

Theory Book

**INFORMATION
TECHNOLOGY**

12



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA



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Information Technology Theory Book Grade 12

ISBN 978-1-928388-57-9

First published in 2020

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Dear Learner

Welcome to the *Theory Book for Information Technology Grade 12*. 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	Data collection
Unit 1.2	Data warehousing
Unit 1.3	Data mining
Unit 1.4	Caring for and managing data

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:
<ul style="list-style-type: none">• provide an overview of data collection• provide examples of data collection• describe data warehousing• compare data warehousing with database• describe data mining and provide examples• describe the processes of data mining• describe how data should be cared for and managed.



WHAT MOST SCHOOLS DON'T TEACH

Before getting started, watch the video in the QR code



<https://www.youtube.com/watch?v=nKlu9yen5nc>



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_LHzcxQIQSimwk4S

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 this chapter, you will learn about what data collection is and also look at some examples where data collection is used. Several key **warehousing** concepts will be introduced. This will enable you to compare data warehousing with a **database**. You will also learn how to collect and **mine data**. However, before learning any new concepts, let's revise what we know about databases.

New words

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



New words

field – a single bit of information about a person or an item, for example, age

record – a group of related fields about an item or person that is captured in the table

Primary key – a field that holds a unique identifier for each record in the database (Unique means there is only one of its kind)

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 1.3

Data collection

- 1.3.1 Define a web form and provide an example.
- 1.3.2 Provide a brief explanation of what tagging is and give an example of how a tagging system (not mentioned in this book) has been used in South Africa. (You will need to do a bit of research to answer this question.)
- 1.3.3 Choose the answer and write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. (You may not simply use the word 'NOT' to change the statement.)
 - a. RFID stands for radio frequency identifier and refers to tiny chips that can store a few kilobytes of information.
 - b. A basic RFID reader will scan all the information stored on the product with an RFID tag and make 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.


Take note

Hardware manufacturers release new components every year, and the relative strength and weaknesses of these components change every year. As such, the table above can, at best, be a starting point. Before purchasing any components, you should do research on them using the internet.


Did you know

Data warehousing is a key tool in business intelligence (BI), which refers to several technologies and applications that are used to improve business decision making.

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=avP5d16wEp0>
[**https://qrs.ly/4la5pff**](https://qrs.ly/4la5pff)

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. Your teacher may also use these to assess your performance during class.

CONSOLIDATION ACTIVITY Chapter 1: Database Management

1. Choose the correct answer.

- a. Which of the following scenarios does NOT need a database?
 - A. Storing the credentials of all Gmail accounts.
 - B. Backing up all the information on your personal computer.
 - C. Storing all the webpages of a website.
 - D. Storing all the information about a business's inventory.
- b. Which of the following techniques is NOT used to protect data in databases?

DATABASE MANAGEMENT

CHAPTER OVERVIEW

Unit 1.1	Data collection
Unit 1.2	Data warehousing
Unit 1.3	Data mining
Unit 1.4	Caring for and managing data

Learning outcomes

At the end of this chapter you should be able to:

- provide an overview of data collection
- provide examples of data collection
- describe data warehousing
- compare data warehousing with database
- describe data mining and provide examples
- describe the processes of data mining
- describe how data should be cared for and managed.

INTRODUCTION

In this chapter, you will learn about what data collection is and also look at some examples where data collection is used. Several key **warehousing** concepts will be introduced. This will enable you to compare data warehousing with a **database**. You will also learn how to collect and **mine data**. However, before learning any new concepts, let's revise what we know about databases.

DATABASES IN A NUTSHELL

Computers store data for a number of reasons. viz. Instructions that a computer uses to function, data required in RAM when an application is being used, data in the form of Images and files that the user's application requires. The structures commonly used to store data are: Files and Databases.

FILES AND DATABASES

Data is saved in the computer's memory while a user is working in an application. The information that the user will need to access later, is stored in a database or file on a more permanent storage devices.

Did you know

Data is unprocessed numbers, facts or signals. 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 using letters and characters.

Databases are a collection of organised data. Databases are the single most important tool used to store data by programmers and web developers. It can, for example, be used to store everything such as, the settings in an application, text on a website, graphics, status updates, personal messages and comments on social networks.

DATABASE MANAGEMENT SOFTWARE (DBMS)

Database management software (DBMS) is the software responsible for managing a database. This includes creating the database and tables and managing data security. Examples of popular database management software include: Microsoft SQL Server, Microsoft Access, MySQL and SQLite.

ACTIVITY 1.1

Revision Activity

- 1.1.1 Define data.
- 1.1.2 What does a computer do with the data?
- 1.1.3 List two reasons why computers store data.
- 1.1.4 Define the term, database.
- 1.1.5 List two instances where a database can be used.
- 1.1.6 Explain DBMS and its advantages.
- 1.1.7 List two examples of DBMS.

1.1 Data collection

In Grade 11, you created a database and manually added some data to your tables. This is a very ineffective way of adding data to a database and is only suitable for small databases. Instead of using manual entries, most databases use different techniques to capture data automatically. In this section, you will learn about a few of these techniques.

FORMS

A web form, is an online interactive page that allows for user input. This page imitates a physical form that users need to complete. To assist with user input and limit errors, a web form usually contains GUI components such as:

- checkboxes
- combo boxes
- spinners
- drop down lists
- text boxes
- buttons, and so on.

Web designers can also create quite sophisticated web forms for most online activities such as banking, shopping and job or enrolment applications by using programmed objects, functions and methods. These Web forms have changed the way that business is done because it limits paperwork and documentation, and favours online documentation.

TAGS

Electronic tags transmit a radio frequency from the tag to a tag reader, or vica versa. It transmits the information to a computer program associated with the tag. Tags can be used to track or identify different items and are often used in merchandising warehouses, for vehicle tracking, pet tracking, and so on. Let's look at some examples of how tags are used.

RFID

RFID stands for radio frequency identification and refers to tiny chips (like those in a phone SIM card) that can store a few kilobytes of information. When scanned, this information is read and displayed on a computer. By using the correct software, it could also be added to a database directly.



Figure 1.1: An RFID access card

RFID is used by thousands of businesses across the world. For example, RFID can be used to tag:

- **all products stored in a warehouse.** When an item is removed from the warehouse, it is automatically scanned and removed from the database.
- **tools stored in a workshop.** This allows the company to track which tools are being used, which employees are using them, and when the tools are returned.
- **the tickets of people going to conferences, sports events or concerts.** When a registered RFID chip arrives at the gate, the gates open automatically, and the data on the ticket is added to the database.
- **the tickets of people using public transport.** For example, the Gautrain uses RFID cards to allow people to board trains. The trip is recorded on a database, and the cost of the trip is subtracted from the user's balance.
- **all products sold in a shop.** When an item is purchased, the RFID tags are scanned and the details about the product are retrieved and added to the bill. The item can then also be removed from the shop's inventory automatically.

A basic RFID reader will only scan the information stored on RFID chips and make them available to a computer. However, there are many software solutions that will automatically take this information and add it to a database. These applications may also write additional information to the database, like the date and time that the RFID chip was scanned and the location.

E-TOLLS AND RFID

In December 2014, South African National Roads Agency Ltd (SANRAL) opened its electronic toll (or e-toll) system in Gauteng. The goal of the system was to help the government pay for the R20 billion highway improvement project that had been running since 2007.



Figure 1.2: An e-toll gantry

Motorists had to purchase an e-tag (the RFID chip read by the toll gantry). The system used a combination of cameras and RFID readers to automatically record the information of any car driving through the gantry. This information is then stored in a database, which is used to automatically generate an invoice at the end of each month.

DIGITAL SENSORS

A digital sensor is an electronic or electrochemical sensor, where data conversion and data transmission are done digitally, for example, temperature, distance, humidity, light. Sensors sense a wide range of different energy forms like movement, electrical signals, radiant energy, pressure, thermal or magnetic energy. For example, wireless sensor tags connect events in physical world, for example, motion in an area, whether a door/window is opened/closed, temperature or humidity exceeding a certain limit, or smartphones or any Web browsers with internet access.



Activity 1.2

Answer the following questions:

1.2.1 Do some research to find out how this e-toll system automatically detects information for:

- a. vehicles with an e-tag, and
- b. vehicles without an e-tags.

Write a short report on how reliable you think this system is.

Discuss ways in which:

- i. the system could work, and
- ii. how this system could work well.

1.2.2 Can you think of any other situations where RFID chips can be used to automatically create an invoice?



QR CODE



<https://www.youtube.com/watch?v=cZwLlxM7PdE>

<https://qrs.ly/66a7ke1>

INVISIBLE ONLINE DATA COLLECTION

Databases form the heart (or memory) of the internet because they store most of the information shown on websites today.

Databases are especially important on websites where users create the content (like YouTube, Facebook and Wikipedia), as 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 on computers or mobile phones also store the user's personal information, such as their email address, username and password.



Figure 1.3: Social media usernames and passwords are stored in a database



Animation

Animation showing a banking transaction. Money is subtracted from one account, then transferred from starting bank to another bank over the internet, but before the destination account the connection is broken. This causes all the transactions to be rolled back.

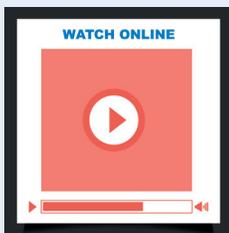


Figure 1.4: Credit card payments make use of database transactions

A cookie is a message given to a web browser by a web server. The web browser stores the message in a text file. Each time the browser requests a page from the server the message is sent back to the server. The cookie identifies users and could customise web pages for each person. When a person first enters a website using cookies, they may be asked to fill out a form providing personal information, which is packaged into a cookie and sent to the browser. The next time you go to the same website, your browser will send the cookie to the server.

Since this incredibly detailed information is recorded for billions of internet users, online advertising companies require massive databases with software that can automatically track users and their activity across web pages.

There are hundreds of different systems that have been designed specifically to automatically record information in databases, for example credit card payments, automatic toll gates, cookies and cell phone calls.

In all these examples, software was specifically built to read the information and record it in a database. This software also allows the companies to create automatic reports from the database. For example, you may receive a credit card statement or phone bill at the end of each month. This is a report that your service provider's database generates automatically.

TRANSACTION TRACKING

Transaction data (type of transaction, store where transaction occurred, employee who performed the transaction, customer information, payment information including signatures if captured) is sent from stores to the corporate database. Data is stored on cards, such as credit cards, store cards (for example, Jet or Edgars) and store loyalty cards (for example, Clicks ClubCard, Pick 'n Pay SmartShopper card). Some transaction tracking benefits include: consumer safety when it comes to purchasing toys, cars, food and medication, enhancing a user's on-site experience by tracking browsing history and demographic profiles, fraud detection, and so on. The main disadvantage of transaction tracking is the unauthorised use of your personal information.

LOCATION BASED DATA

Location based data is data that provides information about different things that can be shown on maps. **Static location-based data** includes data such as maps with roads, street names, shops, offices and other features, but also farming information, government buildings and assets, electric distribution networks with pylons and substations, military information and so on. **Non-static information** obtains the position of aeroplanes, tracking transport or stolen vehicles, personal positioning, satellites, traffic patterns, rhinos and even pets; all of which are based on input from geographic positioning systems (GPS).

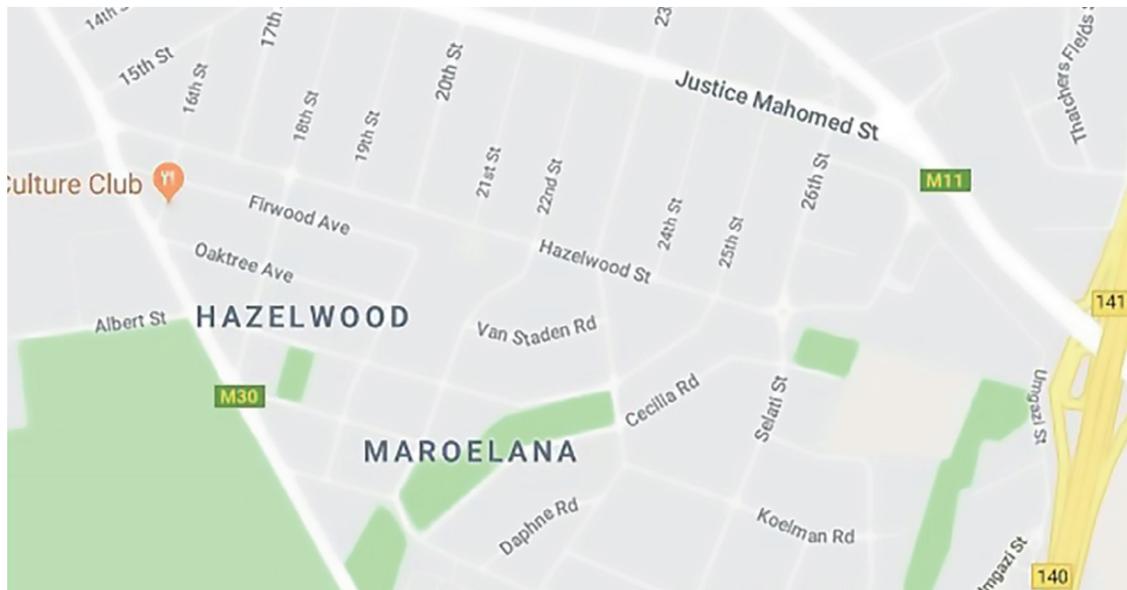


Figure 1.5: A city map based on a GIS database

Location based services (LBS) are services that use software applications together with the location-based databases to deliver a service such as finding the best route to a destination or shop, find the location or movement of a stolen vehicle, a lost pet, find the characters in the Pokémon GO game or the places where photographs were taken during a holiday trip.

Smartphones and tablets are also better at location-based computing, which refers to software based on a user's location. Examples of location-based computing includes:

- Weather applications tell you what the weather in your specific area will be, based on your location.
- Food ordering applications can use your location to deliver food directly to you.
- Car sharing services, such as, Uber use your phone's location to find the nearest Uber driver, who will pick you up and drop you off at the correct location.

The problem with so much data being stored in databases is how to make sense of it and use it. In the next section, you will see how companies mine databases to improve their decision making.



Activity 1.3

Data collection

- 1.3.1 Define a web form and provide an example.
- 1.3.2 Provide a brief explanation of what tagging is and give an example of how a tagging system (not mentioned in this book) has been used in South Africa. (You will need to do a bit of research to answer this question.)
- 1.3.3 Choose the answer and write 'true' or 'false' next to the question number. Correct the statement if it is FALSE. (You may not simply use the word 'NOT' to change the statement.)
 - a. RFID stands for radio frequency identifier and refers to tiny chips that can store a few kilobytes of information.
 - b. A basic RFID reader will scan all the information stored on the product with an RFID tag and make them available to a computer.
 - c. Databases are especially important on websites where users create the content, since it would be impossible for a programmer to add this information manually
 - d. Credit card payments, automatic toll gates and cell phone calls automatically record information in databases.



Activity 1.3

Data collection *continued*

- e. RFIDs automatically identify objects, collect data about them, and enter those data directly into computer systems with little or no human intervention.
- f. Databases are not important on websites where users create the content, since it is possible for a data capturer to add this information manually.
- g. These websites are set up so that any information entered by users are manually stored in different databases.
- h. Invisible data capturing refers to data that is captured online, usually entered by the user.
- i. Online data capturing refers to data that is automatically recorded and captured on a database without requiring user input and usually without informing the user.
- j. Websites help advertisers to create advertisements that are specific to each user. To do this, advertisers create a database recording information from each user on the website that includes information like what the user searches for, what links they click on and how long they stay on different pages.

1.3.4 Whenever an item is purchased from an online shop and the payment is received, several database transactions must occur. Underline what this includes:

- Creating a customer order in the database.
- Removing the purchased items from the company's inventory.
- Subtracting the amount paid from the amount owed on the customer's account.
- Placing an order with a shipping company.

1.3.5 Explain how websites use the data they collect to determine which advertisements to run on the website.

1.3.6 Which other examples do you know of that are commonly used to add information to a database automatically?

1.3.7 On many websites, when an internet transaction is done, the data can be captured without the user's knowledge or consent.

- a. How can this type of data capturing be used in day-to-day life? Give an example of the data that is captured to support your answer.
- b. RFID chips can also be used to automatically capture large amounts of data. What does RFID stand for?
- c. Give four examples of how RFID cards are used in real life to capture data.

1.3.8 What does transaction processing refer to?

1.3.9 Why is this it important to group transfers into a single transaction?

1.3.10 What is meant by 'rolled back' in the following sentence:
'If a single task fails, the transaction is rolled-back.'

1.3.11 Why is a complete roll-back important? Explain it in terms of a bank transfer being cancelled during the final step.

1.3.12 Banks and online shops use transaction processing systems. Can you think of any other situations in which transaction processing systems may be used? Make a list.

1.3.13 Answer the following questions in your own words.

- a. What is location-based data and what is its main goal?
- b. Name and shortly describe each of the two types of location-based data.
- c. Which technology is generally used for location-based computing?
- d. How would location-based computing assist the organisers in gathering information about the participants using mobile devices?
- e. What is the name of the system used to determine the position of non-static devices?
- f. What two technologies are combined by location-based computing to deliver a service to customers?
- g. Give three examples of location-based services.
- h. The Computer Olympiad will be managed from a main office and all communications will be sent from this office. On the day of the event the data will be distributed electronically to all institutions that have registered to participate in the Computer Olympiad.

Suggest ONE advantage for the Computer Olympiad if they use location-based computing.

A warehouse is a place where you can store a large number of items or products.

WHAT IS DATA WAREHOUSING?

Data warehousing is similar to how factories and distribution companies store their products in a warehouse in real life. It is a technique for storing data from more than one database. Unlike most databases, where the data is normalised and stored in the most efficient manner, data warehousing takes the data from these databases and stores it in a non-normalised way.

Since the data is not normalised, there may be **redundancies** and it can use additional storage space.

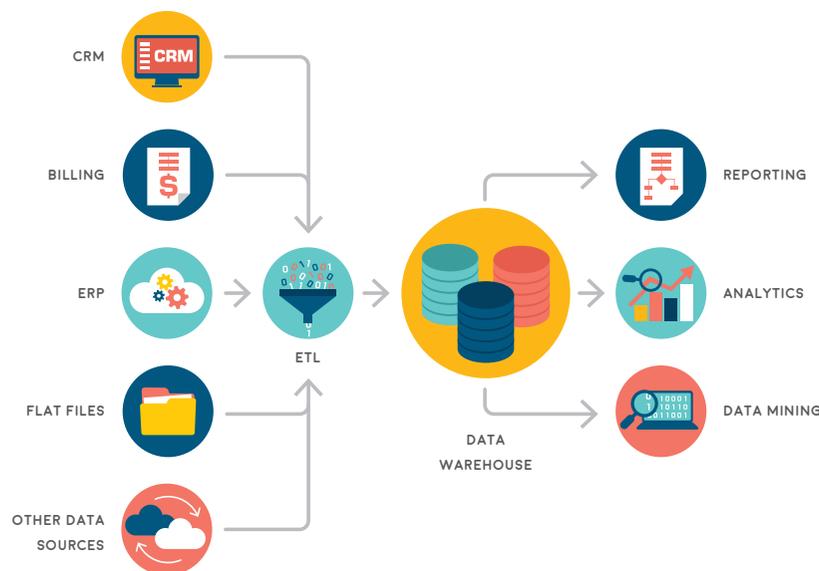


Figure 1.6: Data warehousing is used to make data available for analysis

The goal of a data warehouse is to make the data available and ready for analysis.

It is important to understand that a data warehouse does not contain copies of the original databases, instead, it is a new database that is created to hold structured data from multiple sources. A data warehouse is usually opened to multiple people in different departments of a company. Each of these people can then access the data and use it to create graphs and reports useful to them.

DATA WAREHOUSING VS DATABASE

Data warehouses and databases are similar in that they are both relational data systems. However, they were built to serve different purposes.

- A data warehouse stores a large quantity of historical data and all the data from the various databases are available.
- A database stores current transactions and enables easy access to specific transactions for ongoing business processes.



Did you know

Normalisation is the process of refining the structure of a database to minimise redundancy and improve integrity.



Did you know

Data redundancy occurs within a database when the same piece of data is held in two different places.



Did you know

Data warehousing is a key tool in business intelligence (BI), which refers to several technologies and applications that are used to improve business decision making.

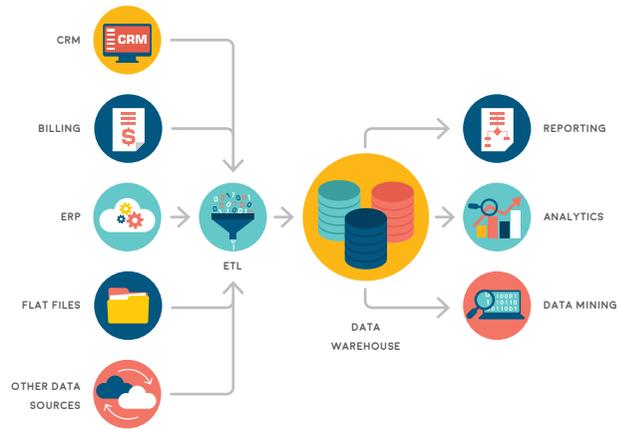


Activity 1.4

Data warehousing

- 1.4.1 In real life, a warehouse is a place where you can store many items or products.
- What is a data warehouse?
 - How does data warehousing store the data? Explain it in your own words.
 - What are two advantages of denormalised databases?
 - What is the goal of a data warehouse?
 - Does the data warehouse replace the original data base? Give a reason for your answer:

1.4.2 Explain in one or two sentences what this diagram means.



1.4.3 Tabulate two differences between data warehousing and database.

WHAT IS DATA MINING?

Data mining is a process used to identify trends and patterns between different sets of data in large databases. Selecting the right data from such large amounts of data (called **big data**) can help show trends and patterns between data sets, which can improve decision making dramatically. For example:

Marketing: Data mining is used to explore increasingly large databases to improve market segmentation. By extracting data like customer age, gender, tastes etc. and looking for patterns and trends between them, it is possible to guess their behaviour in order to direct personalised loyalty campaigns. Data mining in marketing also predicts which users are likely to unsubscribe from a service, what interests them based on their searches, or what a mailing list should include to achieve a successful response rate.



Activity 1.5

Data mining

You have been given access to three massive data sets containing hundreds of thousands of records. The three data sets are:

- Sales information from Amazon, including sales information per product, per product category and per country.
- Number of viewers per television show, including information on the time of day and the demographics of the people watching.
- List of tweets from the past year, including the content of the tweet, the hashtags used and the location the tweet was sent from.

Based on these datasets, complete the following tasks.

1.5.1 Give three questions that would you be interested in answering using these data sets.

1.5.2 Describe how a business owner could you use these datasets to improve their decision making on the following topics:

- a. Women are 50% more likely to purchase your product than men. When should the business advertise their product on TV?
- b. An electronics company is not sure if they should make an affordable electric toothbrush, or a high-quality expensive toothbrush.
- c. A restaurant owner has noticed that people often talk about food on Twitter. How can he use this information to decide which type of restaurant to open in Johannesburg?

To make sense of the massive amounts of information available, people need to follow a basic process. This is called the data mining process.

DATA MINING PROCESS

To mine a database, you will:

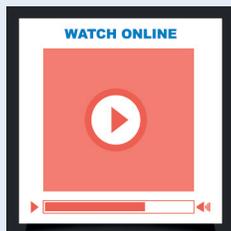
- extract the relevant data
- look for patterns in the data
- discover knowledge from the patterns

This section will look at each of these steps in some detail.



Animation

Animation showing how small pieces from different tables are taken and combined to create a new database.



EXTRACT THE RELEVANT DATA

Once you have access to a database, you need to extract the data that will be useful to you. Many of these databases store incredible amounts of data (such as the UN database, which contains information for most countries in the world), and you may only need a small section of that data to answer your questions. Rather than filtering a massive database the whole time, you use the full database to create a new database containing only the information relevant to you.

In most situations, data will be extracted from the datasets using SQL. This is a programming language that was created specifically to manipulate and extract data from a database. By using SQL queries, users can specify exactly which data they want to extract. This is done by specifying:

- Which fields to extract
- Which data table to use
- What conditions are used

Only data that meets these requirements will then be extracted to be used for analysis.

LOOK FOR PATTERNS IN THE DATA

When working with large amounts of data, it is impossible to look at each data point on its own. Instead, you need to look for patterns in the data that will help you understand the dataset. As you will see in the later steps, these patterns can result in knowledge, which is used to make better decisions and develop strategies.

For example, you may want to determine whether fewer people use the highway between Pretoria and Johannesburg today than before the Gautrain was built. To do this, you may find Gautrain project planning data for 2014 and N1 toll gate data for 2019 and calculate daily and monthly averages that you can then compare. Based on this analysis, you will know if the Gautrain decreased the traffic on the N1 or not, and importantly, by how much. This information can then be used to decide whether or not to build a system similar to the Gautrain system for Durban or Cape Town, who have similar traffic problems.



Figure 1.7: The Gautrain is a high-speed train traveling between Pretoria and Johannesburg

DISCOVER KNOWLEDGE

By identifying these patterns, you have turned an overwhelming amount of disorganised data into a few useful facts. This allows you to understand what happened rather than rely on vague uninformed views of people. Once you have confirmed the situation, informed decisions can be made, or strategies developed.

Example 1.1 Data mining used for Government Social Grants

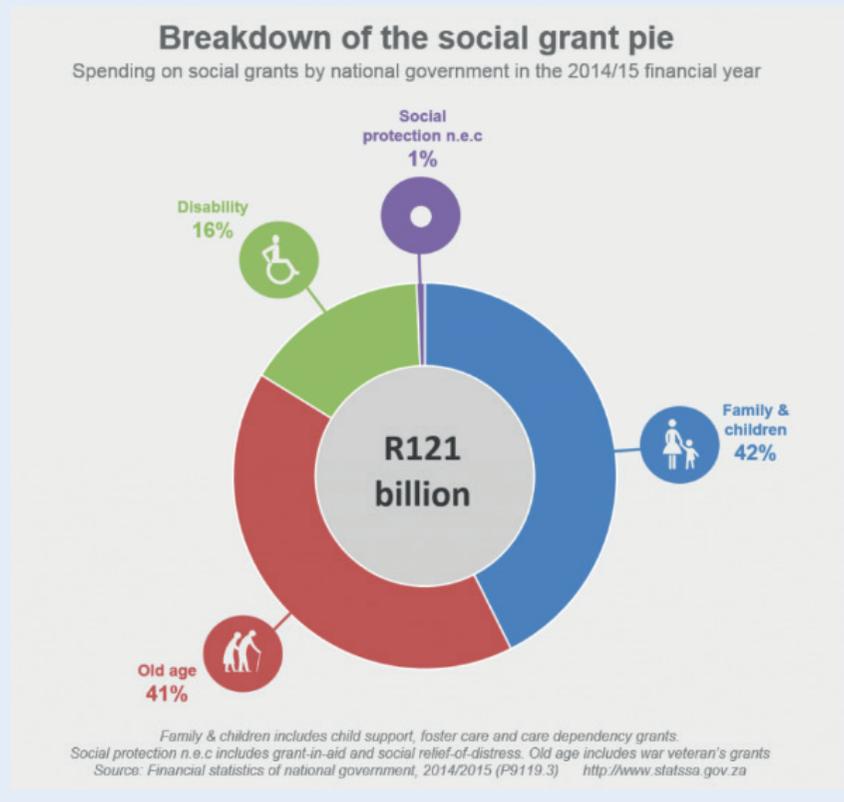
Social grants are administered by the South African Social Security Agency (SASSA). SASSA is mandated to “ensure the provision of comprehensive social security services against vulnerability and poverty within the constitutional legislative framework”. Most social grants are “means tested”, this assesses the value of assets and income. Only a certain threshold is eligible for a social grant.

To measure the living circumstances of South African households, the Government conducts an annual General Household Survey (GHS). This is a household survey which collects big data on education, health, social development, housing, access to services and facilities, food security, and agriculture.

Using data mining techniques the relevant data that will be useful is extracted. This data is then analysed (finding patterns) and used to obtain information/ knowledge.

This knowledge can then be used to provide the necessary budget for social grants and to know what limit to set the threshold or provide reports like:

- The number of households receiving at least one form of social grant rose from 29,9% (of the population) in 2003 to 44,3% in 2010, according to the latest General Household Survey report² from Stats SA. This rose to 45,5% in 2015. Further details and analysis on the issue of the growing social welfare net are available from Stats SA's Poverty Trends in South Africa report³.



Example 1.2 Data mining used by Facebook

Facebook (and other Web giants) accumulate all our personal data over time. Increasingly, identifiable data collection is happening in more dimensions than are ever understood by most users. The more data there is in one place, the more data mining can be done. Over time, and in context of other individual data points, it becomes Big Data.

Using data integration, it's then mixed with other data sources that, as end-users, we'll never be aware.

Companies, individuals and Facebook Itself that have access to this data extract the relevant data that is useful to them and store it in a smaller database.

Apps, that use data analytics, are used to analyze "friends of friends" comments, textual analysis, online behaviour, and so on, to compile data about us.

This *information/knowledge* is then used to: determine our current emotional state, correlate how sad or depressed someone might be, suggest possible friends etc.



Activity 1.6 Data mining

- 1.6.1** The tour company requires the use of a database management system to store details of tours and tour guides. A record of the tours and the agent responsible for each tour is stored in a table called 'TBL Tours'. The first five records of the table are shown below.

TBL TOURS				
TOUR DESTINATION	STARTDATE	ENDDATE	TOURGUIDE	GUIDETELNUM
Kruger National Park	2019-07-01	2019-07-10	Senzo Dhladla	0812345678
Drakensberg	2019-07-20	2019-07-24	Meredith Peters	0731112223
Kruger National Park	2019-08-01	2019-08-06	Senzo Dhladla	0812345678
Cape Town	2019-08-14	2019-08-24	Kajal Singh	0619988772
Sun City	2019-08-22	2019-08-30	Senzo Dhladla	0812345678
Mozambique	2019-08-23	2019-09-03	Kajal Singh	0619988772
Kruger National Park	2019-09-15	2019-09-18	Senzo Dhladla	0812345678

This data in the database can be used for data mining.

- Give examples of three questions that can be analysed using the database?
 - Whom will your answers help? I.e. who will get the advantage of the answers obtained from your questions?
 - What must you do to mine a database?
 - To gain access to a database, which of the following options can you legally apply?
 - You can ask someone that you know to get access for the database.
 - You can buy access to their database from a company.
 - You can give money to an employee of the organisation to get you access to the database.
 - You can hack into a database.
 - You could personally request access to the database.
 - You could use a scraper or the website's API to record data directly from the site.
 - You can use a free database from the internet.
- 1.6.2** Which website does not provide data sets for free.
- Code for South Africa
 - Gapminder
 - University of Pretoria
 - Reddit comments

**Activity 1.6****Data mining** *continued*

- 1.6.3** What must you do after you obtained access to the database?
- Filter the information
 - Read through the information to find what you are looking for.
 - Look for patterns in the information you obtained.
 - Extract the information, creating a new database that contains only the information relevant to you.
- 1.6.4** The following is an example of a pattern that may emerge from the TBL Tour database.
- Senzo does every second trip.
 - The starting dates are evenly spaced.
 - The lengths of the tours are all the same.
 - There is an even distribution between the different destinations.
- 1.6.5** The final step in the data mining process is _____
- Extracting data.
 - Obtaining knowledge
 - Developing a strategy.
 - Accessing a data set
- 1.6.6** Which of the following targets are SMART.
- By decreasing the price of Gautrain tickets by 70%, you hope to increase the number of passengers by 20% over the next six months.
 - By decreasing the price of Gautrain tickets, you hope to increase the number of passengers by 20%.
 - By decreasing the price of Gautrain tickets by 10%, you hope to increase the number of passengers by 20% over the next six months.

1.4 Caring for and managing data

In this unit, you will learn more about the value of data and how data can be protected.

VALUE OF DATA AND METADATA

Data can be valuable for many different reasons. For example, online shopping websites can charge owners a fee for placing an advertisement of their house, used car or gym equipment on the website. However, the only way in which owners will be willing to pay this fee is if the database already contains many other products. To gather the data needed to sell these products, the website's creator can ask sellers to enter the important data for their products on the website, from where it is added to the database.

For a database to be useful, it needs to record and store valuable and useful data. To decide if the data is valuable to record, you can ask yourself these questions:

- n Will I ever use the data in this field?
- n Will anyone else use the data in this field?
- n What fields do I need specifically for my application?
- n What fields would I need for my application in the future?

Based on these questions, you can determine whether certain types of data are valuable to record and store in your database. Only data that will potentially be used by you (either now, or in the future) is valuable. Data that will not be used increases the size of your database without adding value to it.

Once you have determined whether the data itself is valuable, you need to ensure that the data is of a high quality. The following five characteristics determine the quality of the data.

CHARACTERISTIC	DESCRIPTION
Accurate	This means that the data needs to be both correct and precise.
Consistent	This means that the data in one part of your database should not contradict or differ from the data in another part of your database.
Current	For the information to be of high-quality, it is important that it is up-to-date. If you fail to keep your information current, you run the risk that it will no longer be relevant or accurate.
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.
Relevant	Good quality data is relevant to the people who are using it.

HOW TO PROTECT DATA

Databases need to be protected from several different threats, including incorrect data entry, data corruption, data loss, accidental data deletion, purposeful data deletion and unauthorised access. In the following sections, you will look at eight tools and techniques that can be used to protect databases from these threats:

- Data validation
- Data verification
- Data integrity checks
- Logging changes
- Data warehousing
- Access control
- Parallel data sets

Since no single tool offers perfect protection against all threats, most large databases use most or all these tools.

DATA VALIDATION

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 allowing your database to record it. This ensures that the data in your database is consistent and accurate. It can also be used to prevent certain types of unauthorised access (such as **SQL injections**).

For example, if you are recording data for a government survey, you can use a digit validation to ensure all people's ID numbers are exactly 13 digits long. This prevents you from accidentally adding incorrect ID numbers to the database.

DATA VERIFICATION

Data verification is a manual technique that can be used to make sure that the data on a database is correct and accurate. There are two main ways to do this:

- **Full verification** which requires that each piece of data that is entered into a database is read and checked by someone. This, however, can be very time consuming.
- **Sample verification**, in which a randomly selected sample of data is checked to ensure there are not systematic errors. This can help you to notice errors that occur in all data, but with this method it is possible to miss small mistakes (like typing errors).

DATA INTEGRITY

When we speak about data integrity, we are referring to the reliability, accuracy and how trustworthy data is over its entire lifecycle. This ties in with **data security** because uncorrupted data (integrity) is considered to be 'clean data' that stays unchanged throughout its lifecycle.

Many DBMSs have built-in **integrity controls** that help to maintain the data integrity. This includes features such as data validation and access control, but also refers to several automatic maintenance processes to prevent data corruption and errors from occurring in a database.

LOGGING CHANGES

Logging is the process of recording any changes made by users to a database. While logging does not directly protect a database from any possible threats, it can discourage people from sabotaging a database and make it easier to solve any problems once they occur.

This is called creating an **audit trail**. The audit trail records exactly:

- who made the changes
- what the user changed
- when they made the changes.

DATA WAREHOUSING

Data warehousing is a technique used for storing data from more than one database, it is usually stored in a way that is secure, reliable and easy to retrieve. While data warehousing is generally not considered as a security tool, it can help improve data integrity in several ways:

- Data warehouses make incorrect data entries or data corruption more visible by allowing data analysis.
- Data warehouses can make data loss more visible, allowing the problem to be fixed.
- Data warehouses can be used to recover critical data if it is deleted or corrupted.

Data warehouses are also a potential security weakness for databases. Your database could have all the best security features in the world, and it would not matter if hackers could simply access your data warehouse.

ACCESS CONTROL

Access control refers to managing and controlling the parts of a database that users have access to. By limiting the number of people who can change a database, and by limiting what changes each user can make, you can reduce the damage that any single user can do to a database. This becomes especially important when many users have access to your database.

There are three important ways to control access to your data:

- Passwords ensure that only the owner of a username can log in with that username.
- User rights determine which tables and fields every username can access, and what changes (if any) the user can make to these tables. This prevents others from gaining access to certain data or making changes they are not authorised to do.
- Good database security ensures that the data is secure and that outside people cannot find other ways to access the database.

For example, by using access control on a large news website, regular guests may be able to read stories but not change the data. Writers may be able to add new stories to the website but not add new users or delete stories. Finally, one or two administrators may be able to add new users or delete stories.

PARALLEL DATA SETS

Backups are the most important tool to protect databases from data loss and data corruption. To ensure that data has not been corrupted or deleted, the database is checked at intervals against a perfect copy of it, called a parallel data set. If there are differences, it means that data was either corrupted or deleted.

A company, like YouTube, would break the database into smaller pieces and have multiple backups of each piece. In this way you never risk losing the entire database at once, and even if a database crash occurs, the system can automatically load an existing backup while creating new backups.

Database backups should be protected as securely as the database itself. There have been many instances of websites where the database backup, rather than thecan protect data from data corruption, data loss, accidental deletion and purposeful deletion.



QR CODE



<https://www.youtube.com/watch?v=avP5d16wEp0>

<https://qrs.ly/4la5pff>



Activity 1.7

Caring for and managing data

1.7.1 Choose the correct answer.

- a. Data validation refers to ____?
 - A. Built-in integrity controls that help to maintain the data integrity.
 - B. A technique used for storing data from more than one database in a way that is secure, reliable and easy to retrieve.
 - C. The process in which you check whether the data is accurate.
 - D. A manual technique that can be used to make sure that the data on a database is correct and accurate.
- b. Verification refers to ____?
 - A. Built-in integrity controls that help to maintain the data integrity.
 - B. A technique used for storing data from more than one database in a way that is secure, reliable and easy to retrieve.
 - C. The process in which you check whether the data is accurate.
 - D. A manual technique that can be used to make sure that the data on a database is correct and accurate.
- c. Warehousing refers to ____?
 - A. Built-in integrity controls that help to maintain the data integrity.
 - B. A technique used for storing data from more than one database in a way that is secure, reliable and easy to retrieve.
 - C. The process in which you check whether the data is accurate.
 - D. A manual technique that can be used to make sure that the data on a database is correct and accurate.
- d. Databases need to be protected from several different threats, including:
 - A. Data mining
 - B. Unauthorised access
 - C. Data redundancy
 - D. Audit trails
- e. What does an audit trail record? **[Hint: This question has more than one correct answer.]**
 - A. Who made the changes?
 - B. Why were the changes made?
 - C. What did the user change?
 - D. When did they make the changes?
- f. Explain what data corruption is.
 - A. When a hacker steals money from someone else using personalised data.
 - B. When someone says something that is not true about someone else on the internet.
 - C. A criminal action by someone in a position of power using private data.
 - D. Errors in computer data that occur during writing, reading, storage, transmission, or processing, which introduce unintended changes to the original data.
- g. Which of the following threats are prevented by the validation of data?
 - A. Incorrect data entry
 - B. Data corruption
 - C. Accidental deletion
 - D. Data loss



Activity 1.7

Caring for and managing data *continued*

- 1.7.2 Explain in your own words why data is valuable.
- 1.7.3 List three tools and techniques that can prevent accidental and purposeful data deletion.
- 1.7.4 Explain how parallel data is used to detect and correct data corruption or loss
- 1.7.5 Today, the entire world's financial system is stored on databases that are connected to the internet. Whether you are an individual with R10 in your bank account or a massive company with billions of Rand in your account, your money is stored on a database connected to the internet. As you can imagine, this data is not only incredibly valuable, but also incredibly important to protect.

Answer the following questions.

- a. List six techniques that can be used protect data.
- b. Criminal hackers around the world are trying to break into banks' databases. List two techniques that can be used to protect data from unauthorised access.
- c. What is data integrity and why is data integrity critical for a bank's database?
- d. Do you think bank's make backups of their databases? Give reasons for your answer.

1. Choose the correct answer.
 - a. Which of the following scenarios does NOT need a database?
 - A. Storing the credentials of all Gmail accounts.
 - B. Backing up all the information on your personal computer.
 - C. Storing all the webpages of a website.
 - D. Storing all the information about a business's inventory.
 - b. Which of the following techniques is NOT used to protect data in databases?
 - A. Data encryption
 - B. Data validation
 - C. Data verification
 - D. Access control
 - c. Integrity control is used to check _____.
 - A. Unauthorised access, Data loss and Data corruption.
 - B. Data corruption, Incorrect data entry and Data loss.
 - C. Incorrect data entry, Data corruption and Purposeful deletion.
 - D. Purposeful deletion, Accidental deletion and Unauthorised access.
 - d. Which of the following techniques can be used to recover lost data?
 - A. Access control
 - B. Data verification
 - C. Data validation
 - D. Data warehousing
 - e. Which of the following people would financially benefit from data mining?
 - A. Online advertisers
 - B. Programmers
 - C. Database administrators
 - D. Security personnel
 - f. When you create a data warehouse you need to _____ the data.
 - A. Access, Analyse and Use
 - B. Find, Extract and Store
 - C. Access, Extract and Load
 - D. Extract, Transform and Load
 - g. In location-based data, which of the following is an example of non-static information?
 - A. The most popular Gautrain routes.
 - B. The current flight route of an aeroplane.
 - C. The location of a car.
 - D. The location of a hotel.

CONSOLIDATION ACTIVITY

Chapter 1: Database Management *continued*

2. Indicate if the following statements are 'True' or 'False'. 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. Full verification is when someone randomly selects a sample of data and manually checks it for systematic errors.
 - b. Gapminder provides free access to databases of South African matric results.
 - c. SMART strategies are Specific, Measurable, Achievable, Relevant and Time-bound.
3. 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).
4. Explain TWO ways RFIDS can be used to improve each of the following industries:
 - a. Retail stores
 - b. Train transportation systems.
 - c. Universities and colleges
 - d. Medical hospitals
5. Below are THREE development strategies based on different databases. State which of them are SMART strategies. Give a reason for your answer.

STRATEGY	IS IT A SMART STRATEGY?	EXPLANATION FOR ANSWER
Show car adverts on TV between 10 P.M and 12 P.M.		
Sell airtime in clothing stores like Edgars and Woolworths for the next three months to see if it increases clothing sales.		
Use flyers to advertise a new store opening in a mall, so that people will go and shop at the mall more and increase mall sales by 30% before the store opens.		

6. Other than banking, name ONE other industry that can make use of database transaction tracking. Also provide an example of a scenario in which they would use it.
7. Cherry wants to expand her small bakery business, by creating a website so that she can sell her goods online. Cherry will need to make use of a DBMS and she will need to find ways to secure her business's data.
 - a. Who would Cherry need to hire to help her keep her create, maintain and secure her database.
 - b. Mention ONE way location-based technology can help Cherry expand her business.
 - c. Mention ONE way Cherry can use data mining to improve and expand her business.

DATABASE DESIGN CONCEPTS

CHAPTER OVERVIEW

Unit 2.1 Characteristics of a good database

Unit 2.2 Problems with databases

Unit 2.3 How to get rid of anomalies

Learning outcomes

At the end of this chapter you should be able to:

- provide the characteristics of a good database
- describe the problems with databases
- explain normalisation and the process.

INTRODUCTION

Data is stored in tables in a database. It can be stored in a single table (called a **flat database** – as shown in Figure 2.1) or in multiple connected tables (called a **relational database** – as shown in Figure 2.2).

Song information				Album information				Artist information							
Title	Artist	Duration	Album	Track number	Music file	Title	Artist	Date	Duration	Cover art	Name	Albums	Songs	Biography	Artist picture
Broken Whiskey Glass	Post Malone	03:53	Stoney	1	[MP3]	Stoney	Post Malone	09/12/2016	00:50:40	[Cover Art]	Post Malone	Stoney; Beerbongs & Bentleys;	Broken Whiskey Glass; Big Lie; Déjà Vu; No Option; Cold; White Iverson; I Fall Apart; Patient; Go Flex; Feel; Too Young; Congratulations feat. Quavo; Up There; Yours Truly; Austin Post; Paranoid feat. Swae Lee; Spoil My Night; Rich & Sad; Zack and Codeine; Takin' Shots; Rockstar feat. 21 Savage; Over Now; Psycho feat Ty Dolla Sign; Better Now; Ball for Me feat. Nicki Minaj; OtherSide; Stay; Blame It on Me; Same Bitches; Jonestown; 92 Explorer; Candy Paint; Sugar Wraith;	Austin Richard Post (born July 4, 1995), known professionally as Post Malone, is an American rapper, singer, songwriter and record producer. Born in Syracuse, New York and raised in Grapevine, Texas, Malone began his musical career following the release of his debut single "White Iverson" in 2015. The song, which peaked at number fourteen on the Billboard Hot 100 and later certified quadruple platinum, allowed Malone to secure a recording contract with Republic Records later that year.	[Artist Picture]
Big Lie	Post Malone	03:27	Stoney	2	[MP3]	Stoney	Post Malone	09/12/2016	00:50:40	[Cover Art]	Post Malone	Stoney; Beerbongs & Bentleys;	Broken Whiskey Glass; Big Lie; Déjà Vu; No Option; Cold; White Iverson; I Fall Apart; Patient; Go Flex; Feel; Too Young; Congratulations feat. Quavo; Up There; Yours Truly; Austin Post; Paranoid feat. Swae Lee; Spoil My Night; Rich & Sad; Zack and Codeine; Takin' Shots; Rockstar feat. 21 Savage; Over Now; Psycho feat Ty Dolla Sign; Better Now; Ball for Me feat. Nicki Minaj; OtherSide; Stay; Blame It on Me; Same Bitches; Jonestown; 92 Explorer; Candy Paint; Sugar Wraith;	Austin Richard Post (born July 4, 1995), known professionally as Post Malone, is an American rapper, singer, songwriter and record producer. Born in Syracuse, New York and raised in Grapevine, Texas, Malone began his musical career following the release of his debut single "White Iverson" in 2015. The song, which peaked at number fourteen on the Billboard Hot 100 and later certified quadruple platinum, allowed Malone to secure a recording contract with Republic Records later that year.	[Artist Picture]
Déjà Vu	Post Malone	03:54	Stoney	3	[MP3]	Stoney	Post Malone	09/12/2016	00:50:40	[Cover Art]	Post Malone	Stoney; Beerbongs & Bentleys;	Broken Whiskey Glass; Big Lie; Déjà Vu; No Option; Cold; White Iverson; I Fall Apart; Patient; Go Flex; Feel; Too Young; Congratulations feat. Quavo; Up There; Yours Truly; Austin Post; Paranoid feat. Swae Lee; Spoil My Night; Rich & Sad; Zack and Codeine; Takin' Shots; Rockstar feat. 21 Savage; Over Now; Psycho feat Ty Dolla Sign; Better Now; Ball for Me feat. Nicki Minaj; OtherSide; Stay; Blame It on Me; Same Bitches; Jonestown; 92 Explorer; Candy Paint; Sugar Wraith;	Austin Richard Post (born July 4, 1995), known professionally as Post Malone, is an American rapper, singer, songwriter and record producer. Born in Syracuse, New York and raised in Grapevine, Texas, Malone began his musical career following the release of his debut single "White Iverson" in 2015. The song, which peaked at number fourteen on the Billboard Hot 100 and later certified quadruple platinum, allowed Malone to secure a recording contract with Republic Records later that year.	[Artist Picture]
No Option	Post Malone	02:59	Stoney	4	[MP3]	Stoney	Post Malone	09/12/2016	00:50:40	[Cover Art]	Post Malone	Stoney; Beerbongs & Bentleys;	Broken Whiskey Glass; Big Lie; Déjà Vu; No Option; Cold; White Iverson; I Fall Apart; Patient; Go Flex; Feel; Too Young; Congratulations feat. Quavo; Up There;	Austin Richard Post (born July 4, 1995), known professionally as Post Malone, is an American rapper, singer, songwriter and record producer. Born in Syracuse, New York	[Artist Picture]

Figure 2.1: Data stored in a single table in a flat database

We know that each letter in the alphabet represents a character. When you add enough characters together, they form a word (like 'orange' or 'love') that represents a concept. Therefore, allowing communication of useful information between two or more people – even across distances.

In order to communicate data and instructions, data such as numbers, letters, characters, special symbol, sounds/phonics, and images are converted into computer-readable form (binary). Once the processing of this data is complete it is converted into human-readable format, the processed data becomes meaningful information. The information becomes knowledge and can be understood and used by humans for different purposes.

ACTIVITY 2.1

Revision Activity

- 2.1.1** In your own words, explain what a database is and what it can be used for. Provide an example to support your answer.
- 2.1.2** True or False: A data warehouse uses transaction data from various sources and makes analytical use of the data.
- 2.1.3** Fill in the blanks by choosing the correct term from the list below:
[warehouse, tables, current, record, relational, primary, field]
- a. Data is stored in _____ in a database.
 - b. A single bit of information about an item or person is a _____.
 - c. When many related fields about an item are put together they form a _____.
 - d. A _____ key contains unique identifiers for each record in a database.
 - e. A database is designed to store _____ transactions whilst a data _____ stores a large quantity of historical data.
 - f. A _____ database stores data in multiple tables.

2.1 Characteristics of a good database

All good databases should begin with valuable metadata and data. In Chapter 1 we looked at the characteristics of valuable data and how to manage that data. These are illustrated in Figure 2.3 below:

The Infoneering Model

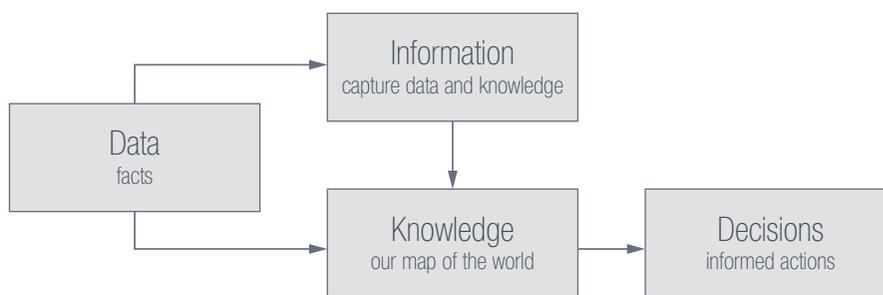


Figure 2.3: How to manage valuable database

Let's now look at the characteristics of a good database:

- The database should be strong enough to store all the relevant data and requirements.
- Should be able to relate the tables in the database by means of a relation, for example, an employee works for a department so that employee is related to a particular department. We should be able to define such a relationship between any two entities in the database.
- Multiple users should be able to access the same database, without affecting the other user. For example, several teachers can work on a database to update learners' marks at the same time. Teachers should also be allowed to update the marks for their subjects, without modifying other subject marks.
- A single database provides different views to different users, it supports multiple views to the user, depending on his role. In a school database, for example, teachers can see the breakdown of learners' marks; however, parents are only able to see only their child's report – thus the parents' access would be read only. At the same time, teachers will have access to all the learners' information and assessment details with modification rights. All this is able to happen in the same database.
- **Data integrity** refers to how accurate and consistent the data in a database is. Databases with lots of missing information and incorrect information is said to have low data integrity.
- **Data independence** refers to the separation between data and the application (or applications) in which it is being used. This allows you to update the data in your application (such as fixing a spelling mistake) without having to recompile the entire application.
- **Data Redundancy** refers to having the exact same data at different places in the database. Data redundancy increases the size of the database, creates integrity problems, decreases efficiency and leads to anomalies. Data should be stored so that it is not repeated in multiple tables.
- **Data security** refers to how well the data in the database is protected from crashes, hacks and accidental deletion.
- **Data maintenance** refers to monthly, daily or hourly tasks that are run to fix errors within a database and prevent anomalies from occurring. Database maintenance not only fixes errors, but it also detects potential errors and prevents future errors from occurring.

There are also many people involved with organising a well-run database. These are:

- the **developers**, who design and develop the database to suite the needs of an enterprise
- the **administrator**, who:
 - checks the database for its usages
 - who is checking it
 - provides access to other uses
 - provides any other maintenance work required to keep the database up to date
- the **end user**, who uses the database, for example, teachers or parents.

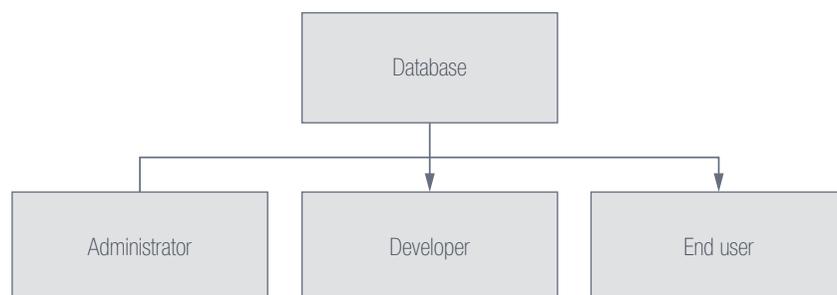


Figure 2.4: People involved with organising a well-run database

 **Activity 2.1**

2.1.1 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. 5–F).

COLUMN A	COLUMN B
1. Data maintenance	A. It refers to how well the data in the database is protected from crashes, hacks and accidental deletion. B. It refers to how accurate and consistent the data in a database is. C. It refers to the separation between data and the application (or applications) in which it is being used. D. It refers to monthly, daily or hourly tasks that are run to fix errors within a database and prevent anomalies from occurring. E. It refers to storing the exact same data at different places in a database.
2. Data integrity	
3. Data redundancy	
4. Data security	
5. Data independence	

2.1.2 Describe the three types of people who are involved with a database.

2.1.3 List the five characteristics of quality data.

2.1.4 A school would like to create a database that can:

- keep the parents informed about their child’s academics, assessments and school activities
- help the teachers record work and assessments
- store details of each child and their families.
 - a. Work in small groups of four or five learners. Discuss each characteristic of a good database and explain these referring to the scenario above.
 - b. Use a mindmap to present your discussion.

2.2 Problems with Databases

If a flat-file database is poorly planned, denormalised and inconsistent, it will create problems when trying to insert, delete or modify the records (tables) in the database. This causes **anomalies**, which make handling the data increasingly difficult as the database grows. It also makes the data integrity harder to maintain. Trying to make the data consistent once an anomaly occurs can become quite difficult.

There are three types of problems that can occur in databases:

- **Insertion anomaly:** The database has been created in such a way that required data cannot be added unless another piece of unavailable data is also added. For example, a hospital database that cannot store the details of a new member until that member has been seen by a doctor.
- **Deletion anomaly:** The legitimate deletion of a record of data can cause the deletion of some required data. For example, deleting some of the patient's details can remove all the details of the patient from the hospital database.
- **Modification anomaly:** Incorrect data may have to be changed, which could involve many records having to be changed, leading to the possibility of some changes being made incorrectly.

Example 2.1 Problems that occur in a database

For example, look at the below schema that represents information related to a school:

AccountInfo

ACCOUNTNO	ACCOUNTNAME	ACCOUNTADDRESS	CHILD	BALANCE
335684	Agatha Jones	Cape Town	Keene	R451
335684	Bob Jones	Cape Town	Keene	R451
335684	Agatha Jones	Cape Town	Joshua	R451
335684	Bob Jones	Cape Town	Joshua	R451

Problems:

- **Data redundancy:** Data redundancy refers to storing the exact same data at different places in a database. Data redundancy increases the size of your database, creates integrity problems, decreases the efficiency of the database and can lead to database anomalies. Data should be stored in such a way that it should not be repeated in multiple tables. The family can be represented as one unit.
- **Update anomaly:** Data will be inconsistent if one entity is updated, for example, if the family address changes, the data capturer will need to change all four entities.
- **Unable to represent some information:** the school cannot keep information about learners who are on the waiting list as they do not have an account with the school.
- **Deletion anomaly:** closure of the account for one child will remove all data of the second child from the database.



Activity 2.2

2.2.1 List the three types of anomalies and provide an example for each one.

2.2.2 Look at the below schema that represents information related to a hospital:

AccountInfo

ACCOUNTNO	ACCOUNTNAME	ACCOUNTADDRESS	DOCTOR	BALANCE
45873	J Jones	Cape Town	Dr Pretorius	R12 342
45874	P Jones	Cape Town	Dr Pretorius	R762
45875	R Jones	Cape Town	Dr Pretorius	R980
45875	R Jones	Durban	Dr James	R2 633

List and explain at least four anomalies with this database.

2.3 How to get rid of Anomalies

To prevent anomalies you need to normalise the database by efficiently organising the data in a database. According to Edgar F Codd, the inventor of relational databases, the goals of normalisation include:

- removing all redundant (or repeated) data from the database
- removing undesirable insertions, updates and deletion dependencies
- reducing the need to restructure the entire database every time new fields are added to it
- making the relationships between tables more useful and understandable.

Normalisation is a systematic approach of decomposing tables to eliminate data redundancy and Insertion, Modification and Deletion Anomalies. The database designer structures the data in a way that eliminates unnecessary duplication(s) and provides a rapid search path to all necessary information. It is a multi-step process that puts data into tabular form, removing duplicated data from the relation tables. This process of specifying and defining tables, keys, columns, and relationships in order to create an efficient database is called **normalisation**.

Normalisation will reduce the amount of space a database uses and ensure that data is efficiently stored. Without normalisation, database systems can be inaccurate, slow, and inefficient. They might not produce the data that you expect.

In practice this means changing your database so that the following requirements are met:

- each table must have a **primary key**
- each record should have single valued attributes/columns (atomic)
- there should be no repeating groups of information.

Keys are used to establish and identify relationships between tables and also to uniquely identify any record or row of data inside a table. A key can be a single attribute or a group of attributes (composite-primary key), where the combination may act as a key. Keys help us to identify any row of data.

When designing a database, the four types of key fields are:

- **Primary key:** the field selected by the database creator to uniquely identify each record on a table. For example, each song in your music database might have a primary key field called “song_id”.
- **Alternative key:** a field containing unique values that could be used as the primary key but is not currently set as the primary key, for example, artist_id.
- **Foreign key:** a field containing values from a different table's primary key field. Foreign keys are used to show the relationship between different tables. For example, each song in your music database might have a foreign key field called “artist_id” that links the song to a specific artist on an “artists” table.
- **Composite key:** a combination of more than one field that uniquely identifies each record on a table, for example, song_id and artist_id.

Let's use this example to understand the four main types of keys:

SONG_ID	ARTIST_ID	TYPE OF MUSIC	YEAR
Twinkle twinkle	Mary	Lullaby	1893
Humpty dumpty	Percy	Nursery rhyme	1872
Snowflake	King	Lullaby	1978
Wheels on the bus	Dwayne	Nursery rhyme	1956

Normalisation rules are divided into the following normal forms:

FIRST NORMAL FORM (1NF)

For a table to be in the **First Normal Form**, it should follow the following four rules:

- **Each column must have a separate field/attribute.** Each column of your table should not contain multiple values. For example, imagine the database for Facebook status updates, specifically the table related to likes. For the records to be indivisible, each like should be stored in a separate record. In this way, each record would either have occurred or not occurred. There is no way to say that only a small part of the like occurred, while a different part did not. However, if all the likes for a status update are stored in a single record, then the record would be divisible, since it would be possible for some of the likes to have occurred while others did not occur.
- **Values stored in a column should be of the same kind or type (domain).** In each column the values stored must be of the same kind or type.
- **All the columns in a table should have unique names.** Each column in a table should have a unique name to avoid confusion at the time of retrieving data or performing any other operation on the stored data. For example, specify Child's name and parent's name, don't use 'Name'.
- **The order in which data is stored, does not matter.** For example

ACCOUNTNO	NAME	SUBJECT
542	Tafadzwa	Eng, Maths
543	Sipho	Science, ICT
544	Gift	ICT, Maths
545	Naledi	English, Science

- The table complies to three rules out of the four rules: the column names are unique, the data stored is in the correct order and there are no inter-mixed different types of data in the columns. However, the learners in the table have opted for more than one subject. This data has been stored in the subject names in a single column. As per the 1NF, each column must contain a single value.

SECOND NORMAL FORM (2NF)

For a table to be in the **Second Normal Form**:

- it should be in the First Normal Form.
- and it should not have Partial Dependency.

This is where an attribute in a table depends on only a part of the primary key and not on the whole key. For example, a table records the primary keys as student_id and the subject_id of each learner. Only the teacher's name depends on subject. So, the subject_id, and has nothing to do with student_id.

THIRD NORMAL FORM (3NF)

A table is said to be in the **Third Normal Form** when:

- it is in the Second Normal Form.
- it does not have Transitive Dependency. Transitive Dependency occurs when an attribute/field depends on other attributes/fields rather than depending on the primary key.

This is an indirect relationship between values in the same table.



Activity 2.3

- 2.3.1 Explain why normalisation is important for a database.
- 2.3.2 How can normalisation be reached?
- 2.3.3 List and describe the four types of key fields that can be used in a database.
- 2.3.4 How would you fix the below table to reach 1N?

ACCOUNTNO	NAME	SUBJECT
542	Tafadzwa	Eng, Maths
543	Sipho	Science, ICT
544	Gift	ICT, Maths
545	Naledi	English, Science

- 2.3.5 Give examples, not mentioned above, of the different key fields.
- 2.3.6 Using the information in the table below, give examples of any two keys.

STUDENT_NAME	STUDENT_PHONE	SUBJECT	TEACHER	TEACHER_PHONE	TEST_1	TEST_2	EXAM
John Smith	082 000 0000	Mathematics	Siyabonga Molefe	083 123 4567	67%	72%	81%
John Smith	082 000 0000	Science	Pieter Botha	083 986 5432	41%	65%	62%
Junior Ndlovu	082 111 1111	IT	Mpho Dlamini	082 333 3333	81%	84%	88%
Junior Ndlovu	082 111 1111	Science	Pieter Botha	083 986 5432	71%	73%	73%
Junior Ndlovu	082 111 1111	Mathematics	Siyabonga Molefe	083 123 4567	79%	65%	81%

CONSOLIDATION ACTIVITY**Chapter 2: Database design concepts**

1. Choose the correct answer.
 - a. Which of the following scenarios does NOT need a database?
 - A. Storing the credentials of all Gmail accounts.
 - B. Backing up all the information on your personal computer.
 - C. Storing all the webpages of a website.
 - D. Storing all the information about a business's inventory.
 - b. Which of the following is a characteristic of a good database?
 - A. Making copies of data in a database for backup.
 - B. Keeping the data and application connected and dependant on each other.
 - C. Preventing errors from occurring in the database.
 - D. Storing data in different formats.
 - c. Which of the following is needed to make each record in a database table different?
 - A. Secondary key
 - B. Foreign key
 - C. Primary key
 - D. Alternative key
2. List the four types of keys used to design a database. Design a table to use as an example.
3. In database design what are the requirements for 1NF, 2NF and 3NF?

HARDWARE

CHAPTER OUTCOMES

Unit 3.1 Mobile technologies

Unit 3.2 Factors influencing performance of a computer

Unit 3.3 Motivate a typical computer system in respect of user requirements

Learning outcomes

At the end of this chapter you should be able to:

- list the advantages and disadvantages of mobile technologies
- discuss the factors influencing the performance of a computer
- make better hardware buying decisions and make recommendations for specific scenarios.

INTRODUCTION

A large reason for this trend towards mobile computing is that mobile computers provide you with most of the advantages of computers wherever you go. Computer users no longer need to sit in one place to use a computer or a fixed internet line to connect to the internet. Instead, any question you have, message you need to send, video you want to watch or song you want to listen to, is now available to you wherever you go – if you have a smartphone.

Most of the tasks smartphones are not suited to do (sending long emails, creating documents etc.), notebooks can do exceptionally well. It is only in specialist areas like programming, video editing and gaming that desktop computers are preferred. As a result, many desktop computers are sold to power users and gamers, while average computer users prefer mobile computers.

In this chapter you will learn about the advantages and disadvantages of mobile computing and how to troubleshoot hardware problems. You will also learn more about choosing hardware components and designing an appropriate computer for different situations.

HARDWARE IN A NUTSHELL

You have learnt about the different hardware devices, their functions and capabilities. Here is a recap of these:

- An input device allows the user to interact directly with a computer. Common input devices include the following: keyboards, pointing devices (mouse), touch-sensitive pads, pen input, video input, scanners, capturing devices, data collection devices, biometric input, and card readers.
- An input/output device is any hardware used by a human operator or other systems to communicate with a computer. They are capable of sending data (output) to a computer and receiving data from a computer (input). Common input/output devices include: touch screens, game controllers, digital cameras, smart phones, smartboards, toy/electronic device interfaces.
- An output device is any device that takes data stored on a computer and makes it available to the user in an easy to understand way. This data may be made available using pictures (such as on a monitor or printed to a page) or using sounds (such as with speakers and earphones). The output devices can be divided into the following: display devices – monitors (LCD, LED), and printers (inkjet, ink tank, laser, 3-D).
- Storage devices all serve the same general purpose: to store data. Because of the differences in storage capacity, portability and speed, different storage devices are generally used for different reasons. Types of storage devices: hard disk drive (HDD), external (portable) hard drives, solid-state drive, hybrid storage device, flash drives (disks), SD/memory cards, cd, dvd and blu-ray drives.
- Processing devices are the computer devices responsible for carrying out instructions and performing calculations. Processing devices include: central processing unit (CPU) and the graphics processing unit (GPU).

ACTIVITY 3.1

Revision Activity

- 3.1.1 List five examples of hardware.
- 3.1.2 List five of your own examples of input devices.
- 3.1.3 Explain how computers have changed (in what way, advantages and disadvantages).

3.1 Mobile technologies

In ICT, mobile technologies refer to computing devices like smartphones, laptops and tablets. These are small, but powerful, devices that are easy to carry around. This unit will look briefly at the advantages of mobile computers, before looking at the constraints faced by mobile computer creators.

UNDERSTANDING SMARTPHONES

Small, mobile computers and smartphones have most of the same hardware as desktop computers. As such, it is important to understand how smartphone components compare with those of desktop computers. In general:

- A smartphone features an onscreen-touch keyboard that is much smaller than that of a standard computer. The keyboard and mouse of a standard computer is preferred because of the comfortable sizing.
- Smartphones screens are touch screens that are smaller than desktop screens.
- Standard computers generally can be fitted with more RAM and faster processors, making them better suited to tasks that require significant processing power.
- Smartphones come standard with communication devices like bluetooth and wifi, making them better at connecting to the internet via the numerous hotspots anywhere in the world.

This means that desktop computers are more powerful and are better suited for serious computing tasks, whether it is a processor intensive task such as encoding videos or inputting large amounts of data. However, high-end smartphones are small, easy to carry around and better suited than computers at many tasks requiring a very mobile computer. This includes tasks like reading messages and emails, setting reminders, checking the weather, updating social media accounts, making bank payments, doing Google searches and making voice and video calls.

Smartphones and tablets are also better at location-based computing, which refers to software that changes the application based on a user's location. As you have learned in Chapter 1, examples of location-based computing include weather applications, food ordering applications, car sharing services, dating applications and **augmented reality (AR)** applications.

All these technologies use a combination of GPS and mobile internet connections to improve the service they offer you. Many of these location-based services are unique to mobile computers.

ADVANTAGES OF MOBILITY

When compared to desktop computers, mobile computers have several significant advantages. Amongst these advantages is:

- **size and weight:** due to these devices being small and light weight, they are easy to carry around, easy to keep on hand, can be used in any location and are comfortable to use without a desk.

As smartphones, tablets and notebooks have become more powerful, the number of uses that desktop computers are significantly better at (like gaming and video editing) have decreased, while the number of tasks that mobile computers are significantly better at continues to increase.

MOBILE CONSTRAINTS

Mobile computing constraints refers to the disadvantages of smart phones, laptops and tablets caused through battery life and computing power versus power consumption.

Let's work through each constraint in order to understand how these constraints affect mobile computers.

BATTERY LIFE

The processing power of a CPU is closely linked to the amount of electricity available to it. The more power your CPU uses; the more instructions it can complete. The problem for smartphones and tablets is that they have a limited amount of power stored in the battery, and this power generally needs to last the whole day.

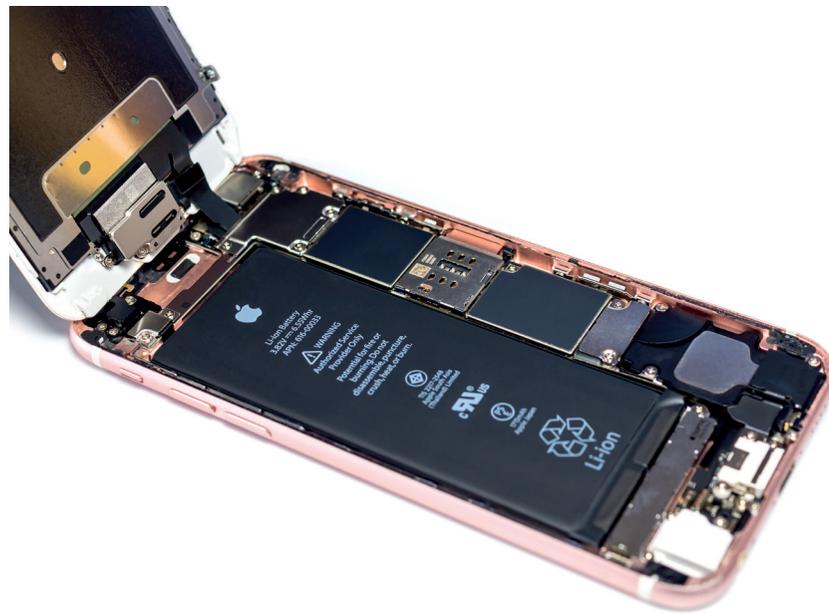


Figure 3.1: Smartphone batteries are designed to last at least one day on a single charge

COMPUTING POWER VS POWER CONSUMPTION

Because of the small size of mobile devices (especially smartphones and tablets), all smartphone components need to be miniaturised. The physical size of a smartphone or tablet CPU is almost the same as the physical size of a desktop CPU. However, unlike desktop CPUs, these chips contain many components, including a CPU, GPU, LTE modem, Wi-Fi connector, RAM, Bluetooth connector and GPS tracker. In a desktop, each of these components are separate – this means that each item can be more powerful.

Even the biggest smartphone monitor is tiny compared to a desktop monitor and can only display a limited amount of information. This makes it unsuitable to use applications that require a large amount of information to be shown (such as spreadsheets or word processing).

- While this works well when it is in a user's hands, it makes it difficult to use with a physical mouse and keyboard.

	A	B	C	
1	Timestamp	Name	Date	Mc
2	01/03/2018 00:00:00	Azhar Patel	01/03/2018	2
3	01/03/2018 00:00:00	Caryn O'mahony	01/03/2018	2
4	01/03/2018 11:49:41	Annamarie Maritz	01/03/2018	2
5	01/03/2018 15:27:59	Brix Els	01/03/2018	2
6	02/03/2018 00:00:00	Azhar Patel	02/03/2018	2
7	02/03/2018 00:00:00	Azhar Patel	02/03/2018	2
8	02/03/2018 00:00:00	Caryn O'mahony	02/03/2018	2
9	02/03/2018 10:10:18	Fahd Lajabu	01/03/2018	2
10	02/03/2018 11:47:51	Annamarie Maritz	02/03/2018	2
11	04/03/2018 23:53:38	Praise Magidi	01/03/2018	2
12	04/03/2018 23:55:17	Praise Magidi	02/03/2018	2
13	04/03/2018 23:57:46	Praise Magidi	03/03/2018	2
14	04/03/2018 23:59:32	Praise Magidi	04/03/2018	2
15	05/03/2018 00:00:00	Azhar Patel	05/03/2018	2
16	05/03/2018 00:00:00	Kassie Kasselmann	05/03/2018	2
17	05/03/2018 00:00:57	Praise Magidi	04/03/2018	2
18	05/03/2018 10:32:20	Marc Pellencin	02/03/2018	2
19	05/03/2018 11:56:16	Annamarie Maritz	05/03/2018	2
20	05/03/2018 13:27:24	Lauwinda Hartley	05/03/2018	2
21	05/03/2018 13:33:43	Marc Pellencin	05/03/2018	2
22	05/03/2018 13:34:51	Marc Pellencin	05/03/2018	2
23	05/03/2018 14:53:59	Ivy Asamoah-awuah	01/03/2018	2

Figure 3.2: Smartphone do not show large amounts of data well

The last element we will explore is the size of the keyboard. While a smartphone or tablet keyboard is well suited to sending quick messages or occasionally typing an email, they are not well suited to entering large amounts of text

Taken together, these functions make smartphones and tablets less suitable for tasks requiring a lot of processing power or user input.

Because of this, smartphones simply cannot run the same CPU-intensive programs as computers. Even if they could somehow get rid of all the heat this would generate, their battery would go flat in a few minutes.



Did you know

A high-end gaming PC uses more power in one day than a high-end smartphone uses in a year!



Case Study

Samsung Galaxy Note 7 heat problems

In 2016, the Samsung Galaxy Note 7 was one of the fastest and most expensive smartphones of the year. However, a few weeks after the phone launched, Samsung received thousands of complaints that the phone was heating up to dangerous levels and were forced to recall and refund the owners of more than 2 000 000 Galaxy Note 7s.



Figure 3.3: Many organisations banned people from travelling with Galaxy Note 7's

Two months after being released, Samsung issued a full recall on all Samsung Galaxy Note 7s and stopped all production of the phone. After testing more than 200 000 phones, Samsung announced that the problem was with the lack of space between the CPU and the battery. As a result, the connectors inside the battery warped from the heat, which caused some of them to short circuit and catch fire.



Activity 3.2

Mobile technologies

3.2.1 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.)

- In ICT, mobile technologies refer to computing devices that are small, but powerful, devices that are easy to carry around.
- The current trend shows that more desktops are sold than mobile devices.
- Notebooks are not suited to do tasks such as sending long emails or creating documents.
- Mobile computing constraints do not refer to the disadvantages of mobile computers.
- The more power a CPU uses the less heat it generates.



Activity 3.2

Mobile technologies *continued*

- 3.2.2** Compare mobile devices with desktop computers and give at least THREE reasons why mobile devices are becoming more popular than their larger counterparts?
- 3.2.3** What are the limitations of smartphone monitors as compared to desktop monitors?
- 3.2.4** You bought yourself a good middle-of-the-range smartphone so that you can play your games wherever you are. However, you soon realise that most of the time you are playing a game, your phone becomes very hot.
- Why does this happen? Explain.
 - Why does this not happen when you play the same games on your desktop computer? Explain in your own words.
 - What other problems may you experience when playing games on your smartphone and why does it happen?
 - Choose whether you would prefer using a desktop computer or a laptop/mobile device. List all the pros and cons of the device you choose. Your list should convince someone else to switch from their current device.

3.2 Factors influencing performance of a computer

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.

There are two factors that have a direct effect on your CPU's (and therefore, your computer's) performance: **The speed of the CPU** and the **ability of the CPU to run multiple processes**.

The speed of the CPU is a direct measurement of how many instructions it can complete per second. The more instructions it can complete, the faster the CPU and your applications run. This is closely linked to the CPU's clock speed (given in MHz or GHz), which indicates how frequently it will complete an instruction per second.

The second factor is the ability of the CPU to do multiprocessing. Multiprocessing allows a computer to complete tasks from multiple applications at the same time. A CPU that is good at multiprocessing might be able to complete the instructions from hundreds of processes at the same time. A CPU that is not as good at multiprocessing might start stuttering if it tries to run too many processes at once.

A slow GPU will not affect your computer's performance on normal applications (like creating a document or browsing the web), but it will have a big effect on the performance of graphic-intensive tasks, such as playing games or creating videos.

The two main factors that affect the GPU's performance are:

- GPU clock speed (MHz) – the higher the clock speed, the more instructions the GPU can process
- the type of GPU.

MEMORY CAPACITY

RAM

When the RAM capacity is too small, using the computer will become much slower as information needs to constantly be added to and removed from RAM. This will be especially noticeable when switching between two open applications since the computer would need to remove all the previously open application's data from memory and replace it with the new application's data. When this problem becomes serious enough, your computer might automatically close some applications to free up memory.



Not enough memory to open this page

Try closing other tabs or programs to free up memory.

[Learn more](#)

Figure 3.4: A computer might close applications or web pages if it runs out of RAM



New words

seek time – the time taken for a disk drive to locate the area on the disk where the data to be read is stored.

rotational latency – also called rotational delay, is the amount of time it takes for the desired sector of a disk (i.e., the sector from which data is to be read or written) to rotate under the read-write heads of the disk drive)

CPU CACHE

Another form of memory is caching. Caching refers to a small, temporary form of storage that is created so that the data stored in the cache can be accessed more quickly. There are three important forms of caching:

- **CPU cache:** Due to the growing difference in speed between a computer's CPU and RAM, many CPUs now have a small, high-speed cache built into the CPU where it can temporarily store the data it needs. The speed and size of the CPU cache can have a significant impact on a CPU's performance.
- **Disk cache:** The disk cache 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.
- **Web cache:** The web cache 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. This allows users to quickly load those images from their computers, rather than over a slow internet connection, when they open a page that they have previously viewed.

STORAGE

Secondary Storage (also called external memory or auxiliary storage) is not directly accessible to the CPU. The computer uses its Input/output channels to access secondary storage and transfer the desired data to primary storage. **Hard Disk Drives (HDDs)** and **Solid State Drives (SSDs)** are used as secondary storage. Other examples of secondary storage technologies include USB flash drives, Compact Disks(CDs), Digital Video disks(DVDs) external hard disk drives.

SPEED

The access time per byte for HDDs or SSDs is typically measured in milliseconds (one thousandth seconds), while the access time per byte for primary storage is measured in nanoseconds (one billionth seconds). Thus, secondary storage is significantly slower than primary storage. Rotating optical storage devices, such as CD and DVD drives, have even longer access times. Once the disk read/write head on HDDs reaches the proper placement and the data, subsequent data on the track are very fast to access. To reduce the seek time and rotational latency, data are transferred to and from disks in large contiguous blocks.

DISK CACHING

The disk cache 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 and if the same data is required then it is taken from the disk cache improving the time it takes to read from or write to a hard disk. It is usually included as part of the hard disk or a specified portion of random access memory (RAM).

NETWORK INTERFACE CARD (NIC)

The NIC provides the hardware interface between a computer and a network and enables a device to network with other devices. It can either be in the form of an add-in card that fits in an expansion slot on a computer's motherboard to expand the functionality of the system or is usually built-in and is a part of the circuit board. The standard wired NIC is measured by its speed in Mbps (Megabits per second): 10 Mbps is too slow, 100 Mbps is faster, and 1000 Mbps (1 gigabit) is the fastest.

The speed of the NIC can affect performance when it comes to:

- loading webpages or web applications
- downloading applications or games from the internet
- downloading program updates from the internet
- copying large amounts of data over the network
- watching multimedia over the network.



Activity 3.3

3.3.1 Choose the correct answer.

- What is the purpose of the CPU?
 - Completes the graphics processing tasks of the computer.
 - Completes the general processing tasks of the computer
 - Slow, long-term storage of data used on the computer
 - Fast, long-term storage of data used on the computer
- What is the purpose of the GPU?
 - Completes the general processing tasks of the computer
 - Slow, long-term storage of data used on the computer
 - Connects all the components of the computer.
 - Completes the graphics processing tasks of the computer
- What is the purpose of the ROM?
 - It stores the BIOS, the motherboard's operating software
 - Connects computers to a network and the internet.
 - Fast, long-term storage of data used on the computer.
 - Very high-speed storage which temporarily stores data the CPU is using.
- What is the purpose of the HDD?
 - Very high-speed storage which temporarily stores data the CPU is using
 - Very high-speed storage which temporarily stores data the CPU is using
 - It stores the BIOS, the motherboard's operating software
 - Slow, long-term storage of data used on the computer.
- What is the purpose of a NIC?
 - Displays the images generated by the computer.
 - Connects all the components of the computer.
 - Connects computers to a network and the internet.
 - Completes the general processing tasks of the computer

**Activity 3.3***continued*

3.3.2 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. 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. C. _____ have more and better communication devices, making them better at connecting to the internet from anywhere in the world. D. It is a small, high-speed cache built into the CPU where it can temporarily store the data it needs. E. _____ have more RAM and faster processing devices, making them better suited to tasks that require significant processing power.
2. Disk cache	
3. Computers	
4. Smartphone	
5. Web cache	

3.3.3 Choose the correct answer.

- a. What causes a computer program to stutter, stall, or take a long time to complete a task?
 - A. The speed of the storage device.
 - B. Slow CPU.
 - C. A RAM capacity that is too small.
 - D. All three
- 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 NIC 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.

3.3.4 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 too slow.
- b. The speed of the CPU and its ability to run multiple processes have a direct effect on the CPU's performance.
- c. The speed of the CPU is a direct measurement of how many instructions it can complete per minute.
- d. The CPU's clock speed indicates how frequently it will complete an instruction per second.
- e. The CPU's ability to do a single task determines how good it is.
- f. Data that the computer is using, is permanently stored by the cache and RAM.
- g. Since the cache and RAM are both much faster 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 CPU.



Activity 3.3 *continued*

- i. Your computer (or CPU's) cache is a slower form of memory, used to send and store all the information the CPU needs.
 - j. Storage speed is unimportant when opening a program or a large data file.
 - k. Storage speed is important when loading your operating system.
 - l. Network speed also affects the computer's performance. If the time to download a video is shorter than the video time, the video will stutter if you try to play it on YouTube.
 - m. The network speed will negatively affect a computer's performance when downloading applications or games from the internet.
 - n. Buses are the electrical circuit 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 browse the web much more quickly.
- 3.3.5** Answer the following questions in your own words:
- a. Which Three computer components can have a significant impact on a computer's performance?
 - b. How does a CPU's clock speed affect the computer's performance?
 - c. Why does the speed of a storage device determine how quickly a new program opens?
 - d. Why does the computer become slower if the RAM's capacity is too small?
- 3.3.6** 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?
- 3.3.7** 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?

By using top-of-the-line hardware components, you could build a computer able to play the latest games with ultra-quality graphics and 4K resolution, encode videos in a fraction of the time of normal computers, and complete any daily computing task while only using a small percentage of the power available!

In this unit, you will learn more about different hardware configurations. You will learn what range of hardware to select for a specific type of user, how to compare and select between two different types of hardware, and finally, how to identify the hardware configuration already installed in a computer.

SELECTING AN APPROPRIATE CONFIGURATION

This section will look at typical computer setups for the following types of users:

- Home user
- Small office user
- Gamer
- Power user

For each user, you will learn to identify what they are most likely to use the computer for, what components are important for their use and why certain components should be selected.

HOME USER

The average home user mostly uses a computer for:

- browsing the internet
- posting on social networks
- sending email
- doing word processing
- watching online and local videos
- listening to music.

However, categorising someone as an 'average' home user has become a lot harder than it used to be.

SMALL OFFICE USER

The average business user uses a computer for:

- online research
- sending emails and business communication
- using word processing and spreadsheet applications
- note taking.

None of these tasks require a very powerful computer. However, there are four factors that are particularly important to business users:

- **Mobility**, which allows them to take their computers to meetings or home.
- **Battery life**, which allows them to use their computers for extended periods of time without access to a power source.
- **Screen resolution**, which allows them to view more information on a screen at a time.
- **Speed**, since business users are usually paid for the work they deliver, the computer should never decrease their productivity.

GAMER

Modern games are designed to take advantage of the incredible processing power of CPUs and GPUs. As a result, they are one of the most processing-intensive tasks completed on personal computers.

Gaming is such a good measure of a computer's processing power, that games are often used to **benchmark** computer hardware and see how well certain types of hardware perform.

This does not, however, mean that all gaming computers must be expensive. There are three options for gaming PCs:

- entry level
- mid-range
- high-end

The biggest difference between an entry-level gaming computer and a mid-range gaming computer is the graphics card. High-end gaming computers will be able to play all games at high or very high quality, while the most expensive of these computers will be able to play games at ultra-high quality at very high resolutions.

With gaming computers, it is incredibly important that you build a balanced setup where all the components are roughly the same speed. Having a CPU that is much faster than your GPU will not help your computer, since the quality of your game will be limited by the speed of your GPU. The same is true if you have too little or too slow RAM.

POWER USERS

The term *power user* is a general term that refers to people who use their computers to do advanced tasks. Examples of power users include computer programmers, web developers, video editors and graphic designers.

In general, these tasks do not require computers more powerful than those of gaming computers, although processing speed and RAM are especially important for power users, as it allow these users to run more applications at the same time and complete processing-intensive tasks (such as video encoding or compiling a program) more quickly. Power users may also require more storage space on their computers and usually use at least two monitors for their work.

SELECTING THE HARDWARE

Now that you have a basic idea of the types of computers to purchase for different users, you can look at specific components to use for different configurations. The table below suggests hardware configuration for different types of computers.

Table 3.1: Hardware configuration for different types of computers

	HOME	SMALL OFFICE	GAMING	POWER USER
CPU	Entry	Mid	High end	High end
GPU	No Specification/ Entry	No Specification	High end	High end
RAM	Entry	Mid	High end	High end
STORAGE	Entry/Mid	Entry/ Mid	High End	High end
MONITOR	Entry	Entry	High End	High End



Take note

Hardware manufacturers release new components every year, and the relative strength and weaknesses of these components change every year. As such, the table above can, at best, be a starting point. Before purchasing any components, you should do research on them using the internet.



Activity 3.4

Analysing pre-built computers

Look at the following computer advertisements, then answer the questions below.

Based on these advertisements, answer the following questions.

- 3.4.1 Which computer would you recommend for a high-end gamer?
- 3.4.2 Which notebook would you recommend for a power user?
- 3.4.3 Which computer would you select for a family and why would you select it? Are there any extra accessories you would purchase for this computer?



Activity 3.5

Hardware configurations

3.5.1 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. Someone who uses a computer or network service for own personal use.	A. Gamer
5. This refers to the small or home office environment and the business culture that surrounds it.	B. Home user
6. A hobbyist or individual that enjoys playing various types of digital or online game.	C. Power user
7. This is a person that uses their computer to do advanced tasks.	D. Small office user
8. Mobility, battery life, screen resolution and speed in a computer is important for this type of user.	
9. The computers used by this type of user require powerful computers with very good processing speed and RAM. They also require more storage space on their computers and usually use at least two monitors for their work.	
10. This type of user can start with a desktop computer with a mid-range CPU and mid-range graphics card (for gaming).	
11. An Ultrabook or mid-range notebook is a good choice for this type of user.	
12. This user uses a computer with word processing and spreadsheet applications mostly for online research, sending emails and business communication, note taking	
13. This user uses a computer mostly to browse the Internet, post on social media, send emails, watch online and local videos and listen to music.	



Activity 3.5

Hardware configurations *continued*

- 3.5.2 If you have a computer at home, what do you do on the computer as a home user?
- 3.5.3 Let's say you choose to do home-schooling where you learn and study at home, will your uses of the computer change? How?
- 3.5.4 What are the four factors that are particularly important to business users when they are selecting a computer to do their work on?
- 3.5.5 What are the main characteristics of a gaming PC?
- 3.5.6 What is a power user? Give two examples of power users.
- 3.5.7 Explain the term, "hardware configuration" in your own words.
- 3.5.8 Give two reasons why you should know your computer hardware configuration.
- 3.5.9 Look at the following advertisements of four computers.

ACER AXC-780 i3 DESKTOP	AMD RYZEN 7 2700	INTEL 8TH GEN	HP 15-SERIES INTEL CORE i5 LAPTOP
Intel® Core™ i3-7100 processor 4GB RAM & 1 TB hard drive Wireless mouse and keyboard Windows 10 Home 1-year warranty R4 800 (Price includes VAT) Featuring Intel 7th generation CPU Competent multi-tasker Smooth computing Great HD visuals Enjoy added functionality	AMD RYZEN 7 2700 (3.2 GHz; 20 MB cache; 8 x cores, 16x threads, turbo 4.1 GHz) CPU MSI B350 PC mate gaming AM4 DDR4 USB3.1 RYZRN motherboard 500W 80+ high performance power supply 4.1 GHz GeForce GTX 1070 TI Pro-gaming PC 8GB DDR4 2666MHz high performance gaming RAM with heat spreader 480GB SSD up to 500MB/s + speed ultra-fast SSD (OS drive) 6 x 120mm RGB fans + dual tempered glass Integrated 8 CH high definition sound card LCD and OS optional 24 months warranty	INTEL 8th generation core i7-8700 (3.2GHz; 12MB cache; 12 x cores; Turbo 4.6GHz) CPU MSI H310 PRO VD DDR4 LGA 1151 USB 3.1 INTEL 8th Gen motherboard Default CPU integrated 3D graphics video INTEL 8th generation UHD 630 DX12 integrated graphics core 8GB DDR4 high performance gaming RAM 1TB HDD 7200rpm 64MB cache high performance hard drive Standard black case with 400W PSU 24 x dual layer DVD +/- writer Integrated 7.1 CH HD sound card Gigabit LAN card + broadband ready LCD and OS optional 24 months warranty	Intel core i5 – 7200U (up to 3.10 GHz) Integrated 3D graphics 8GB RAM 1 TB HDD 8 hour battery life Ethernet/Wi-Fi/Bluetooth Windows 10 Home Includes backpack and mouse 2 year collect-an-repair warranty

Based on these advertisements, answer the following questions:

- a. Identify the CPU used for each of the four computers.
- b. Write down the name of one of the motherboards included in these computers.
- c. Which computer is sold with a solid-state drive?

**Activity 3.5****Hardware configurations *continued***

- d. Why do you think each of these advertisements start by listing the computer's CPU?
- e. The third advertisement states that an OS is optional. What do you think this means?
- f. Which computer would you suggest for the following users? Give reasons for your answers.
 - i. A family that will use the computer for browsing the internet and playing some games.
 - ii. A gamer and power-user.
 - iii. An office worker who often travels.

3.5.10 This is an optional activity.

Read through the following table showing hardware configurations for different types of computers.

	HOME	SMALL OFFICE	GAMING	POWER USER
CPU	Intel Core i3; AMD Ryzen 3	Notebook Intel Core i5	Intel Core i5; AMD Ryzen 5	Intel Core i7; AMD Ryzen 7
GPU	None; GeForce x50-series	None	GeForce x60 or x70 series; Radeon x70 or x80 series	GeForce x60 or x70 series; Radeon x70 or x80 series
RAM	8 GB, 2 400 MHz	8 GB	8 GB, 2 666 MHz	16 GB, 2 666 MHz
Storage	1 TB, 7200 RPM	500 GB	256 GB SSD and 2 TB, 7200 RPM	256 GB SSD and 4 TB, 7200 RPM
Monitor	23" FHD	14" – 15" built-in	23" FHD	2 × 23" FHD
Additional	Speakers, Printer	23" FHD Monitor, Printer, Wireless mouse and keyboard	Gaming mouse, Gaming headset	Speakers

Based on internet research, answer the following questions:

- a. What is the best price you can find for the home computer's components?
- b. How much would the gaming computer cost?
- c. Which components have the largest impact on the price?
- d. How much would a similar small office notebook cost?
- e. How much does a gaming notebook cost?

3.5.11 Building your own computer: Imagine you had a job that paid R100 per hour and wanted to save for a new computer. Based on the money you can save and the prices of components, complete the activity below:

- a. Make a list of all the components you would purchase for your computer. Make sure to include at least the following components: CPU, motherboard, RAM, case, power supply, monitor, keyboard and mouse.
- b. Give reasons why you selected each of your components.
- c. Using the internet, search for a benchmark for the CPU you selected. How does it compare to other CPUs on the list?
- d. Did you include a GPU in your computer? Why or why not?
- e. How much would your computer cost to build?
- f. How many hours would you need to work to save up for this computer?
- g. Realistically, how many hours could you work per week?
- h. Based on this information, would you change any of your components?

CONSOLIDATION ACTIVITY Chapter 3: Hardware

1. Choose the correct answer.
 - a. Which of the following affects the performance of the CPU?
 - A. Memory clock speed
 - B. Number of cores
 - C. Amount of RAM
 - D. Amount of space
 - b. Which of the following would permanently store the operating system?
 - A. CPU
 - B. ROM
 - C. RAM
 - D. Hard disk
 - c. Which of the following devices is best suited for location-based technology?
 - A. Smartphone
 - B. Laptop
 - C. Server
 - D. Desktop PC
 - d. Which of the following devices is best suited for creating PowerPoint presentations?
 - A. Server
 - B. Smartphone
 - C. Notebook
 - D. Mainframe computer
 - e. Which of the following devices is the best device for a web developer?
 - A. Entry-level notebook
 - B. Mid-range tablet
 - C. High-end Smartphone
 - D. Mid-range desktop PC
 - f. Which of the following does not affect a computer's performance?
 - A. Storage capacity
 - B. Control processing unit
 - C. Central processing unit
 - D. Memory speed
 - g. If you want to install a large program on your computer, which of the following would affect your RAM's performance?
 - A. Storage space
 - B. Storage speed
 - C. Cache
 - D. Network speed

CONSOLIDATION ACTIVITY

Chapter 3: Hardware *continued*

- h. Which of the following connects the CPU with the memory and the input and output devices?
 - A. Bus system
 - B. GPU
 - C. Network
 - D. RAM
 - i. Which of the following devices would be best suited for a small office user?
 - A. Smartphone
 - B. Desktop PC
 - C. Laptop computer
 - D. Workstation computer
 - j. Two of the most important requirements for a gamer are _____.
 - A. Mobility and storage capacity.
 - B. CPU speed and GPU processing power.
 - C. CPU speed and RAM capacity.
 - D. Cache speed and CPU speed.
2. Indicate if the owing statements are 'True' or 'False'. 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. Disk cache is located on the RAM.
 - b. The purpose of a heat sink is to cool down all the internal components of a computer.
 - c. The GPU's quality is dependent on the CPU's speed.
 - d. Two of the most important requirements for a home user are mobility and battery life.
 - e. The most important requirements for an office user are a lot of RAM, CPU speed and storage space.
3. 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. A constraint of mobile computing devices that is caused by a lack of heat sinks and fans.	A. Network speed
2. Memory that stores data being sent and received by the hard disk.	B. Power and heat
3. This a factor that affects the download speed of online content.	C. CPU
4. A computing component that processes instructions sent from the computer's internal and external components.	D. Small office user
5. Memory that stores instructions being sent and received by the central processing unit.	E. CPU cache
6. A person who requires a lot of processing power, storage capacity, and memory to run multiple resource-intensive applications at the same time.	F. Power user
7. The measure of how many instructions the CPU can process each second.	G. GHz
8. A factor that affects the visual quality of images displayed on your monitor.	H. Graphics processing ability
9. The capability for a mobile computing device to supply power without a power source.	I. Battery life
10. A person who requires a computing device that can be used for multiple purposes and by multiple users.	J. kW
	K. Gamer
	L. Home user
	M. GB
	N. Disk cache
	O. Motherboard

CONSOLIDATION ACTIVITY

Chapter 3: Hardware *continued*

4. Determine which of the following factors should be considered for the following performance issues:

- CPU* *Memory capacity* *Storage speed*
Network speed *Graphics processing ability* *Bus performance*

PERFORMANCE ISSUE	FACTOR
a. Clarissa recently built a top of the range desktop computer, with all the best and most expensive components. But for some reason her computer's performance is very slow.	
b. Every time Jung Min opens an application his computer automatically closes any other open applications.	
c. Kiva is a teacher and usually creates PowerPoint presentations from digital textbooks that are in a PDF format. Whenever she switches between the presentation and textbook to compare the two, her computer starts to lag and freeze.	
d. Yves is a gamer who loves playing first-person shooter games. Whenever he plays online games, they load slowly and have reduced graphic quality.	
e. All the applications on Mpano's computer slow down each time he opens a new application in the background.	
f. Whenever Nicolas copies files from his flash disk onto his computer's hard drive, his computer takes a long time to complete the copying process.	
g. Tsholofelo bought a brand new notebook but noticed that whenever she tries to run Adobe products like Adobe Premiere her computer takes a long time to open it and it takes a long time to compile video files.	
h. Imogen likes to play the latest racing games for titles like Dirt, Forza and Need for Speed. Her computer has an overclocked Intel i5 core processor, but her games perform very slowly when she tries to use high resolution settings, so she must use the lower game graphic settings.	
i. Every time Martinique tries to install a new program on her computer, her computer starts to slow down significantly.	
j. Before Sean buys an album from a musician, he prefers to download the songs so that he can listen to them because it takes too long to stream them online.	

5. Consider the following 3 users:

- a. Ahmed is a freelance graphic designer that travels a lot for business.
- b. Belinda is a banker that must regularly check and edit accounting spreadsheets.
- c. Nkosi is a professional gamer that plays at international gaming tournaments.

5.1 Which type of computer would be best suited for each user? Give ONE reason for each answer.

5.2 What type of user do you think Ahmed is? Give a reason for your answer.

5.3 Based on Belinda's computing requirements, would she benefit from using a smartphone or a mobile computer. Give TWO reasons for your answer.

5.4 a. Name ONE piece of computing hardware Nkosi should financially invest in upgrading. Mention TWO benefits of upgrading this piece of hardware.

- b. Other than being potentially expensive, mention ONE other disadvantage or problem that could occur because of Nkosi upgrading this piece of hardware.

CONSOLIDATION ACTIVITY**Chapter 3: Hardware** *continued*

6. Tokozile is a young entrepreneur who wants to open a computer centre for tourists in Cape Town. Her goal is to have 16 computers with high-speed internet that can be used by tourists to browse the internet or send messages home. However, she would also like the computers to be able to play modern multiplayer games so that youths from the area will visit her centre.

She has obtained the following two quotations for her centre.

COMPUTER A	COMPUTER B
3.2 GHz Quad Core CPU with 4 MB cache	3.6 GHz Dual Core CPU with 1 MB cache
8 GB DDR3 RAM	2 GB DDR3 RAM
2 TB HDD	256 GB SSD
Gigabit (1 Gbps) network card	802.11 g (50 Mbps) wireless adapter
NVidia GeForce graphics card (4 GB VRAM)	Integrated graphics (32 MB VRAM)
15" LCD monitor	17" LCD monitor
Windows Home 10	Ubuntu Linux
Microsoft Office	OpenOffice
Skype (VoIP Software)	Skype (VoIP Software)
R10 795	R7 995

She starts her comparison by looking at the CPUs of the two computers.

- Name TWO manufacturers of CPUs.
- One CPU is a "dual core" CPU, while the other is a "quad core" CPU. What do these terms mean?
- Which CPU will be faster for multitasking? Give reasons for your answer
- The two CPUs have different amounts of cache memory. Define the term cache memory?
- Tokozile expects that some of her customers will want to play games on the computers. Advise her on which computer (according to the quotations) would be best for games and why.
- The computers not only have different hardware, but also different software. List the operating systems installed on each computer.
- Which computer's software will be the most expensive. Give reasons for your answer.
- The operating systems of both computers support multitasking and multithreading. Define these concepts and explain how they differ.

SOCIAL IMPLICATIONS

CHAPTER OVERVIEW

Unit 4.1 Impact of Mobile technology on privacy – (personal and business)

Unit 4.2 IoT – Technologies enabling the IoT and their impact on society

Learning outcomes

At the end of this chapter you should be able to:

- Discuss the advantages and disadvantages of mobile technology and how it impacts on Privacy (Personal and Business)
- Internet of Things (IoT) and their Impact on society

INTRODUCTION

Mobile Technology has radically changed our personal and social lives and how the business world works. Although these changes have mostly been positive (social networking, navigation, and so on), the security of our personal information is at great risk.

4.1 Mobile technology

In Chapter 3 we learned that a mobile device is any type of handheld computer, for example, tablets, e-readers, global positioning system (GPS) devices, wireless debit/credit card payment terminals and smartphones. These devices are portable, fit in your hand and are powerful enough to do many of the same things you can do with a desktop or laptop computer.

Internet privacy (also called online privacy) is the right of personal privacy in regards to the rearranging, storing, provision to third parties, and display of information relating to you via the internet. In general, the right to be free from secret surveillance and to determine whether, when, how, and to whom, one's personal or organizational information is to be revealed.

IMPACT OF MOBILE TECHNOLOGY

ADVANTAGES

INSTANT COMMUNICATION

Family and friends have easy access to SMS, text messaging, call, video chat, and apps that allow them to instantly communicate with everyone across the globe. Smartphone cameras allow this 'selfie' generation to constantly post pictures of themselves, business related pictures, holiday videos and business related videos etc. via social media.

ACCESS TO INFORMATION

These devices are integrated with mobile browsers that enable them to access websites anytime and anywhere. A large amount of the total time spent by people on smartphones is used in opening browsers to surf the internet. With easy access to helpful content, learners can have interactive learning through watching education videos, playing education applications and researching topics.

ENTERTAINMENT

Mobile technology (especially smartphones) provides a source of entertainment. Users can listen to their favorite music, play games, gamble on-line, watch movies and read e-books among other things.

SAVING TIME – INCREASED PRODUCTIVITY

Smartphones can do almost everything with the help of apps. Both individuals and businesses benefit from the use of apps like: photo and video editor, ticket booking, online store, payment system, data analysis, personal assistant, and so on. These services are not restricted to business hours. With Global Positioning System (GPS), people can locate certain addresses and areas all around the world which has helped both individuals and business with communication and especially transportation.

PRIVACY

You can do whatever you want without anyone knowing it via a smartphone. You can snap photos of yourself and secure your photo library with a password. You can also send messages to your loved ones without the fear of anyone knowing it. Online transactions can also be done through smartphones.

DISADVANTAGES

COST

Smartphones can be expensive, especially high-end phones with great specs and features. This added cost has a negative impact on a family's and businesses financial budget.

POOR SOCIAL INTERACTION

'Real' social interaction degrades. People no longer interact with people outside since they spend more time with their smartphones.

DISTRACTION

Smartphones can be distracting. Applications notify you when there are messages, updates, latest offerings, etc. These interrupt the momentum and can affect your productivity.

HEALTH

Mobile devices (like smartphones) emit radiofrequency energy which can be absorbed by the tissues in the body. Sleep deprivation, damage to your eyes etc. are some of the health issues associated with the use of smartphones. Addiction to games, social media, and so on, also impacts negatively on your health.

EXTRA WORK

Smartphones are widely used in business. Various apps allow you to work on extra workloads which were not even existent before. Your boss can instantly call you even in the middle of the night.

UNCENSORED CONTENT

With easy access to information and the internet, people, especially children can see uncensored content including violence, pornographic content, fake news, and so on.

IMPACT ON PRIVACY

Your smartphone interrupts you with texts, WhatsApp messages, tweets, e-mails, Facebook alerts, and so on. You are being overloaded by social networking information on a daily basis. This flood of messages and alerts, distracts you to an extent that productivity and efficiency suffers. All networking tools, sites and apps encourage you to share information, but you are not told of the possible negative consequences. You are also unaware of how your information and uploads will be shared. Search engines are built into various social networking tools and apps and privacy settings are defaulted to 'maximum sharing and visibility'. These settings allow search engines to access data that you have not restricted. Even if you keep your data private, a search engine can still access your networking profile. Anything you say or do in a group environment is immediately public and vulnerable in terms of being shared. Some social engineers can be con artists who pretend to be what they are not in order to benefit themselves (gain access to information, money, and so on). The availability of personal information on social networking sites makes the jobs of social engineers much easier and hence identity theft (stealing and using another person's identity to fraudulently open accounts) is becoming increasingly prevalent.

Although smartphones are made private, there is still security risks and threats everywhere. Hackers are always present and virtual viruses are potent. Smartphones are vulnerable to these threats when you access the internet.

Several other institutions give internet users cause to worry about their personal or corporate privacy online. Government and law enforcement agencies, Internet Service Providers (ISPs), public search engines, and social media gain access to our private data as we interact with them online – and many of them gain from gathering and distributing this information more widely. This might be for political, investigative purposes, as leverage in facilitating criminal activities or as a profit-making tool in sales to third parties.

Mobile technology users often aren't even aware that by making an online transaction, they may in effect be selling data about themselves to not only the parent company or website they're dealing with, but their affiliates and supply chain partners, as well. The ease of connecting mobile devices to public free wifi hotspots and always-on networks has compromised personal and corporate privacy online.



Activity 4.1

Privacy

- 4.1.1** Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number in your homework book.
- A person's ability to control how information about them is shared with other people or institutions is referred to as _____
 - _____ are used to store data about a user and a user's preferences in a local file on the user's hard drive. The website can then read this data and update the website according to the user's preferences.
 - The goal of the _____ is to make users aware of the way in which websites use cookies.
- 4.1.2** On 21 January 2019, Google was fined R800 000 000 for breaking the rules of the General Data Protection Regulation (or GDPR). Specifically, a French court found Google guilty of not informing users well enough how their personal data will be processed and not asking for legal consent before showing users targeted advertising. Similar lawsuits filed against Instagram, Facebook and WhatsApp are still being fought in court. Based on this scenario, answer the following questions.
- Do you think it is important to protect your privacy online?
 - Do you think targeted advertisement is a bad or a good thing?
 - Do you think it is a good idea to stop targeted advertisements, even if it significantly decreases the amount of money websites can earn from these advertisements?
 - Do you think the GDPR will help people understand how their data is used?
 - Do you think people should be informed about how their data will be used? Is there a good way to inform people?
 - Do you think the fine against Google was too much or too little. Give reasons to support your answer.

The Internet of Things (IoT) consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware. IoT refers to the billions of devices around the world that are connected to the internet through sensors or Wi-Fi.

TECHNOLOGIES THAT ENABLE IOT

The recent convergence of three technological trends has made the IoT possible:

- **Increasing processing power of embedded platforms:** due to the smaller sizes, reduce in cost and reduce in power consumption, general purpose CPU's have gradually replaced microcontrollers in devices. The transition to CPUs is critical because CPUs can run operating systems that support networking and popular programming languages.
- **Development of smaller OSs and protocol:** as the performance of embedded platforms rose, lightweight versions of mainstream operating systems like Windows and Linux displaced embedded operating systems and brought their massive software ecosystems, and large pool of developers, with them.
- **Development of wireless communications:** Wi-Fi has gotten faster with each new addition to the 802.11 class of protocols. The connectivity options for low-power devices have also been expanding in the industrial and consumer electronics markets. Impact on society

There are many ways that IoT will affect and benefit society, below are a few examples:

- **Waste management:** sensors in a fridge will record anything that is not used so that you can examine the trends and patterns. The less waste the less pollution. Sensors in bins can record the trends and patterns of what can be recycled.
- **Daily commute:** Sensors will let you know the shortest route to your work or home; which routes would be the most economical on petrol and if you can rather take public transport. Taxi services for business meetings can be planned according to your calendar and synced with your smartphone.
- **Smart cities:** These can include fast and convenient transportation systems, street lighting that switches on or off depending on the amount of natural light and energy-efficient buildings. For example, Barcelona has a citywide WiFi and information network linked to sensors, software and a data analytics platform. This provides the city with smart water technology, automated street lighting, remote-controlled irrigation for parks and fountains, "on-demand" waste pickups, digital bus routes and smart parking meters. This has reduced traffic jams and pollution, as well as water, light and energy usage.
- **Agriculture:** Sensors can track microclimates across farms, to monitor temperature changes and humidity levels as perishable goods move from field to warehouse to store. This can extend their shelf life and eliminate waste.
- **Businesses:** IoT is used to detect and troubleshoot remote issues, predict maintenance needs, track production line efficiency, monitor devices etc. These directly impact a company's revenue.
- **Smart water sensors:** These sensors monitor the water quality, temperature, pressure, and usage. This data is used by the water company to analyse how customers are using water and to help them be more efficient. Water leak detectors are used to find tiny leaks that can lead to huge water waste.



Activity 4.2

- 4.2.1 In small groups discuss at least three ways IoT impacts society, you can research your answers. Each group presents their findings to the class.
- 4.2.2 Read the following article on the top five predictions of IoT in 2019.

5 Internet Of Things Trends Everyone Should Know About

By **BERNARD MARR**

Johannesburg, 15 Feb 2018

2019 will see the Internet of Things (IoT) becoming more deeply embedded in our day-to-day lives at home and at work. We may begin to hear the term itself used less frequently – but that's because it's moving out of the hype phase and quickly becoming a part of everyday life.

Soon, it will be taken for granted that pretty much any device we own – cars, TVs, watches, kitchen appliances can go online and communicate with each other. In industry too, tools and machinery are increasingly intelligent and connected, generating data that drives efficiency and enables new paradigms such as predictive maintenance to become a reality, rather than a pipe-dream. In fact, it is predicted that by the end of 2019 there will be 26 billion connected devices around the world.

Here are five predictions about how this is likely to play out over the next 12 months as we become increasingly used to the fact that the internet isn't just something we connect to using computers and smartphones, but virtually anything we can think of:

Businesses will get serious about IoT: According to research by Forrester, businesses will lead the surge in IoT adoption in 2019, with 85% of companies implementing or planning IoT deployments this year.

IoT clearly offers huge benefits

to businesses: Some examples we have seen in recent years include mannequins that can communicate with customers' smartphones in retail environments, beaming information about products on display.

Manufacturing, however, is the clear leader when it comes to IoT deployment. Here, throughout 2019, businesses will increasingly see the value in connected machinery that is capable of reporting every detail of its operating parameters and efficiency to other smart, connected devices.

Predictive maintenance is something that has been promised for a while by tech evangelists but is currently only achieved by the biggest players who have invested heavily in IoT for several years now.

With a growing **understanding of when these solutions are (or aren't) useful, these solutions will start to trickle down** to smaller organizations, that can be confident that their investments will pay off.

[Source: <https://www.forbes.com/sites/bernardmarr/2019/02/04/5-internet-of-things-trends-everyone-should-know-about/#5a1e747f4b1f>, accessed 10 June 2019]



Activity 4.2

continued

- a. Do you agree with each prediction?
 - b. Explain why you say so.
- 4.2.3** What are your top five predictions for IoT for 2020? For each prediction provide an explanation of its use for society or businesses.
- 4.2.4** Watch the following video on The Ultimate Smart Device: An Intelligent Diaper (or Nappy) <https://www.youtube.com/watch?v=sUynHP7D8Uc>.
 - a. Discuss the benefits of this IoT device.
 - b. Do you think it is necessary? Explain.

CONSOLIDATION ACTIVITY**Chapter 4: Social implications**

1. Mention any THREE mobile technologies that make life easier, how they have improved your life, and the danger of using this technology.

TECHNOLOGY	BENEFIT	RISK

2. Mention any THREE mobile technologies that make life easier, how they can improve a business, and the danger of using this technology.

TECHNOLOGY	BENEFIT	RISK

3. Research the following companies and complete the table. Sometimes an app might not have any disadvantages.

APP	HOW CAN IT HELP SOCIETY?	HOW CAN THE APP HINDER SOCIETY?
Whats App		
Moodle		
FaceBook		
LinkedIn		
Shopify		

4. What is your ultimate smart device, either real or invented. Explain its benefits. Design an advertisement and present your smart device to the class.

COMPUTER MANAGEMENT

CHAPTER OVERVIEW

Unit 5.1 Factors influencing computer management

Learning outcomes

At the end of this chapter you should be able to:

- discuss computer management issues.
- recommend management tasks for general housekeeping, maintaining data integrity and protecting the system

INTRODUCTION

In this chapter you will learn about several different computer management tasks. These tasks include clearing up storage space, updating software, and increasing the capability of your computer by installing new software and hardware. You will also learn how to change the key settings of your computer.

COMPUTER MANAGEMENT IN A NUTSHELL

Computer management is a process of managing, monitoring and optimising your computer's functionality to best serve your needs. This process could include improving and maintaining the security features, performance, and reliability of your computer.

The key tasks that you can do to ensure your computer remains fast, reliable and secure include the following:

- managing your desktop
- managing files and folders by:
 - freeing up storage space
 - compressing files and folders
 - updating your software
 - backing up your files
 - scanning for viruses and malware
 - checking your hard disks.

Remember that to keep your computer running effectively, you need to ensure that you have enough free storage space available. If not, you might not be able to create new files or install new programs.

The majority of programs also automatically create temporary files and folders when you run them. Without enough free space, these programs cannot create the temporary files they need, and this will cause the files to crash or display error messages. The operating system uses some of your hard drive space as virtual memory. This will allow the operating system to operate more smoothly – so without any free space, your computer will slow down noticeably.

ACTIVITY 5.1 Revision Activity

- 5.1.1 Define backup and explain its importance.
- 5.1.2 What two methods can you use to create a backup?
- 5.1.3 List the eight steps to perform a backup.
- 5.1.4 Define malware and explain how it harms your computer.
- 5.1.5 List the four steps to scan for viruses or malware.
- 5.1.6 Why should you update your software?

5.1 Factors influencing computer management

A computer's speed, ease of use and security are influenced by various factors. The five most important factors are:

- software
- security
- housekeeping
- amount of unused space on the hard drive
- errors and corrupt files

SOFTWARE

Software refers to computer instructions in the form of operating systems, utilities, programs, and applications that enable computers to work.

Software affects a computer's performance in different ways:

- installing too many applications may use up a computer's resources and cause the computer to slow down,
- out-of-date software may contain bugs or security problems
- viruses are also a form of software and are often installed with other software applications.

The most important software task you should complete is to regularly update your software. (An update is new, improved, or fixed software, which replaces older versions of the same software.)

Most applications follow one of three update strategies. They:

- Ask you to allow them to update automatically: Whenever your computer asks to update a program, allow it to update as soon as possible. If it is not possible to install the update immediately, schedule a suitable time to install the update.
- The application informs you that an update is available and links you to the update location.
- This will update the program to the newest version without changing your settings.
- The application can release patches but does not inform you. If this occurs, then search the internet once or twice a year to see if a new version has been released. If it has, download this version and install it to update your software.



Figure 5.1: Microsoft Windows automatically installs updates

Today, most computer programmers continue to release patches and updates to their software after the software is released. Software patches and updates generally repair security holes, fix or remove computer bugs and add new features and improve existing ones.

SECURITY

Computer security is the protection of computer systems and information from harm, theft, and unauthorized use. Closely linked to a computer's software is the security of the computer. As you learned in Grade 10 and 11, weak security can result in files being accessed illegally, and viruses being installed leading to reduced computer performance. As such, a computer's security must be managed.

When it comes to computer security, there are two main goals: Prevent any malicious software from affecting your computer by using antivirus software, and backup your files so that they are safe, even if your computer is damaged in some way.

In this section, you will look at these tasks:

Firewall: A firewall is a network utility that prevents unauthorized network connections to and from your computer. This means that only the applications you allow on your computing device can send or receive data from and to the internet.

Antivirus: An Antivirus is a software programme that is designed to prevent, search, detect and remove malicious software (Malware) from your computing device. **Spyware:** Spyware is a piece of code that hides on your computer and tracks all your activity without your knowledge. You can control the Spyware, by activating the pop-up blocker on your browser settings or by installing an anti-spyware software application.

Adware: Adware is a type of malware that presents unwanted advertisements to the user of a computer in the form of pop-up or an 'unclosable window'.

BACK UP DATA

Data backup is a process of duplicating data and storing it in an alternative location to allow retrieval of the duplicate set after a data loss event (natural disaster, theft situation, accidental deletion).

Data loss can occur due to:

- hardware failure
- many potential threats to your data (like viruses and Trojans don't just steal your data. In some cases, they erase it)
- the threat of ransomware (when a hacker puts a virus on your computer that encrypts your data, making it useless).

Backing your data up is the single best way to protect your data. With an up to date backup, any data that you lose can be recovered easily.

To make sure your backup is effective, you should use the following guidelines when creating a backup system. The backup:

- must include all important files and folders.
- should be run regularly, preferably every day, but at least once a week.
- must be saved on a different storage device from the data it is backing up.
- should be saved on a storage device that is not permanently connected to your computer.
- should be kept in a safe place to protect it from physical damage.
- data should be verified occasionally to make sure the backup system is still working.

There are three main techniques you can use to create a backup:

- *Copy and paste* (select files and folders you would like to backup, copy them using the copy command and paste in a folder on an external hard drive),
- *Backup and Restore Software*: (This utility can be used to automatically backup your data to an external hard drive by simply updating changes to the relevant files that were backed-up previously).
and
- *Online backup* (back files up online using a service like Google Drive).

HOUSEKEEPING

This refers to the way in which a computer and its files and folders are organised so that they are quick and easy to find. General housekeeping tasks include:

DISK CLEAN-UP

Disk clean-up is a computer maintenance utility designed to free-up storage space on a computing device. It identifies and removes temporary files that are no longer needed and cleans out old files, programs and settings that cause your computer to slow down. Defragmentation of the hard disk also improves the speed at which the files are accessed.

SCHEDULING AND UPDATING

You can use a task scheduler to create and manage common tasks that your computer will carry out automatically at a time you specify, for example, you can schedule your computer to run a software update or make a backup at a specific time.

ARCHIVE AND BACKING-UP

Archiving is the process of moving data that is no longer actively used to a separate storage device for long-term retention. These files are, however, not duplicated. Archived data consists of old data that remains important and is retained for future reference.

A back-up is the process of making copies/duplicates of data and storing it on a different device in a different geographical location in the event of the original data being lost or destroyed.

COMPRESSION AND DECOMPRESSION

File compression refers to the process that makes use of advanced algorithms and mathematical formulas to decrease the amount of disc space used by big files. Decompressing a file is the method of extracting the compressed file back to its original form using the same algorithms or mathematical formulas.

INSTALLING AND UNINSTALLING SOFTWARE

All installed applications used on your computing device are managed by the operating system. These applications may be used to view images, play videos or run tasks on your computing device. There are different ways of installing software. Examples include custom and default installations.

- A custom installation will allow you to see and select parts of the software you want to install.
- A full installation will select all parts of the software and install it on your computing device.
- Product keys and activation codes: Some applications may give you a unique product key or activation code once you purchase the application. The installer will then request this product key before allowing you to install the application.

ORGANISING YOUR FILES

Organising your files refers to the planned system that you use when you save your files on your computer (stand alone computer or network drive). Well organised saving of files will allow you quick and easy access to them, avoid duplication and ensure that your data can be backed up.

To organise your files:

1. Decide on a logical folder structure that can be used to organise your files and a naming convention.
2. Move existing files to the appropriate location within this folder structure.
3. Save any new files in the appropriate location within this folder structure.
4. Occasionally, check your hard drive to ensure that your new files have not become disorganised.

AMOUNT OF UNUSED SPACE ON THE HARD DRIVE

Computers need sufficient unused space on the hard drive in order to operate smoothly. Free space on your drive is required because certain programs/applications create temporary files whilst in use and the computer system requires hard disk space to supplement RAM (virtual memory). To free up space on a drive, there are a few things you can do:

- use the disk clean-up tool
- uninstall unused software.
- empty the recycle bin
- compress data not frequently used.

ERRORS AND CORRUPT FILES

Errors and corrupted computer files are files that have been damaged or saved incorrectly and can't be opened in the normal way.

Files with errors and corrupt files are difficult to detect and they can cause everything from videos not loading to applications crashing, or even your operating system not opening.

Regularly scanning for files with errors or corrupt files using an appropriate utility (e.g. SMART scan or Disk Check) will warn you before errors become a problem.



Activity 5.1

- 5.1.1** 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). There can be more than one answer (column B) to a question (column A).

COLUMN A	COLUMN B
1. A computer's speed, ease of use and security are influenced by various factors. The FIVE most important factors are:	A. Housekeeping B. Free space on drive C. Computer management tasks D. Errors or corrupt files E. Security F. Software
2. When this is weak, it can result in files being accessed illegally, viruses being installed leading to reduced computer performance.	
3. This refers to the way in which a computer and its files and folders are organised so that they are quick and easy to find.	
4. Too many applications can cause the computer to slow down, while out-of-date applications may contain bugs or security problems	
5. This is often difficult to detect, since it can cause everything from videos not loading to applications crashing and even your operating system not opening.	
6. Without this, some programs will stop functioning and the computer may slow down dramatically.	
7. This refers to the tasks used to maintain the computer.	

- 5.1.8** List the management tasks for general housekeeping. Which tasks do you use on your computer or school computer? Which task do you think is the most important? Explain.
- 5.1.9** List steps that can be followed to guide a friend on how to go about creating a well organised filing system.

CONSOLIDATION ACTIVITY

Chapter 5: Computer management

1. 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. 1.1–A). There can be more than one answer (column B) to a question (column A).

COLUMN A	COLUMN B
1. The most important software task that you must do.	A. They become infected with viruses and malware.
2. Prevent any malicious software from affecting your computer by using antivirus software, and backup your files so that they are safe, even if your computer is damaged in some way. This refers to _____.	B. Backing up the data
3. This can be done to prevent your computer to overheat and either crash your computer or limit the speed of your computer.	C. Free disk space
4. This is the single best way to protect your data.	D. Regularly update your software
5. This should be used to set the location where your documents, images and media files are saved.	E. Disk Clean-up tool
6. This is one of the biggest reasons why computers slow down as they get older.	F. SMART scan
7. This space can be used as the page file, to save new files or to create temporary files required by the application.	G. Disk check
8. To ensure that your hard drive does not fail, it is important that you regularly check the health of your hard drives by running a _____ and disk check on it.	H. Computer security
9. Together, these two tests should inform you if your hard drives have any issues.	I. File organisation
10. To clean-up a disk, you can use this technique.	J. Physically clean the computer

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.)
- To make sure that your computer is protected against viruses, you should install more than one virus scanner.
 - The two biggest ways to pick-up malware is by installing applications without reading all the instructions carefully and by inserting other people's flash disks into your computer.
 - You should clean your computer more regularly during the rainy season as they become especially dirty during this period.
 - Manually backing up your data is the best and easiest way to make sure that your data is safe.
 - The best file organisation strategy is to make sure that files are always saved in the correct location the first time.
 - It is important that you also organise files within an application's folder.
 - You can always recover a file that has been permanently deleted.
 - To regularly uninstall used applications will free up disk space as well as memory and decrease Internet use.
 - While you can uninstall applications to free some disk space, you should not wait until you run out of storage space to uninstall applications.
 - It is very important to run a Disk Clean-up and SMART scan if you are struggling to open files, if your hard drives take a long time to load, or if your hard drives are making clicking noises.

CONSOLIDATION ACTIVITY**Chapter 5: Computer management** *continued*

3. Do the following on a computer under instruction and supervision of your teacher.
 - a. Update software
 - b. Scan for viruses
 - c. Physically clean the computer
 - d. Back up the data on the computer using copy and paste.
 - e. Back up the data using Backup and Restore
 - f. Manually back up files on Google Drive
 - g. Automatically back up files to Google Drive
 - h. Organise your files
 - i. Free disk space by using the Disk Clean-up tool
 - j. Manually delete files
 - k. Uninstall unused programs
 - l. Run a SMART scan
 - m. Run a disk check
4. What is the difference between installing software and uninstalling software?
5. Give FOUR reasons for uninstalling a program.
6. Name THREE programs you have installed on one of your computing devices and give a reason for each of your answers.
7. Mention ONE negative experience you have had because of installing a piece of software. In addition, mention why you think this happened.
8. Do the following tasks on your computer (Ask your teacher for a suitable application to practice with):
Install new software onto your computer.
Uninstall software from your computer.
9. Which of the following is NOT a good reason to delete a file:
 - a. It is large.
 - b. It is redundant.
 - c. It is not needed.
 - d. It is infected with a virus.
10. Which of the following programs can be uninstalled if your computer's hard drive is full:
 - a. The operating system
 - b. Pre-installed software
 - c. Antiviruses
 - d. Applications you installed
11. If software on your computer stops working properly, which of the following could fix it:
 - a. Uninstalling the program
 - b. Updating the program
 - c. Defragmenting the hard drive
 - d. Installing a driver

CONSOLIDATION ACTIVITY**Chapter 5: Computer management** *continued*

12. Which of the following is NOT a technique that can be used to backup data:
- a. Using Windows Backup
 - b. Copying files to a memory card
 - c. Using Cloud storage
 - d. Moving files to an external hard drive
13. When Philip connected his new keyboard to his laptop, it did not want to work. What do you think the problem is?
- a. He needs to install its drivers manually.
 - b. He needs to free up space on his computer.
 - c. He needs to change his system settings.
 - d. He needs to scan it with his antivirus.