop applications have become incredibly thin.

Popular web applications include:
- **Office 365**: Microsoft Office, with all the typical features, available from a web page.
- **Google Drive**: Google's free-to-use office suite and online backup application.
- **Gmail**: Google's online email client is the most popular email client in the world.
- **Messenger**: Facebook's online instant messaging service.
- **Trello**: An online project management application used by many businesses.
- **Sketchpad**: An online drawing application and sketching application.

In 2015, Google announced that *Assassin's Creed Odyssey*, the newest game in Ubisoft's incredibly popular series of action role-playing games, would be playable through the Google Chrome web browser. As one of the most graphically demanding games available in 2018, this will continue to make the distinction between an application and a web application even smaller.
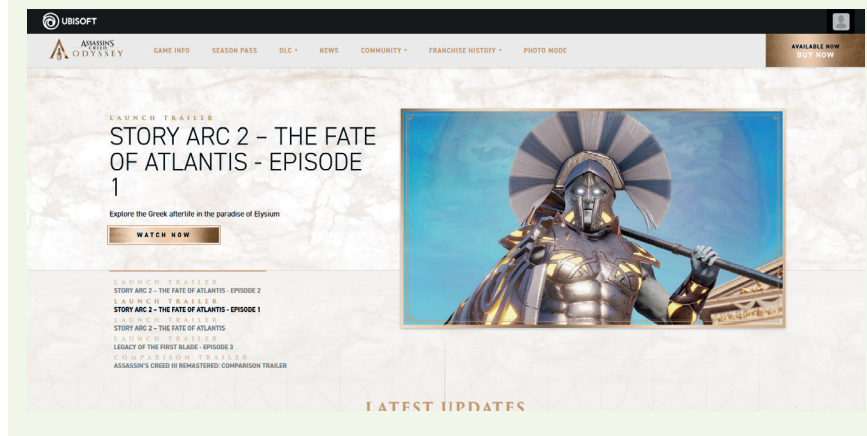
11.2.1 Match the COLUMN A with the correct answer in COLUMN B. Write down only the question number (1.1–1.6) and the matching letter (A–F) in COLUMN B, for example 1.1-A.

COLUMN A	COLUMN B
1. Website	**A.** Office 365
2. 1 Byte	**B.** Webpages became more interactive
3. Web application	**C.** Spotify
4. Social Networking	**D.** Facebook
5. Web 2.0	**E.** Communication through the internet
6. Web 3.0	**F.** 8 bits

11.2.7 Having the world at your fingertips through internet so commonly used nowadays, you and your cousin decides to take your entrepreneur business to the next level. To get your business out there, you realised you need a website. Soon you face the challenge between choosing between Web 1.0 versus Web 2.0.

a. Define a website.

b. Explain the difference between these two web versions by listing TWO characteristics of each.

c. Give TWO examples of a Web 3.0 application.

11.2.8 Optional activity

Visit the following websites and state (with reasons) which type of website it is, i.e. Web 1.0, Web 2.0 or Web 3.0.

a. www.hatch.com

b. www.virginactive.co.za

c. www.standardbank.co.za

d. https://twitter.com/

Big data isn't easy to define because everyone uses it differently. However, big data generally is:
- large datasets
- the category of computing strategies and technologies that are used to handle large datasets.

It is the non-traditional strategies and technologies needed to gather, organise, process, and gather insights from large datasets. We have looked at the relationship between data, information, knowledge and decision-making. If the quantity of data is so vast and there are not correct strategies of extrapolating knowledge then decision-making cannot happen and the company will fail. Dealing with data is thus very important.

There are four characteristics of big data. These are listed in the table below:

Table 11.1: *Characteristics of big data*

VOLUME	These datasets are larger than traditional datasets, so there is more demand placed on the processing and storage life cycle. Often, the data will exceed the capabilities of a single computer.
VARIETY	Big data comes from many different sources and needs to handle potentially useful data by consolidating all information into a single system. The formats and types of media can vary significantly as well.
VELOCITY	Big data practitioners prefer a real-time streaming system as data is constantly being added, processed, and analysed. This requires robust systems with highly available components to safeguard against failures along the data pipeline.
VALUE	The ultimate challenge of big data is reaching decision making process which is aided by the input of valuable data. Sometimes, the systems and processes in place are so complex that using the data and extracting actual value can become difficult.

There are many different uses for big data but we will look at three, namely:
- **Customer profiling:** by using big data, you can gain an insight into your customers. Businesses can gain a comprehensive and data-based description of a customer that includes variables such as demographics, and consumption patterns. These patterns give you insights as to who your customers are, what they want and what they need, allowing you to connect with your customers in a way that appeals to their interests.
- **Advanced patient care:** In the past, nurses and doctors monitored patients' physical vital signs every few hours but a patient's condition may have declined between the time of scheduled visits. Or if a patient has been discharged, there is no way to monitor their progress, if they skip their medications or ignore dietary and self-care instructions given by their doctor after leaving the hospital.

Real-time monitoring and body sensors provide a more personalised treatment to enhance patient outcomes. This has the potential to lower costs of hospital care as less attention is needed by a nurse, because a computer can analyse the big data. Wireless sensors can capture and transmit patient vitals far more frequently than human beings can visit the bedside, and these measurements can be analysed in real time for advanced care. Diagnosis times are shortened and treatments are prescribed quicker.

- The **agricultural sector** has benefited from big data in many ways. Sensors on fields and crops provide data on the soil conditions, wind direction and speed, fertiliser requirements, water availability and pest infestations. Farm equipment like tractors are equipped with GPS units to find their optimal usage. Analysis of big data can also help prevent spoilage by moving products faster and more efficiently. Drones can patrol fields to alert farmers to crop ripeness or potential problems. RFID-based traceability systems can provide a constant data stream on farm products as they move through the supply chain, from the farm to the compost or recycle bin. Individual plants can be monitored for nutrients and growth rates.

Activity 11.3

In small groups research other uses for big data. Share your findings with the class.

Multimedia plays a big role in the internet's popularity. Thanks to multimedia, billions of people have access to high quality books, music and videos at affordable costs. For many people today, internet access has replaced expensive items such as movie rentals and satellite television subscriptions. To see how multimedia on the internet has changed the world, you can look at three of the world's largest multimedia websites: YouTube, Netflix and Spotify.

These websites are considered streaming websites, which refer to the way in which the media is sent to users. In the next section, you will learn more about the difference between downloading, streaming, live streaming and video-on demand services. You will also learn a bit more about multimedia compression and how this affects both **bandwidth** usage and video quality.

DOWNLOADING AND STREAMING

It is possible to listen to music or watch videos from the internet in two different ways:
- media can be downloaded to your computer and played from your hard drive
- media can be streamed directly from the internet and played in your web browser.

DOWNLOADING

Downloading is the easiest way to share media on the internet. The media owner can simply upload the file to their website and then share a link to that file with website visitors. To play an item shared like this:

1. open the website in your web browser
2. download the media file to a location on your hard drive
3. open the media file on your hard drive using any installed media player.

Since the media file has been saved to your hard drive, you can play it as many times as you like (even without an internet connection).

Figure 11.5: *Downloaded media like movies can be played using a media player*

For online media companies, the problem with sharing media like this is that it is difficult for the companies to make money from the video. Once the video has been downloaded, it can be shared with hundreds or thousands of people without the video creator earning any additional money. As a result, there are currently almost no popular media websites that allow their videos or music to be downloaded.

> **Case Study**   Video On-Demand
>
> The one type of service that still allows videos to be downloaded are IPTV (short for Internet Protocol Television) services like DSTV's Catch-up. These services are usually sold as an optional extra with an expensive satellite television contract and allow you to watch episodes or movies that you missed later (or 'on demand').
>
> Since the videos are not downloaded to a desktop computer but rather to a satellite television decoder, IPTV service providers are not worried that these files will be shared with thousands of people. Furthermore, since each subscriber already pays a significant monthly subscription fee to the IPTV service provider, the IPTV service is simply a marketing tool they use to sell more satellite television subscriptions.

STREAMING

Since downloaded media is difficult to monetise, most large online multimedia companies share their media through streaming. To play streaming media:
1. open the website in your web browser
2. open the media file in your web browser
3. the media file should start playing automatically.

With media streaming you never save the media file to your hard drive. Instead, the moment you click the play button on the website, your computer downloads a few seconds of the media in the background and shows it to you. As you play these downloaded seconds, your computer downloads the next few seconds. This is called buffering and your computer continues to buffer and play the media until you reach the end of the item.
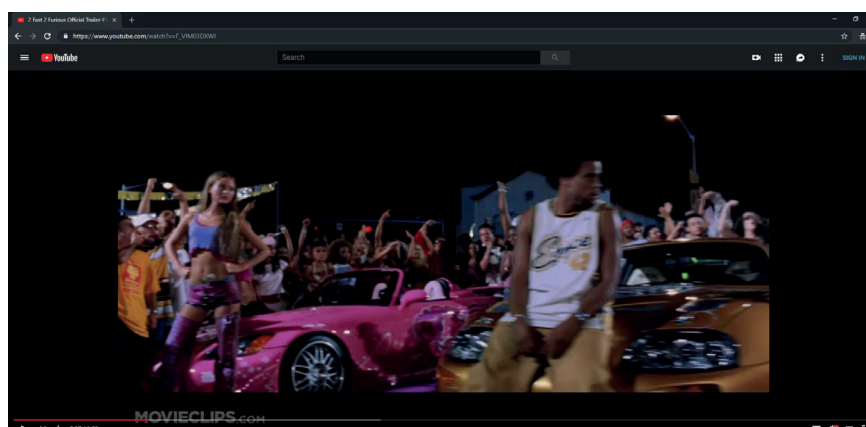
Figure 11.6: *The buffered section of the video is indicated by light grey line below the video*

When you then close your browser, all these buffered seconds are deleted from your computer. As a result, you will need to stream the video again the next time you want to watch it.

For online media companies, the advantage of this system is that they can show advertisements before or during the item. As a result, each time you or your friends stream it, the media company makes a small amount of money. Therefore, websites like YouTube, Netflix and Spotify only allow their videos and music to be streamed.

Before finishing this unit on media streaming, there are two specific types of streaming websites you should also be aware of:

- **live streaming websites:** As the name suggests, live streaming websites like Twitch.tv allow 'live' videos to be streamed. These videos show a live broadcast of something happening, whether it is a game being played, a music concert or a sporting event.
- **video on demand websites:** Video on demand (VOD) websites, like Netflix and Showmax, allow you to watch broadcast television shows and events 'on demand'. Unlike YouTube and Facebook that allow anyone to upload videos, VOD service providers are more like satellite television providers in that they specialise in high-quality, professionally produced television series and movies. Unlike with television, you can watch these episodes and movies whenever you want to.

For videos that are watched only once, there are no differences between downloading and streaming in the amount of data and bandwidth used. The only difference is whether the data is saved on your computer (as with downloading) or displayed and deleted (as with streaming). However, when a video is watched more than once, the downloaded file will not use any additional data (since it is already saved on your hard drive), while the streamed file will need to be streamed again, using the same amount of data as the first time. As such, downloading videos will save data if the video will be watched more than once. Fortunately, thanks to media compression (which you will learn about next), these streamed media files do not require as much bandwidth as they used to.

Activity 11.4

11.4.1 One of the reasons to connect the devices to the internet is watching online television programs. You can either stream or download the programs. Differentiate between streaming and downloading

11.4.2 List TWO ways you can listen to music using the internet.

11.4.3 Discuss why there aren't any popular sites that allow music or video to be downloaded freely.

11.4.4 One of your clients has indicated that he might need your services since they are planning to go into partnership with a popular Internet Protocol TV (IPTV) company which also offers VOD services.

    a. What is the internet?

    b. Differentiate between IPTV and VOD services. Indicate where each one may be used.

11.4.5 The following advertisements were placed on advertising boards outside the administrative building:

    a. What is a Wi-Fi?

    b. Advertisement C suggests that streaming can take place live online. Explain the term streaming.

    c. List TWO ways you can download a music video using the internet.

Streaming or downloading media, especially videos, from the internet can require a lot of bandwidth and use a significant portion of your bandwidth limit. To give you an idea, the table below shows a rough estimate of how much data different internet activities use per hour.

Table 11.2: *Estimate of data used per hour*

ACTIVITY	DATA USED PER HOUR
High quality videos	1 Gb/h
Medium quality videos	0,5 Gb/h
Low quality videos	0,25 Gb/h
Surfing the web / Facebook	0,1 Gb/h
Playing multiplayer games	0,1 Gb/h

Take note that this is for a single person. If four people watch an average of two hours of high quality videos per day, they will use 240 Gb in a month!

High quality videos differ from low quality videos in two important ways:
- High quality videos have a higher resolution
- High quality videos may have a higher frame rate

The resolution of a video refers to the number of pixels shown on the screen at any time. Every pixel is a single dot of a specific colour (recorded as a mixture of red, green and blue). It is the most basic unit of colour and resolution. When creating a digital video, every part of the picture is converted into pixels. The more pixels that are used, the higher the quality of the image. The figure below shows the letter R at seven different resolutions. With anything less than 100 pixels (10 × 10), it is completely impossible to see what is being shown, and the image only becomes clear at 2 500 pixels (50 × 50).
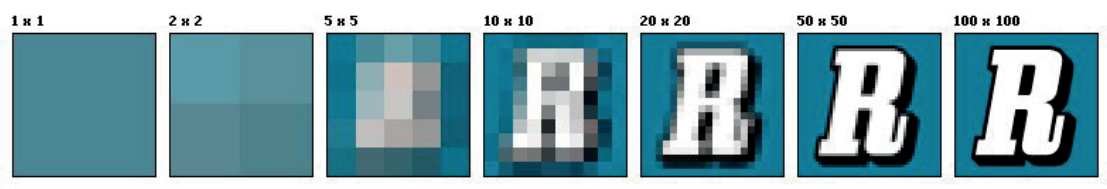
Figure 11.7: *The higher the pixel count, the better the image quality*

Video compression allows video streaming sites to dramatically decrease the size of videos without significantly decreasing the quality of the videos. As a result, 1 second of raw video uses the same amount of data as a 10-minute compressed video (like an WebM or MP4 video) with the same resolution and frame rate!

After a file has been compressed, it is saved in a compressed file format. The table below lists and describes a few of the most popular compressed file formats.

Table 11.3: *Compressed file formats*

FORMAT	FILE CONTENT	COMPRESSION
MP3	Audio	The .mp3 file format (short for MPEG Audio Layer 3) is one of the most common formats used to store audio files in the world. The MP3 compression works by looking at the soundwaves stored in the audio file and simplifying or throwing away any waves that cannot be heard by the average person.
Mpeg4	Audio and video	Today, most compressed videos are saved with the .mp4 extension (short for MPEG-4 or Moving Pictures Expert Group version 4). The MP4 file is a file container that can store files that have been compressed using several different compression algorithms.
Mpeg2	Video	Mpeg2 describes a combination of lossy video compression and lossy audio data compression methods, which permit storage and transmission of movies using currently available storage media and transmission bandwidth. MPEG-2 is used in Digital Video Broadcast and DVDs.
JPEG	Image	The JPEG (or .jpg) file format (which is short for Joint Photographic Experts Group) is one of the most popular formats used to store images. As with MP3s, a JPEG can compress a file to almost 10% of its original size, allowing you to dramatically decrease the size of images. It does this by looking at the image as small blocks of pixels and determining if they can be represented using fewer colours without changing the way the image looks. This works well in photos.

Regardless of the type of compression used, a compromise must always be made between the quality of the final image, audio or video file and the size of the file. The more a file is compressed, the smaller the file becomes but the worse its quality becomes. This means that compressed files require less bandwidth to stream and can be downloaded more quickly, but they may not look as good as uncompressed files. The goal for most websites is therefore to find a compression algorithm and compression level that allows the files to be streamed smoothly without noticeably decreasing the quality of the files.

> **Did you know**
>
> All compression is a trade-off between file size, quality, and the processing power required to decompress the media in a reasonable time.

11.5.1 The following statements are either true or false. State whether each statement is True or False. Correct each of the false statements by rewriting the statement to make it true. In other words, replace the bold-printed, underlined portions with the correct term.

   a. The resolution of a video refers to the number of <u>pixels</u> shown on the screen at any time.

   b. The <u>less</u> a file is compressed, the smaller the file becomes but the worse its quality becomes.

   c. The <u>more</u> pixels that are used, the higher the quality of the image.

   d. Each pixel is represented by 3 bytes of data this is 1 <u>byte</u> for each colour.

   e. Video compression <u>artefacts</u> can save a lot of space by only recording the pixels that change noticeably from one frame to the next.

11.5.2 The Dance Society at the school needs to share a video of their dancing competition amongst each other. They are suggesting that you compress the file for better quality.

   a. Mention the main disadvantage of media compression.

   b. It is suggested that you compress the file using JPEG format. Indicate why this is not possible and provide an appropriate compression format.

   c. Discuss how compressing a file affects the quality of the file.

11.5.3 Why won't YouTube allow you to freely download Netflix videos to watch?

11.5.4 What is the difference between a live-streaming website and a video-on-demand website?

11.5.5 How do high quality videos differ from low quality videos? Explain this in your own words, referring to the resolution and frame rate.

11.5.6 How does video compression work?

   a. Explain the purpose of video compression.

   b. What is an example of a compressed image file?

1. Complete the software comparison table.

SOFTWARE	DEFINITION	APPLICATION
WEBB 1.0		
WEB 2.0		
WEB 3.0		
Inter of Things		

2. Define big data by completing the mind map.

Characteristics:
– Volume
– Variety
– Velocity
– Value

Big Data

Definition

Uses:
1.
2.
3.
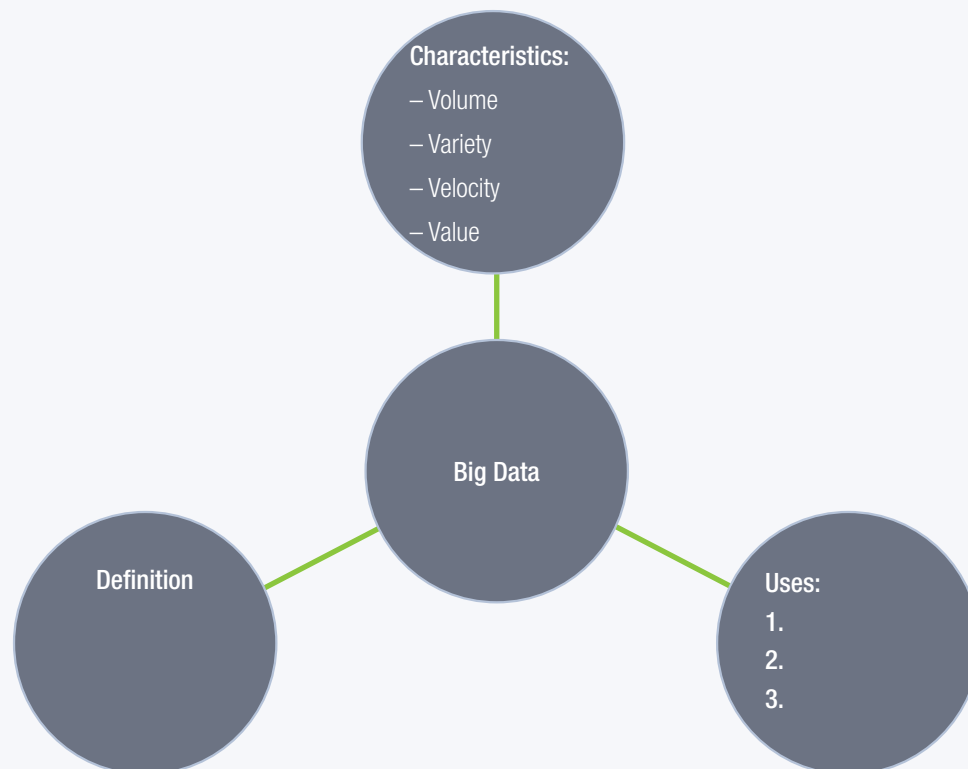
3. In your own words explain the following:
   a. Download vs streaming multimedia:
   b. Live broadcasts
   c. Video on-demand
4. What is compression technology and how does it affect media?

INTERNET SERVICES TECHNOLOGIES

CHAPTER OVERVIEW
Unit 12.1   Types of websites and supporting technologies
Unit 12.2   Internet-related careers

Learning outcomes

At the end of this chapter you should be able to:
- give an overview of internet services technologies
- compare static vs dynamic sites and location-based services sites
- explain the function of HTTP, HTTPS
- describe the purpose, advantages and limitations of multi factor authentication, one time pin (OTP) and security token valid for limited period
- describe internet related careers

INTRODUCTION

In 2018, there were more than 1,8 billion websites in the world, which means that there is probably a website for every topic you can think of. Databases are especially important on websites where users create the content (like YouTube, Facebook and Wikipedia), since it would be impossible for a data capturer to add this information manually. Instead, these websites are set up so that any information entered by users are automatically stored in different databases. This includes items like status updates, likes, tweets and any videos or pictures the user uploaded. The databases also store the user's personal information, such as their email address, username and password.

INTERNET SERVICES TECHNOLOGIES

The table below lists different types of websites and gives examples of each type.

Table 12.1: *Some types of websites you can explore*

TYPE	DESCRIPTION
Advocacy	Advocacy websites are websites that fight to change laws or public opinion. This can be about any topic that they feel strongly about.
Blog	A website that posts short, informal stories about any topic, so that the newest story appears at the top of the website.
Business	A website run by a business as a way of marketing the business and communicating with customers.
Content aggregator	A website that gathers news and information from many different area websites and provides links to the most interesting information.
Educational	A website meant to educate people. You can find both general and very specific educational websites.
Information	A website that provides people with information on a specific topic.
News	A website that provides up to date news on several different topics. New news is usually posted daily.
Personal	A website about a single person. A personal website can be a marketing tool for individuals, but it can also simply be a place to share things with the world.
Portal	A website that brings several different types of websites together. They are designed to be the one place you go to for everything but are often not that good at any specific thing.
Search engine	A website that allows you to find information on the internet. Search engines are central to how you use the internet.
Shopping	A website that helps you to do your shopping online. Different online shopping websites exist for different types of products.
Social network	A website that connects you to people by making friends, seeing what they are up to, and posting your thoughts and photos.
Web application	An application that runs directly on a website, like a word processing application or a fitness tracker.
Wiki	A website that people across the world can build and edit together. The most famous is Wikipedia, the online encyclopaedia, although wikis exist for many different topics.

Activity 12.1   Revision activity

12.1.1 In small groups, look at each website and discuss the following questions:

    a. Define each type of website.

    b. How is each website different and unique? What purpose does this serve?

12.1 Types of websites and supporting technologies

Websites are made up of web pages. When the information that will be displayed on a web page are coded directly into the web page, the web page is called static. In contrast, when the web page is a container that collects information from a database based on user inputs (), the web page is called dynamic.

Websites can also be categorised based on criteria, such as whether the website is static or dynamic, uses location-based services and has been made accessible to mobile devices. The remainder of this unit will look at these characteristics.

STATIC WEBSITES

Static websites are websites where the information is coded directly into the website using HTML. This means that the content of the website will never change, unless someone changes the HTML of the website. It also means that a web developer has developed a separate HTML file for each page of the website.

ADVANTAGES
• Easy to host and develop. • Affordable to host and develop. • Can display multimedia.

DISADVANTAGES
• Changes affecting multiple pages (such as to the header and footer) need to be made on each page. • Need to be a web developer to add content. • Information updates less frequently. • Need to code a separate web page file for each page of your website. • Website is not interactive. • Changes are time consuming to make.

DYNAMIC WEBSITES

In contrast, in a dynamic website the information displayed on the website is stored in a database and dynamically loaded onto pages based on the user's request. When the user visits the page about Bafana Bafana, a request is sent to the Wikipedia database that retrieves all the information for the Bafana Bafana webpage. This information is then placed into a standard Wikipedia web page template. If a different page is visited, then new information is requested and placed into the same standard web page template.

The advantages and disadvantages of dynamic websites are shown below.

ADVANTAGES
• Changes to the template can be made once and immediately affect all pages.
• Can be updated without programming knowledge.
• Scripts can be used to update the website to only show the most relevant information.
• Can interact with the user.
• Since the content is dynamic, users are more likely to revisit the site to read the new content.
• Can display multimedia.

DISADVANTAGES
• Requires more knowledge to develop the initial website.
• Takes longer and is more expensive to develop.
• A single template mistake can affect all pages using that template.

LOCATION-BASED SERVICES SITES

Location-based websites work by making use of the user's location to determine which website or information to show the user.

Other websites like Facebook and Google make use of location-based services to determine which advertisements and search results to show to users, while a service like Google Maps uses your location to find the shortest route to nearby locations.

ADVANTAGES OF LOCATION BASED SERVICE SITES
Location based services work, use real-time data from a mobile device or smartphone to provide information, entertainment or security.
Some advantage of location based services are:
• Enable marketers to gain a better idea about the group of customers that are more likely to favor a particular product or service.
• By forming a network, companies can support and promote each other, the success of one company can prove beneficial to all the others.
• Once businesses identify their customers' behavior pattern by using location based services, they can be targeted by offering rewards and discounts for the services that are used by them the most.

Did you know

Today, almost all popular websites, both large and small, are dynamic websites. This allows these websites to be updated more easily, to stay relevant and to interact with the user.

SUPPORTING TECHNOLOGIES

Part of the evolution of the internet has been the development of technologies that help people use the internet. The following are some of the most important technologies:
- **HTTP (Hypertext Transfer Protocol)** is the protocol that controls how web pages are sent from a web server to a user's web browser. It helps to transfer information like document, file, image, video between computers over internet
- **HTTPS (Hypertext Transfer Protocol Secure)** is a secure version of HTTP in which data is encrypted before it transferred. This type of technology is used by, for example, banks because of all the sensitive information their clients access when doing transactions on internet banking.

SECURITY SERVICES

Internet security services include services like:

	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Multi-factor authentication	Individuals are authenticated for online services through more than one required security and validation procedure. It comprises of physical, logical and biometric validation techniques used to secure an online facility, product or service.	- Protection in layers improves security. - Achieves necessary compliance requirements. - Increases productivity and brings a better usability experience.	- Inability to login due to theft of smartphone or physical device which is required and may not be available. - Cost of setting up this system is high.
One-time pin (OTP)	A password that is valid for only one login session or transaction, on a computer system or other digital device. OTP is an example of a security token that is valid for limited period.	- Safe from re-use attacks: a fraudster who uses trickery to capture your OTP can't reapply it, since it's no longer valid for future logins or sessions. - Allows you to keep your emails safe: OTPs are generally received on mobile devices via SMS hence you don't need to have access to your email while you're connected to an unsecured Wi-Fi hotspot. - Convenient to use: most individuals own a mobile phone, and SMS functionality exists on every device making one-time passwords convenient to use.	- Could get out of sync: algorithm-based OTPs need to cope with drifting out of sync with the authentication server if the system needs the OTP to be submitted by a deadline. - Can lock you out of your account: if your OTP device is ever stolen or lost, multiple login attacks by the hacker can permanently lock you out of your account. - May be costly for the providers: for OTP providers, costs can be a problem, especially if they're offering OTP hardware.
Security token valid for limited period	The security token is generated after successful authentication of the user. It remains valid for a specific period that has been set. After the specified duration is over, the authentication token expires and cannot be used to perform operations.	When you forget your password, the specific site will generate a security token that will be emailed to your account, which can be used to change your password.	If your email address that is stored on that site is incorrect then you cannot receive a security token or it might be sent to an incorrect email address.

12.2.1 Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in your theory writing book.

a. This type of website is used to fight to change laws or public opinion. This can be about any topic that they feel strongly about.

b. A website that gathers news and information from many different area websites and provides links to the most interesting information.

c. A website that brings several different types of websites together

d. A website that connects you to people by making friends, seeing what they are up to, and posting your thoughts and photos.

e. An application that runs directly on a website, like a word processing application or a fitness tracker.

f. A website that posts short, informal stories about any topic, so that the newest story appears at the top of the website.

g. A website about a single person.

> Peter has this idea of creating a website where he can load the programmes and show information on the gala. People must also be able to enter the gala online. The swimmers must use the web pages as a platform to write blogs and be able to upload videos of their events.

12.2.2 Should he create a Web 1.0 or a Web 2.0 website? Give a reason to support your answer.

12.2.3 Seeing the needs for the web page, should you suggest Peter to a static page or a dynamic page? Support your answer with a reason for your choice.

a. List TWO advantages of a static page.

b. List TWO advantages of a dynamic page.

12.2.4 Peter wants to assign a person to upload blog posts as the event is progressing, allowing users to view and comment on the event in real-time. What do we call this?

12.2.5 Explain to Peter the difference between HTTP and HTTPS and which is better to use.

12.2.6 Compare the types of security services.

	EXAMPLE	PURPOSE	ADVANTAGES	DISADVANTAGES
Multi-factor authentication				
One time pin				
Security token valid for limited period				

With the incredible growth of the internet, millions of internet-related jobs were created worldwide. These jobs range from web content developers, to independent web designers, to specialist back-end web developers!

The table below will briefly summarise five of the most important internet-related careers. It is important that you pay careful attention to the different job titles, since small differences in the titles can result in completely different jobs!

Table 12.2: *The most common internet-related careers*

TITLE	DESCRIPTION
Web designer	A web designer is the person who designs a website. This includes: • designing the layout of web pages • identifying features for the website • designing the look and feel of the website. • coding the website, although this function is often left to specialised web developers.
Web author	• A web author is responsible for writing and editing the text and creating the videos that are used on a website. Even though this does not require extensive programming knowledge, websites succeed or fail based on the quality of the content they create.
Graphics and multimedia designer	• The graphics and multimedia designer is responsible for creating all the graphical elements on the website. This includes all the buttons, icons and pictures shown on a website. The graphics of a website create a first impression, and many visitors will not look at the content of a website if it does not have professional graphics.

Activity 12.3

12.3.1 Discuss what a graphics and multimedia designer does.

12.3.2 As the workload is increasing you realise that you need to hire someone to assist you in designing websites. A friend introduces you to a possible employee who says he has been a web designer for the past five years.

    a. State TWO duties of a web designer.

    b. Motivate why you would hire or not hire this web designer for the job.

1. Choose the correct answer.

   a. Which one is NOT an advantage or characteristic of static website?

      A. Relatively simple to design

      B. Don't need much Server power

      C. Designed for client side only

      D. Can adapt to user needs and preferences

   b. What is the immediate and real time delivery of media content to a receiving device, starting from the time at which the media is opened called?

      A. Streaming   B. Uploading   C. Codec   D. Resolution

   c. Which one of the following is NOT an advantage of a static website?

      A. Easy to develop

      B. Can be updated without programming

      C. Easy and affordable to host

      D. Can display multimedia

   d. Which one of the following is NOT a disadvantage of a dynamic website?

      A. Website is not interactive.

      B. A single template mistake can affect all pages using that template.

      C. Takes longer and is more expensive to develop

      D. None of the above

2. Choose the answer and write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. Change the underlined word(s) to make the statement TRUE. (You may not simply use the word 'NOT' to change the statement.)

   a. Web 2.0 and 3.0 websites are generally <u>static</u> web pages.

   b. Webpages uses <u>scripts</u> to collect information from a database and place it on the page.

   c. <u>Downloading</u> is the easiest way to share media on the internet.

   d. Video s<u>uppression</u> works by recording the difference between a frame and the next.

   e. <u>The JPEG (or .jpg)</u> file format is one of the most popular formats used to store images.

3. There are business and marketing websites. List THREE other types of websites.

4. What is a location-based website?

5. You have specific news websites that you visit regularly, RSS feeds have been suggested to you.

   a. Explain how RSS feeds work.

   b. Name another application of RSS feeds.

6. Explain what a web author is responsible for.

7. You and your friend decide to start a business selling gaming t-shirts and other accessories. Answer the following questions regarding this business.

   a. What website will you use to advertise your business?

   b. You have decided to employ a web designer to create the website. State TWO skills that a web designer must have to create a website.

   c. Give ONE difference between a live-streaming website and a video-on-demand website.

   d. Motivate THREE capabilities of computer application systems that have made life in business and life much better.

   e. You have advertisements both in the form of videos and pictures to upload onto the new website. Give TWO compressed file formats you would use. Motivate your answer.

SOCIAL IMPLICATIONS

CHAPTER OVERVIEW	
Unit 13.1	Social implications of big data
Unit 13.2	Influences of globalisation and fourth industrial revolution (4IR)

Learning outcomes

At the end of this chapter you should be able to:
- discuss the social implications of big data with regards to online services and video conferencing, interactive whiteboards, social websites
- describe the influences of globalisation and fourth industrial revolution (4IR).

INTRODUCTION

Big data has many positive aspects and has given us insights in all industries, some examples were discussed in Chapter 11. However, big data is constantly evolving and is difficult to monitor or analyse. Organisations and tech departments, government agencies, consumer protection groups and consumers are struggling to keep up with the continual changes.

BIG DATA IN A NUTSHELL

Big data is larger, more complex data sets, especially from new data sources. These data sets are so large that traditional data processing software cannot manage them. These massive volumes of data can be used to address business problems you would not have been able to solve before.

Big data has become capital. The value that the world's biggest tech companies offer comes from their data, which they're constantly analyzing to produce more efficiency and develop new products.

Did you know

Here are some examples of how big data is used in teaching and learning applications:
- Learnwithhomer.com is designed to help children learn to read and has a complete phonics program and hundreds of science field trips and exciting art and recording tools. An engaging app connects learning to read with learning to understand the world.
- Red Roof Inn is an app that helps people who are stranded in a foreign place due to bad weather. The marketing department uses historical weather information and plan in advance to target stranded airport passengers. Daily in America, 500 flights are cancelled, leaving approximately, 90,000 passengers stranded. Big data is used to identify the areas of demand by using search advertising, mobile communications, and other methods to drive digital bookings.

Activity 13.1 — Revision activity

13.1.1 List and describe the four characteristics of big data.

13.1.2 Explain three ways that big data can be used.

13.1.3 How can big data be used in a school environment?

13.1.4 How was big data used in the two case studies above?

13.1.5 What is the downside to the use of big data? Provide an example.

13.1 Social implications of big data

Big data is used in online services like:
- **Online banking**: Proper analysis of big data can help detect any and all the illegal activities that are being carried out, like the misuse of credit cards, misuse of debit cards, customer statistics alteration and money laundering.
- **Booking reservations**: Big data from several sources has helped travel agencies, hotels and the tourism industry better understand what customers are looking for and this has led to more direct reservations.
- **E-learning**: Big data that is being collected is related to the students, faculties, courses and results. This can provide insights to improve the effectiveness of educational institutes, like:
  - customised learning programs suited for each individual to improve the overall student results
  - reframing the course material directed at what is relevant and what students are needing to learn
  - improved grading systems to get clarity on students' progress
  - individual career prediction based on the student's progress, strengths, weaknesses, interests
  - providing relevant resources necessary for students' learning, for example, data for interactive whiteboards.
- **Video conferencing**: Video conferencing is the use of technology, by users living in different areas that receive and transmit audio-video signals enabling real-time communication. This can help to link companies' far-flung employees and customers in order to reduce travel cost.
- **Social websites**: Social media wouldn't be possible without big data, as people share photos, videos, personal data and commentary on social media websites like: Facebook, Twitter, LinkedIn and Instagram. Social websites collect big data on the relationships, interests, and spending habits and social networks of their users. This helps them to provide personalised content, and advertisers are able to hyper-target users.

ADVANTAGES OF BIG DATA
- Big data makes it possible for you to gain more complete answers because you have more information.
- More confidence in available data—means a completely different approach to tackling problems.

DISADVANTAGES OF BIG DATA
- Analysis from Big Data can be used by businesses to discriminate against consumers when they are being analysed and assessed in greater detail.
- Companies also capture big data on consumer habits for targeted marketing. This has raised concerns about privacy because every time you click on a website, post on social media, use a mobile app and comment via email or to call centres, your data is collected for future use. Society have a right to their privacy but without their knowledge or consent this right is being eroded.
- As big data increases, it exposes more of our data to potential security breaches. For example, if you have approved a company to analyse your data, how certain are you that they will not fall prey to a cyber-attack or that they will not sell your data. This could result in your private data being in unsafe hands.

USES OF BIG DATA
Big data can help you address a range of business activities, from customer experience to analytics.
Once data is online, it is analysed by various organisations in order to make decisions. Big data helps businesses become better marketers and service providers. Big data also enhances product development, customer experience, operational efficiency and innovation.

In small groups discuss if and how big data has social implications on:

- Online banking
- Booking reservations
- E-learning
- Video conferencing
- Interactive whiteboards: Read the following article for further information:

Smart Classrooms come to public South African schools

By Brent Lindeque

Figure 13.1: *Learners benefit from access to education through its Smart School initiative.*

The newest Smart Classroom in South Africa will be unveiled today by Samsung's President and Managing Director, Mr Sung Yoon, at Michael Zulu Primary School in Tsakane, Brakpan.

According to Equal Education, 41.7% of South African Grade 10 pupils drop out of school before their matric year. One of the main reasons – the absence of a solid early schooling foundation. Samsung is not only providing tools and skills towards learners passing Grade 12. This goes beyond matric. This approach is rooted in their core values and business philosophy which states that they will devote their human resources and technology to create superior products and services to contribute to a better global society.

Providing access to technology and education for underserved communities is a step closer to reaching this goal.

'As a market leader that drives innovation and develops products according to our clients' needs and wants, we understand that the future of education is in technology. With Samsung's classroom technology,

educators can get more students engaged, improve participation, and most importantly, make learning fun,' says Pitso Kekana, Samsung's Head of Public Affairs and Corporate Citizenship.

Mr Kekana went on to say that 'in addition to providing the appropriate technologies, Samsung also wants to ensure that the teachers at Michael Zulu Primary School take ownership of the Smart Classroom and receive adequate training to optimise the use of the facilities'.

Samsung believes that technology is a powerful tool for social change, especially when it comes to education. The Samsung Smart Classroom was born out of the belief that success cannot only be measured by business achievements but should also be measured by how well a business serves its communities and impacts people's lives.

[Adapted from source: https://www.goodthingsguy.com/business/smart-classrooms-south-africa/, accessed 12 June 2019]

- Social websites

Globalisation can be defined as a process of connection, interaction and integration among people, companies, and governments. This process is driven by international trade, investment, technology and big data. This has resulted in:

- An efficient market where there is an equilibrium between what buyers are willing to pay for a good or service and what sellers are willing to sell for a good or service.
- Increased competition between companies which improves the service and quality of goods or services delivered to the consumers.
- Security as countries' economies are intertwined and dependant on each other.
- Wealth equality throughout the world as poorer nations have more job opportunities.

Society has gone through various stages. These are:

- **First Industrial Revolution** is famous for industrialising agricultural work.
- **Second Industrial Revolution**, in the late 19th and early 20th century, brought iron and steel into industry.
- **Third Industrial Revolution** is the Digital Revolution with the age of the computer and the internet.
- **Fourth Industrial Revolution** sees the digitisation of our society.

Globalisation and technology are intertwined as the movement of people, goods and ideas is accelerated and broadened by new forms of transport and communication. The spread of the internet and the relatively low cost of digital technology connect more people with the world. For example, small traders in shanties on the outskirts of Nairobi export across east Africa. In China, 'Taobao villages' allow previously cut-off rural populations to sell goods on Alibaba's trading platform.

Sectors which the Fourth Industrial Revolution has impacted greatly includes:

- **Agricultural sector**: AI-powered machine vision systems can measure crop populations and detect weeds or plant pests and use robotic sprayers to precisely apply herbicides.
- **Healthcare sector:** Precision medicine helps doctors analyse a patient's genome sequence, medical history, and lifestyle, making a diagnosis more reliable.

Activity 13.3

In small groups research the influences of the Fourth Industrial Revolution on the following sectors:

- Retail
- Building
- Social
- Travel

1. Read the following and then answer the questions that follow.

   Margaret and Joe have decided to sail around the world with their two children. They have several concerns including:

   - the weather that will affect their route
   - schooling for the children
   - accommodation in a foreign country when they want to travel inland
   - transport to various tourist destinations
   - social platform if they have any queries with sailing or to connect with like-minded people
   - using currency in foreign countries
   - connecting to their office and continuing to work.
     a. How can big data and globalisation make this family's experience easier?

     b. Suggest apps that use big data for each concern that they have.

     c. For each app that you suggested, provide the pros and cons of using that app.

2. What are interactive whiteboards and how can they benefit the classroom experience?

3. Do some research, then explain what the Fourth Industrial Revolution and what impact it is having on society.

Glossary

A

accessory any device or program added to a computer to perform an additional function, that is not required

active window the currently selected window

AR (augmented reality) sound, images and text are added (superimposed) into our natural world to create an enhanced user experience

archive can contain many separate files in one large archive

asynchronous communication it describes communication in which data can be transmitted at irregular intervals rather than in a steady stream

B

bandwidth it refers to the amount of data that can be transferred over a network in a specific amount of time

binary it describes a numbering scheme in which there are only two possible values for each digit: 0 and 1

BIOS (basic input/output system) a set of computer instructions which control input and output operations

boot the computer loads the operating system and checks that all the components of the computer are in good order

bus a communication system transferring data between components inside a computer, or between computers

C

caching a small, temporary form of storage that is created in a fast form of memory so that the data can be accessed more quickly

capacitive (touchscreen) it senses the conductive properties of an object, usually the skin on your fingertip. a capacitive screen or smartphone usually have a glass face and does not rely on pressure. this makes it more responsive than a resistive screen when it comes to gestures such as swiping and pinching

cardiovascular system a part of the larger circulatory system which circulates fluids throughout the body

clone a computer that operates in a very similar way to the one that it was copied from

codec used to compress and decompress a video where the video files are too big

compiler it takes the entire source code and translates it into machine code before sending the instructions to the CPU

computer virus a program, script or macro designed to cause damage, steal personal information, modify data, send emails, display messages or any combination of these

container a set of files that stores information about the digital file

contrast ratio a figure used to measure the difference in light intensity between the brightest white and the darkest black

core the processing unit that receives instructions and performs calculations or actions based on those instructions

CPU (central processing unit) the processing unit responsible for processing general instructions

D

data cap a term used to describe the data limit

default settings controls of computer hardware or software (or of a device, equipment, or machine) as preset by its manufacturer

directories

disk drive an important component that helps you store and retrieve data from the computer

DOS (distributed operating system) a network that consists of autonomous computers that are connected using a distribution software

DPI (dots per inch) a measure of the sharpness that is the density of illuminated points on a display screen

driver a set of instructions that tells the operating system how to communicate with a specific piece of hardware

E

embedded operating system a term used to describe an object, software or hardware that is independent and does not need an external program or device to run it

ergonomics the study of people's efficiency in their working environment

ethernet a way of connecting computers together in a local area network

ethernet cables cables that are used to connect a computer to a local area network or one network to another network

expansion cards a circuit board that can be inserted in a computer to give extra facilities or memory

F

format prepare to receive data

FTTH (fibre to the home) the installation and use of optical fibre from a central point directly to individual buildings such as residences, apartment buildings and businesses to provide unprecedented high-speed internet access

G

gigabyte (GB) it is a multiple of the unit byte for digital information. a gigabyte is 1 000 000 000 bytes

GPS (global positioning satellite) a system of satellites, computers, and receivers that allows land-, sea-, and airborne users to determine their exact location, velocity and time 24 hours a day in all weather conditions, anywhere in the world

graphical interface element elements used by the gui to make it easier to interact with a computer, for example checkboxes, buttons, drop lists, icons, menu bars, etc.

graphics processing unit (GPU) the part of a computer responsible for processing the instructions that create a picture on the screen

GUI (graphical user interface) an interface through which a user interacts with electronic devices such as computers, handheld devices and other appliances

H

HAN (home area network) a network within a user's home that connects a person's digital devices

hexadecimal a numbering system that has 16 unique numbers

high-level programming language a programming language that enables a programmer to write programs that are more or less independent of a particular type of computer and that are closer to human languages and further from machine languages

homing pigeon a pigeon trained to fly home from a great distance away

hotkey a combination of keys, when pressed on your keyboard, helps you perform a task much faster

I

icon a picture that shows a file, folder or a program

influencers people who have built a reputation for their knowledge and expertise on a particular topic

interpreter a computer program that reads the first language of the code, interprets it into machine code and sends it to the CPU, before reading the next line of code

IP address a unique string of numbers separated by full stops that identifies each computer using the internet protocol to communicate over a network

IPS (in-plane switching) panel a type of LED display panel technology characterised by the crystal molecules moving parallel to the panel plane instead of perpendicular to it

K

keyboarding refers to a set of skills required to operate a keyboard smoothly while typing. this includes understanding the computer keyboard layout and its functions

KB (Kilobyte) the smallest unit of measurement greater than a byte. one kilobyte is technically 1 000 bytes

L

laggy slow to react

LAN (Local area network) a computer network that covers a fairly small area like a home, office or building. the network usually has a limited number of computers on it (between 2 and 25), although there is no absolute limit

latency a term to describe the total time it takes a data packet to travel from one node to another

LED light-emitting diode is a semiconductor that illuminates when an electrical charge passes through it

location-based computing it refers to a number of different technologies that use a person's location as part of a computer program

log on screen the screen that allows authorised users access to the computer

lumens the SI measurement for brightness.

M

machine code the executable instruction code provided by all running computer system programs and applications

megabyte (MB) one megabyte is equal to 1 000 000 bytes, 1 000 kilobytes and precedes the gigabyte unit of measurement. it is often used to measure the size of large files

menu a list of options or commands for the user can select to execute the proper application function

mesh a type of network in which a device (node) transmits its own data as well as serves as a relay for other devices (nodes)

MHz (megaherz) used to measure the transmission speed of electronic devices, including channels, buses and the computer's internal clock

MNP (mobile network provider) a telecommunications service provider organisation that provides wireless voice and data communication for its subscribed mobile users

modular a software engineering approach geared toward developing software applications in terms of modules or components

multiprocessing the use of two or more CPUs within a single computer system

multithreading a technique by which a single set of code can be used by several processors at different stages of execution

N

NAS (network attached storage) a dedicated server, also referred to as an appliance, used for file storage and sharing.

NFC (near field communications) a wireless technology that allows a device to collect and interpret data from another closely located NFC device or tag.

network adapter/dongle a piece of hardware that can be added to a computer that allows it to connect to a network

network cable see ethernet cables

network medium communication channels used to interconnect nodes on a computer network

network or server operating system an operating system that is designed to help other computers on a network.

NIC (network interface controller) a computer hardware component that connects a computer to a computer network

noise refers to random data that can either accidentally be sent with a signal or join a signal automatically which hides the actual data you meant to send.

Notepad an application in Microsoft Windows used for opening and creating text files

notification tray it contains miniature icons for easy access to system functions such as antivirus settings, printer, modem, sound volume, battery status, and more

O

OS (operating system) the system software allowing a user to communicate with a computer

optical (sensor) it converts light rays into an electronic signal

overclocking the process of running a computer component at a faster clock rate than the manufacturer's specifications

P

packet loss it refers to the amount of data (number of packets) that fails to arrive at its intended destination

Pagefile a reserved portion of a hard disk that is used as an extension of random access memory (RAM) for data in RAM that has not been used recently

PAN (personal area network) a network built for a single person and contains all the devices connected to this network

PCB (Printed circuit board) an electronic circuit used in devices to provide mechanical support and a pathway to its electronic components

PCI (Peripheral Component Interconnect) an interconnection system between a microprocessor and attached devices in which expansion slots are spaced closely for high speed operation

plain text text that has no special formatting such as fonts, font sizes or images

podcast a digital recording of music, news or other media that can be downloaded from the internet to a portable media player

POST (Power-on self test) a diagnostic testing sequence that a computer's basic input/output system runs to determine if the computer keyboard, RAM, disk drives, and other hardware are working correctly

password a basic security mechanism that consists of a secret phrase created using alphabetic (abc), numeric (123), alphanumeric (a14b) and symbolic characters ($%*), or a combination thereof

prefrontal the foremost part of the brain

processor multitasking when a single processor splits its time between different processes

R

random access memory (RAM) a very fast storage device that can only store a small amount of information at a time

resistive (touchscreen) a resistive screen consists of a number of layers. when the screen is pressed, the outer layer is pushed onto the next layer and the technology senses that pressure is being applied and registers input

resolution it refers to the clarity of the text and images displayed on the computer screen

read-only memory (ROM) type of computer memory that keeps its contents even when the computer or device is turned off

revolutions per minute (RPM) the number of turns in one minute

S

sandbox a security mechanism for separating running programs to prevent system failures or software vulnerabilities from spreading

Serial AT Attachment (SATA) a computer bus interface used to connect host bus adapters with mass storage devices like optical drives and hard drives

screenshot an image of a computer desktop that can be saved as a graphics file

shortcuts an alternative way to do something that is shorter than the one usually taken

SIM (subscriber identity module) a microchip in a mobile phone that connects it to a particular phone network

sneakernet the method of transmitting electronic information by personally carrying it from one place to another on a removable medium such as hard drives, flash drives and optical disks

social media a form of electronic communication through which users create online communities to share information, ideas, personal messages, and other content

software interface it allows either two pieces of software to communicate with each other (software-software interface), or to for software to communicate with a hardware device

solid-state drives (SSD) a type of internal hard drive that, unlike normal hard drives, does not have any moving parts. this makes them many times faster

stand-alone operating systems a complete operating system that works directly on a computer (or smartphone) to make sure that the tasks of the operating system are completed

star topology all devices are connected to a central router which manages all the communication on the network

streaming is when a multimedia file can be played back without being completely downloaded first

switch (hub) a device that allows multiple computers to connect to the same network. they can also be used to connect two networks to each other

synchronous (communication) real- time communication between two people

system software a type of computer program that is designed to run a computer's hardware and application programs

T

taskbar the bar at the bottom of the screen that contains the start button on the left side and the systray on the right. it also includes the current time on the far-right side and can hold shortcuts to programs directly to the right of the start button

terabyte (TB) a terabyte is a unit of information equal to one million million (1012) bytes

thread a way for a program to split itself into two or more simultaneously running tasks

touch typing typing without looking at the keys

U

USB (Universal serial bus) a common interface that enables communication between devices and a host controller such as a personal computer

user interface the way in which people interact with computer programs or a website

username a username is a word, phrase, number or combination of characters that uniquely identifies a user on any computing device or related service that requires user authentication

utilities small programs which help users to maintain their computers

V

virtualisation it refers to the act of creating a virtual (rather than actual) version of something

vlogging a blog in which the postings are mostly in video form

VOIP (voice over internet protocol) the set of rules that makes it possible to use the internet for telephone or videophone communication

VPN (virtual private network) an encrypted connection over the internet from a device to a network

W

WAN (wide area network) a network that covers a large area. this could include all the people in a suburb or city, but it is most often used to refer to the internet, the world's largest WAN

WAP (wireless access point) a wireless receiver which enables a user to connect wirelessly to a network or the internet

window an area on the screen that displays information for a specific program

wizard a dialogue box that instructs you step by step what information it needs to create a shortcut

world wide web it refers to the millions of websites that are hosted on the internet

QR Code list

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