Information and Computer Studies

for Secondary Schools

Student's Book

Form One

Tanzania Institute of Education

Information and Computer Studies for Secondary Schools

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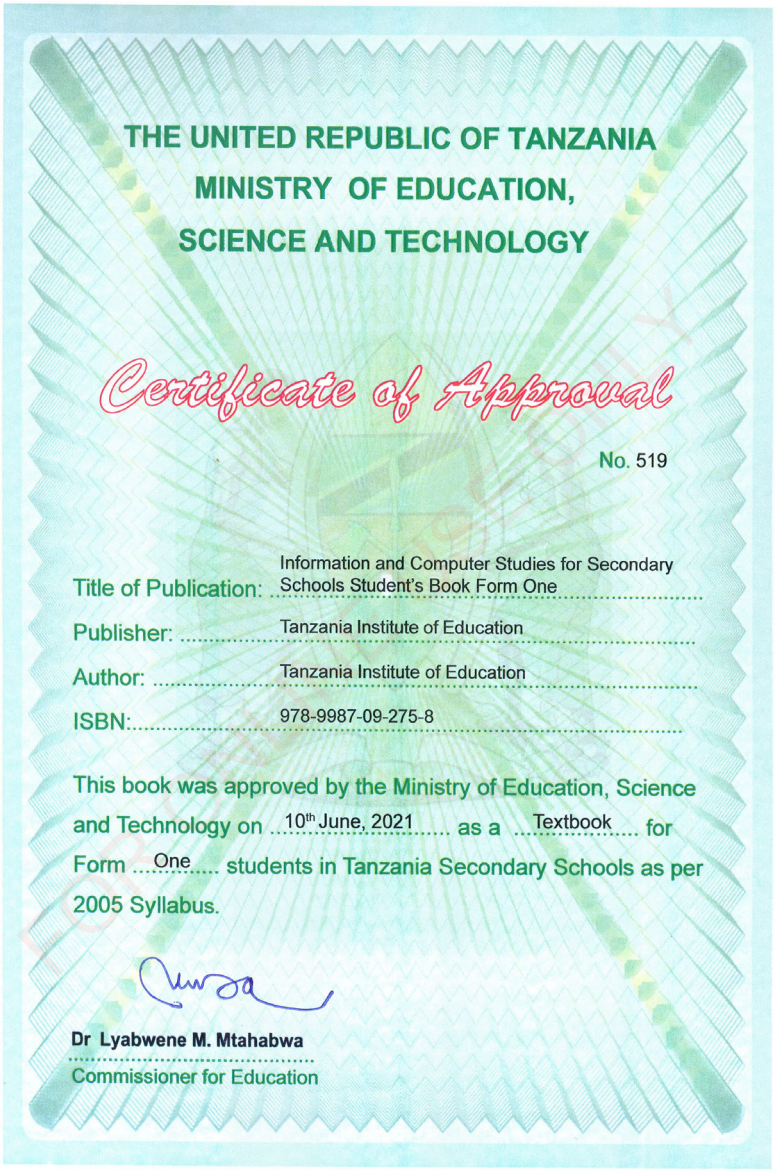

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Preface

This textbook, *Information and Computer Studies for Secondary School,* is written specifically for Form One students in the United Republic of Tanzania. The book is prepared in accordance with the 2005 Information and Computer Studies Syllabus for Secondary Schools, Form I - IV, issued by the then Ministry of Education and Culture.

The book consists of six chapters, namely Introduction to Information and Computer Studies, Data and information, Computer evolution, Computer hardware and software, Classification and significance of computers and Computer handling. Each chapter contains activities, illustrations and exercises. You are encouraged to do all activities and exercises together with other assignments that will be provided by your teacher. Doing so will enhance your understanding and promote the development of the intended competencies.

Tanzania Institute of Education

Chapter One

Introduction to Information and Computer Studies

Introduction

In this chapter, you will learn about the concept of Information and Computer Studies (ICS), the importance of studying computers and information and the relationship of ICS with other subjects. The competencies developed will enable you to use Information and Computer Studies to learn other subjects.

The concept of Information and Computer Studies

The Information and Computer Studies (ICS) subject consists of two themes, which are *information* and *computer*. *Information* is the processed data or knowledge acquired through study, experience or instruction. A *computer* is an electronic device that accepts data from users and stores or manipulates them to produce information. Therefore, ICS is the subject in which students learn how to use computers in processing, organising and managing information.

Importance of studying Information and Computer Studies

We are living in an information age in which computers are important working tools. They are used in almost all fields such as agriculture, business, education and health. Similarly, information is an important resource for making relevant decisions about different aspects of life such as development activities, providing social service, and doing business. Producing information for all these activities can be facilitated by computers. In this age, information is power. Individuals, communities or countries with relevant information and knowledge to use it better can be more powerful than others. For example, if a maize farmer in a village has relevant information on maize markets that offer the best prices, the farmer can make more money than others who lack such information in the village.

In education, computers are becoming an integral part of teaching and learning. In schools, they are used to communicate, create, disseminate, store and manage

information. Schools use different pieces of equipment such as desktop computers, portable computers, projectors, and sound and video recorders. They also use software, such as Microsoft Office, together with multimedia resources and learning management systems for learning and teaching. Other computer uses include browsing the Internet for learning materials, broadcasting lessons, and organising as well as presenting learning and teaching materials. For example, when schools were closed due to the COVID-19 pandemic in 2020, some schools and other learning institutions organised teaching and learning through other ways such as radio, television and the Internet. Recorded lessons could be retrieved anytime and anywhere using computers or other electronic devices.

Activity 1.1: Information and Computer Studies

In groups, discuss how computers, smartphones and radios can be used to facilitate learning at school and home.

Relationship of ICS with other subjects

ICS is about the use of computers and other electronic devices. When these devices are integrated in teaching and learning process, studying becomes more engaging for students. This is because technology provides different opportunities for students to learn the same things in different ways. Figure 1.1 shows how ICS knowledge and skills can assist in performing different tasks in teaching and learning other subjects.

ICS

Maths, Physics, Chemistry & Biology	Social Science	Languages	Creative Arts
▪ Simulating experiments	▪ Drawing graphs	▪ Listening skills	▪ Creating and updating music
▪ Drawing graphs	▪ Searching materials	▪ Drawing graphs	▪ Producing and promoting fine art
▪ Searching materials	▪ Processing data	▪ Searching materials	▪ Exploring and creating theatre art
▪ Processing data	▪ Keeping records	▪ Processing data	▪ Processing data
▪ Keeping records	▪ Giving presentations	▪ Keeping records	▪ Creating animations
▪ Giving presentations		▪ Giving presentations	▪ Keeping records
			▪ Giving presentations

Figure 1.1: *Relationship between ICS and other subjects*

The following are examples of how ICS is used in other subjects:

i. Computers can be used to simulate experiments in Chemistry, Physics, Biology and other subjects. These interactive simulations can be repeated several times by students without using actual experimental materials and equipment. They allow students to practise conducting different experiments through interactive simulations. Figure 1.2(a) shows a simulation of a Chemistry experiment, while Figure 1.2(b) shows a simulation of a Physics experiment.

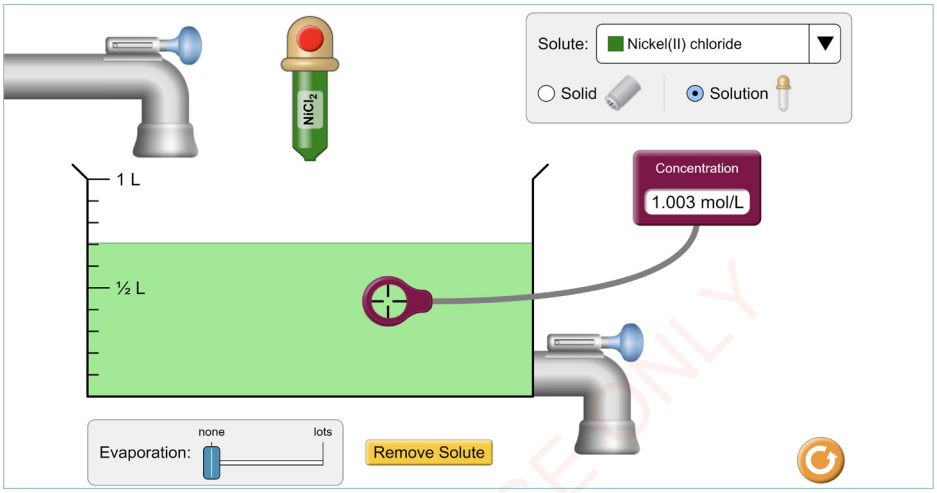


Figure 1.2 (a): *Simulation to measure concentration of solutions*

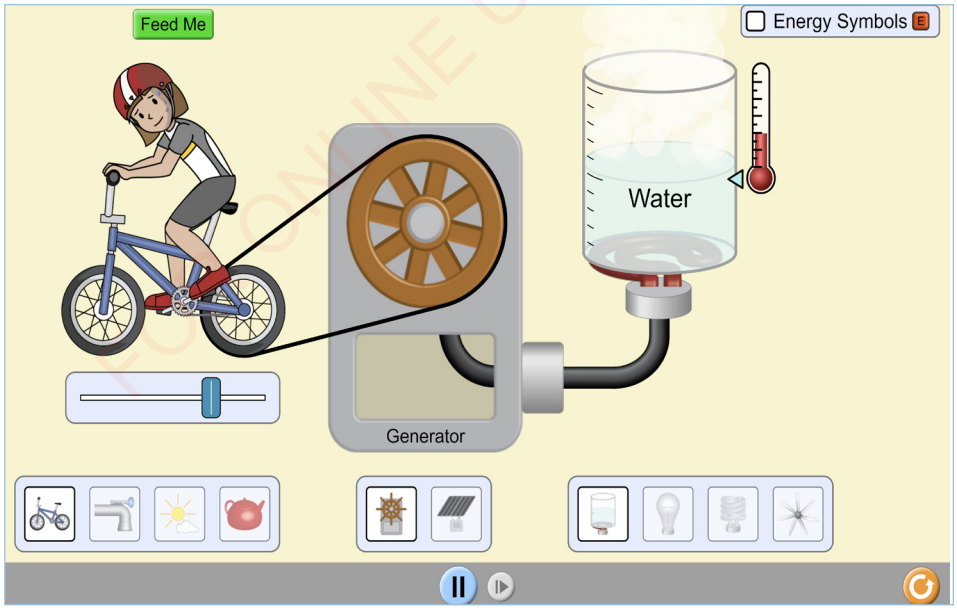


Figure 1.2 (b): *Simulation of forms of energy and how they change*

ii. Students can use the Internet to search and organise various educational materials such as notes and books for different subjects.

Activity 1.2: Relationship between ICS and other subjects

Outline the usefulness of computers in learning the subjects listed in the following categories:

1. Language subjects (English, Kiswahili, French, Chinese)
2. Science subjects (Agriculture, Biology, Chemistry, Home Economics and Physics)
3. Mathematics
4. Social Studies (History, Geography and Civics)
5. Business (Commerce and Bookkeeping)
6. Creative Arts (Music, Fine art, Theatre art)

Hint: *You can discuss with your peers or use the Internet and other sources.*

Exercise 1.1

1. Explain why studying ICS is important.
2. How does ICS relate to other subjects?

Chapter Two

Data and information

Introduction

We live in the era of science and technology in which data and information are as valuable as land, capital and labour. In this chapter, you will learn about the concepts of data and information, information dissemination and communication media. The competencies developed will enable you to use computers and other devices to process data and disseminate information.

The concept of data and information

The meaning of data

Data can be defined as raw facts and figures before being processed. Data have no meaning until they are processed. Data processing involves computing, sorting or grouping them in a meaningful way. Data processing results into information which provides answers to questions such as *who, what, where,* and *when*. Data come in different formats as follows:

(a) linguistic expressions such as name, age, address, date and ownership;

(b) physical measurements of quantities such as mass, volume and height;

(c) signals, such as gestures and facial expressions;

(d) unprocessed facts, such as images and sounds; and

(e) symbolic expressions, such as road signs.

A singular form of data is datum. For example, if *15,16,14* and *13* is a list of ages of four students in years, then the ages are data. However, if we consider the age of one student only such as the first one on the list, this age is a datum.

The meaning of information

Information is data that have been processed to give meaning in a given context. Therefore, information represents a state of awareness and physical manifestations. Information, as a phenomenon, represents both a process and

a product. For example, the number of hours employees work and the pay rate for each hour are data. Multiplying the rate and hours worked per month using a computer to get the total wage per month is a process. The total wages payable to employees per month is information, which is a product of processing data.

Relationship between data and information

Data are raw facts that have an abstract meaning. To be meaningful in a certain context, data need to be processed. When they are processed in a given context, they give meaning, hence becoming *information.* For example, *51, 77, 58, 82, 64,* and *70* are raw data. These numbers do not mean anything as they could have been anything from street numbers to chart positions of a certain record. When these raw data are given some context, such as being the test scores of ICS by a group of students, they make sense. However, even with the context, the data still need to be processed to turn them into information. The processing, in this example, might be to compute the average from the set of scores. Information in this example is *67* which is an average test score of the students from the provided data. Figure 2.1 illustrates further the relationship between data and information.

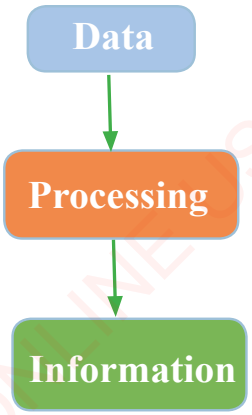


Figure 2.1: *Relationship between data and information*

Generally, people use information in everyday life. For example, you talk to your parent or guardian face-to-face to receive instructions or state your needs. You also use a mobile phone to call someone to exchange ideas and share information. You watch TV or listen to the radio to get news and ideas about different things such as HIV/AIDS trends, an education program, and small business management. On other occasions, you may listen to music, attend an art concert and see a poster or a banner along the road, at the bus stop or

on a building; these inform you about something useful in a particular context. Likewise, when you read a book, magazine, map or report and write notes in your exercise books, or when you read a report using a computer, you either search for or provide information. Both aspects inform you about something meaningful in different ways. Figure 2.2 illustrates different sources of information.

Figure 2.2: *Different sources of information*

Another example of getting information is when you go to a bus terminal and enquire about arrival or departure. The responses from the bus attendant can be regarded as information. Figure 2.3 shows a person enquiring bus information at a booking office.

Figure 2.3: *Passenger inquiring bus information at the booking office*

Similarly, when someone asks you, "What time is it?" as in Figure 2.4, and you reply, "It is 12 o'clock," the response is information about time.

Figure 2.4: *Asking and telling the time*

Consider test scores in a class. If you take the scores of every student from different subjects and calculate the average scores, you will get information that determines the position of each student in the class. The information obtained

from the calculation is used to inform parents or guardians about students' progress. Unprocessed scores cannot indicate which student is the first in the class because each student's score is just a datum. This information can be used to make decisions on how to assist or motivate students based on their performance. This example shows the usefulness of information.

Activity 2.1: Data and information

Identify data and information from the following list of words and justify your answers.

List of words: *result slip, student name, grade, identity card, date of birth, driving license, sex, expiry date, and salary*

Discus your answers with your fellow student.

Sources of information

Sources of information can be a person, materials or place from which information is obtained. These include speeches, documents, pictures, actions, organisations or websites. Sources of information can be classified into two categories, namely primary and secondary sources.

(a) Primary sources of information

Primary sources of information are sources from which first-hand information has been collected by an investigator. Such information is recorded for the first time when the event occurs. For example, if an ICS teacher assigns students to visit a computer laboratory and study the types and specifications of the available computers, the students' observation report is the primary source of information about the computers in the laboratory.

(b) Secondary sources of information

Secondary sources of information are derived from primary sources of information. Examples of secondary sources include dictionaries, textbooks, biographies and encyclopedias.

Importance of information

Information is essential to our daily life. Most things we do are connected with information. Information helps us to prepare responding to different situations such as disasters, weather changes and examinations. It also helps us when we plan to go to a particular place at a specific time. When listening to the radio, one could, hear for example, "*Several people have been admitted to hospital due*

to cholera in a neighbouring village." Due to such an outbreak, the Ministry of Health alerts people in the affected area and those in the neighbouring villages to observe health guidelines. In this case, they should wash hands with soap and clean water after using the toilet, wash fruits before eating them, wash hands with soap before and after eating and drink safe water. Therefore, information is essential to any community since it plays several vital roles in the society as follows:

i. helping to make better decisions;
ii. giving records of past events;
iii. producing knowledge and helping us to identify missing knowledge about a subject; and
iv. helping us to identify opportunities for work, business and innovation.

Knowledge

Knowledge is the understanding of information developed through education or experience. Knowledge enables us to describe and interpret available information on a particular fact, event or phenomenon. The knowledge of a particular situation enables us to make informed decisions or solve problems. Therefore, knowledge influences the thinking, judgement and actions of people. Figure 2.5 shows the relationship between data, information and knowledge.

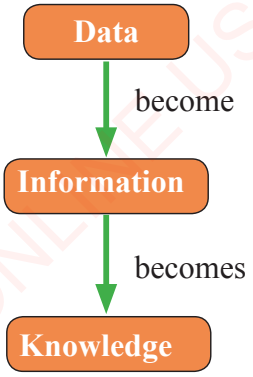


Figure 2.5: *Relationship between data, information and knowledge*

Information dissemination

Information should become meaningful and useful when it is made known to the intended audience. The transfer of information from the source to the receiver is referred to as information dissemination. It is a two-way traffic since feedback should be provided to the sender of the information. In disseminating information, four major components are involved: the source, medium, receiver and feedback. Figure 2.6 is illustrative.

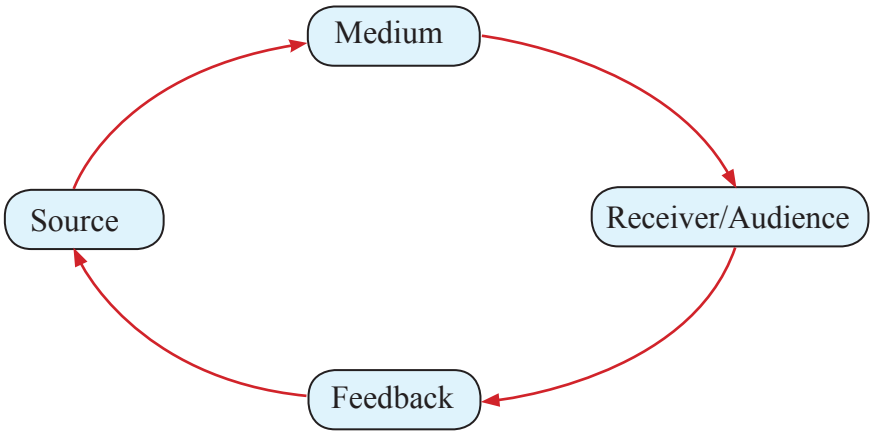


Figure 2.6: *Information dissemination cycle*

The source of information is the originator of the message intended to be disseminated. The medium receives the message from the source and then transfers it to the receiver. The receiver, in most cases, involves people or audiences such as companies and communities to whom the desired information is intended. Additionally, the receiver can turn to be a source of information when giving feedback, thus making the source to become the receiver. As technology enhances the emergence of new means of communication, it simplifies communication. If information is to be used and promoted, it must be disseminated in the manner that best facilitates its reception. Therefore, the challenge is to determine the most appropriate method to disseminate information to the target audience. Two main ways can be used to disseminate information: traditional and modern ones.

Traditional ways of disseminating information

Recalling from history studies, our ancestors used different means to communicate and disseminate information. You might have heard from parents or grandparents, telling stories about how they used to send and receive information from one another. They used messengers or tools, such as drums and horns, to disseminate information. These means were used to give directives, report news, make advertisement, provide entertainment and educate people. We refer to these means as traditional means of information dissemination. Some of these traditional means are still used today. For example, the use of bells in schools to give information to students is a traditional means. The sound of the bell may inform them that it is assembly time; there is an emergency or it is the end of a period. Figure 2.7 illustrates traditional means of disseminating information.

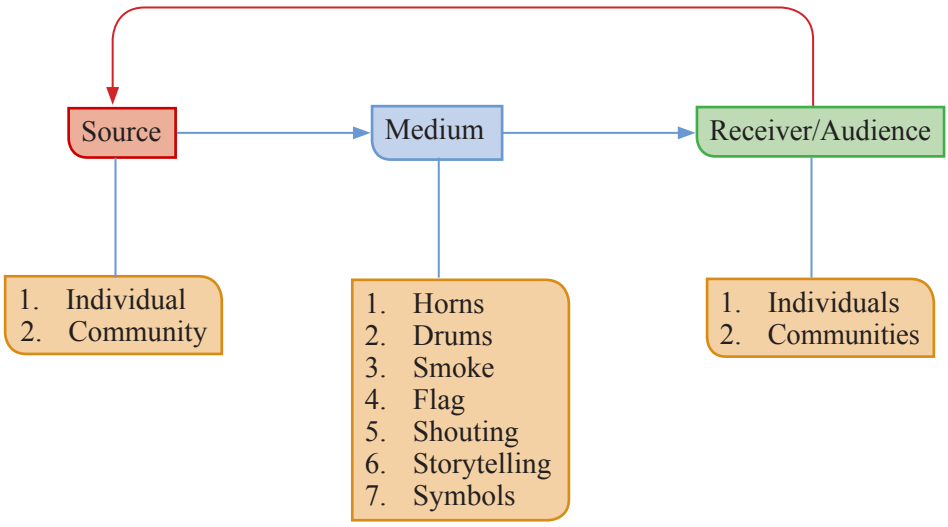


Figure 2.7: *Traditional information dissemination cycle*

The following are traditional means which have been used to disseminate information from time immemorial.

(a) Horn blowing

Traditionally, horns were used when there were issues to be communicated to everyone in the community. Such issues included meetings, deaths, wars, theft and other related matters. Figure 2.8 shows a person blowing a horn.

Figure 2.8: *Person blowing a horn*

(b) Drum beating

Drum beating was done in different styles to produce different sounds. Each sound indicated a particular type of call or information. For instance, there was a drumbeat of a meeting announcement, war alert or disaster warning. Figure 2.9 shows a person beating a drum.

Figure 2.9: *Person beating a drum*

(c) Storytelling

Information was transferred from one generation to another through stories, drama, songs, proverbs, saying and poems. These were told to young ones by grandparents, parents or elders in the community. Stories were told by elders in the evening or during leisure time and traditional rituals. The narrated stories were used to pass information about past life, culture, traditions or teachings. Through their experiences, the elders could also analyse a certain situation and, hence, pass information to the younger generation. Figure 2.10 shows elders telling stories to youths.

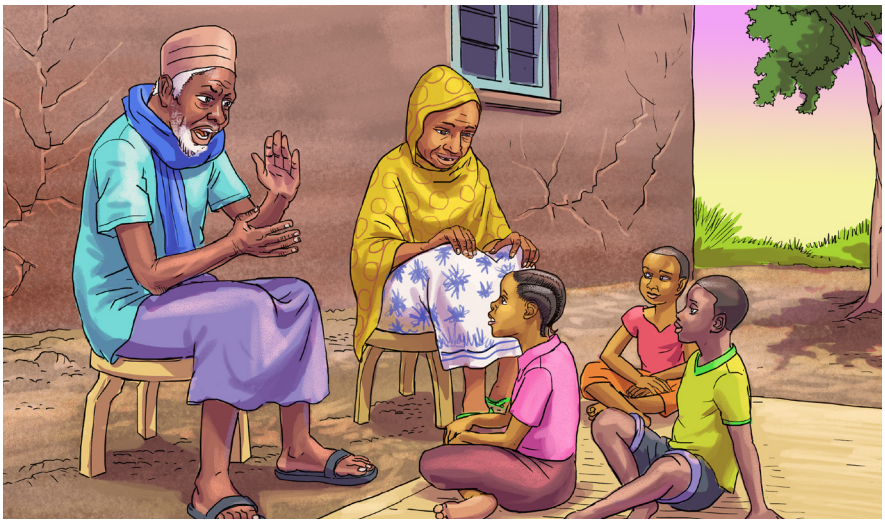


Figure 2.10: *Elders telling stories*

(d) Meetings

Meetings are one of the means used to deliver messages to many people at once. People gathered together around their leaders when they had important messages to deliver. Although this method is traditional, it is still used today. Figure 2.11 shows people in a formal meeting.

Figure 2.11: *People in a formal meeting*

(e) Drawing and painting

Different drawings and paintings were used to pass information to communities. Drawings and paintings could be found on walls, rocks, houses and human bodies and each carried specific information. Examples of these are the Kondoa Irangi rock paintings in Tanzania. Figure 2.12 shows a person drawing on a rock.

Figure 2.12: *Person drawing on a rock*

Modern ways of disseminating information

As human civilisation advanced, people invented several pieces of equipment to facilitate communication, leading to the discovery of different media such as televisions, radios, newspapers, the Internet, telephones and cell phones as listed in Figure 2.13. These modern media have improved the process of disseminating information. In modern ways of disseminating information, the source can be an individual such as the teacher, a company such as Tanzania Telecommunication Company Limited (TTCL), Non-governmental Organisation (NGO) such as Haki Elimu or a government such as the United Republic of Tanzania.

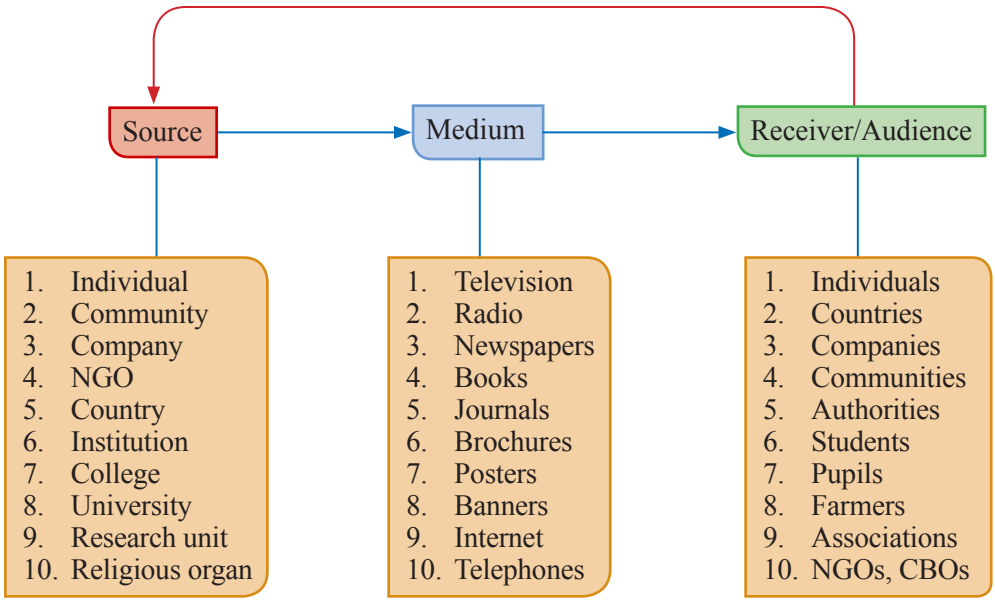


Figure 2.13: *Modern information dissemination cycle*

Comparing modern and traditional ways of disseminating information

The comparison of the two ways of information dissemination is based on the speed, cost and the means of disseminating information. Furthermore, the aim of advertising, giving directives, public relations, education and news are considered in the comparison as shown in Table 2.1.

Table 2.1: *Differences between modern and traditional ways of disseminating information*

Traditional ways	Modern ways
i. Media or pieces of equipment are manual. ii. It may take a long time for information to reach the receiver. iii. Information is delivered to a small area or group of people at a time. iv. Information can easily be distorted or changed before reaching the audience.	i. Most of the media or pieces of equipment use advanced digital technologies. ii. Messages can be sent and received by the receiver within a short time. iii. Information can be delivered to a large area and reach many people at a time. iv. Information cannot be easily distorted before reaching the audience.

Similarities between traditional and modern ways of communication

i. Both deliver information to the intended audience.
ii. Both enable one source to communicate with many receivers.
iii. Both use media to deliver information.
iv. Both can be used to socially bring people together.

Barriers to effective information dissemination

Information dissemination barriers are factors which can prevent, change, hinder, break or delay effective communication. Barriers are all factors that interfere with the communication process and that may negatively affect the delivery of intended messages. Some barriers to effective information dissemination include the following:

(a) Selecting the medium that is not understandable or accessible to the audience or receiver;
(b) Using knowledge beyond the receivers' level of understanding;
(c) Using an unknown language to the receiver;
(d) Blockage of communication channels;
(e) Faults in the mass media due to power cuts, technical faults, weak network signals or receiver problems; and
(f) Interference of transmission signals by other types of signals.

Effective communication can be made possible if all barriers are removed.

Communication media

Communication is the process of transmitting a message or information from one point to another, from one person to another, or from one device to another. Communication media can be defined as a form of technology used to communicate information from one point to another. Examples are telephone lines, radios, televisions, computers, mobile phones and printed materials such as newspapers and journals. Communication is a two-way process. It can be two people talking to each other or a person reading a newspaper. Communication media involve four components, namely the source, medium, receiver and feedback. When two people speak to one another, the one speaking is the sender of the information. Likewise, the one listening is the receiver of the information. When the receiver responds to the message, the response is called feedback. Figures 2.14 (a), (b), (c), (d) and (e) illustrate different ways in which information can be communicated.

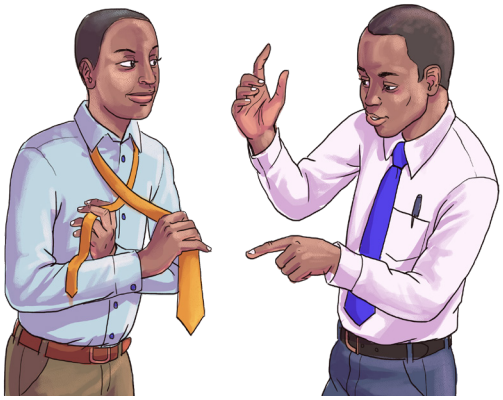


Figure 2.14 (a): *Two people speaking to one another*

Figure 2.14 (b): *Person reading a newspaper*

Figure 2.14 (c): *Person listening to the radio*

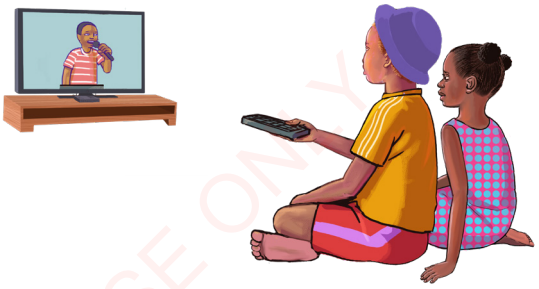


Figure 2.14 (d): *Children watching television*

Figure 2.14 (e): *Person using a smart phone*

Effective communication requires the receiver to understand the exact information the sender provides. The most commonly used communication media are print, electronic and oral ones.

Print media

These are printed publications used to convey information. Examples of print media are brochures, newspapers, magazines, reports and newsletters, as shown in Figure 2.15.

Figure 2.15: *Examples of print media*

Advantages of print media

1. Most of print media are popular among consumers.
2. They can easily be used to spread awareness of different matters and make advertisement.
3. They are mostly trusted, and they have many readers.
4. They can easily be kept for future reference.

Disadvantages of print media

1. They are not easily accessible to the global audience.
2. They are expensive, and they may be exclusive to certain groups of people.
3. They are vulnerable to natural disasters such as fire and floods.

Electronic media

Electronic media convey information electronically. Examples of electronic media are radio, telephones, mobile phones, televisions, computers and the Internet. Figure 2.16 illustrates electronic media devices.

Figure 2.16: *Examples of electronic media devices*

Advantages of electronic media

1. Electronic media provide instant access to the latest news.
2. They help to bring out hidden talents as they give power to individuals to produce and share information.
3. They have increased access to knowledge and information.

Disadvantages of electronic media

1. Some people spend much time on the Internet and television accessing irrelevant information.
2. Some media contents are not suitable for students.
3. They can be used to infiltrate and spread negative foreign ideas and culture in the community.
4. They can be used to spread misinformation in the community.

Oral communication media

These involve the exchange of information and ideas through spoken words. Examples of oral communication media are face-to-face and online meetings, speeches, discussions and interviews.

Advantages of oral communication media

1. They are flexible since they allow changes during a conversation.
2. A decision can be made quickly.
3. They encourage team work and cooperation.
4. They are ideal for discussing confidential information.

Disadvantages of oral communication media

1. They are mostly informal.
2. Long speeches and meetings can be time-consuming.
3. They are mostly not owned by anyone.
4. They may not leave permanent records.

Activity 2.2: Communication media

1. Identify communication media devices used in the community, at home and school.
2. Write how each can be used to communicate information.

Hint: *You may use the Internet or other reference resource materials.*

Exercise 2.1

A. Answer the following questions:

1. What is information?
2. What are the differences between data and information?
3. Why is it important to study ICS?
4. How can you collect information from your grandparent?
5. List the traditional and modern ways of disseminating information.
6. Compare and contrast traditional and modern ways of disseminating information.
7. What are communication media?
8. What is the importance of communication media?
9. List five differences between print media and electronic media.
10. Describe primary and secondary sources of information.

B. Write TRUE for a true statement and FALSE for a false statement.

11. Data can only be alphabets A-Z or a-z.
12. In ICS, we usually say that data are comprised of four basic types: numbers, text, images and sound.
13. Information refers to meaningfully processed, organised, structured or presented in a given context.
14. An information source is anything that might inform a person or provide knowledge about something.
15. Data can be described as unprocessed information.

Chapter Three

Computer evolution

Introduction

Modern computers differ from old computers in terms of structure, technology, appearance and performance. The differences stem from technological advancement. In this chapter, you will learn about computer evolution from the mechanical calculator to the modern digital computers we use today. The competencies developed will enable you to appreciate the contribution of early inventors and predict the future computer generation.

Early computer development

Early inventors

The history of computers goes back to the effort to simplify tasks, such as computation of numbers using calculators and recording information using type-writers. Several inventors participated in the development of computers. Some of the famous inventors are Blaise Pascal, Gottfried Wilhelm von Leibniz, Charles Babbage, William Seward Burroughs I, Herman Hollerith, Howard Aiken, John William Mauchly and John von Neumann. Their inventions are briefly presented below:

i. **Blaise Pascal (1623-1662)** was a French mathematician who invented a calculator to perform addition and subtraction. In 1642, while still a teenager, and having seen that calculations were done using little stones to add and subtract, he started some pioneering work on calculating machines. After three years of effort and fifty prototypes, he invented a mechanical calculator, which performed addition and subtraction. He developed the machine because he had to help his father to collect tax. Blaise Pascal then made a machine that later became known as the Pascaline. Pascal realised how tens and hundreds could be carried forward in calculations. This had to be solved first if one was to work with numbers larger than 10 using the machine. Pascal used this principle: When a gear with ten teeth made one rotation (tens), a second gear shifted one tooth until that gear rotated ten times (hundreds), which shifted another gear (thousands). This principle is

still applicable today in car speedometers, petrol pumps, electricity metres and water metres.

ii. **Gottfried Wilhelm von Leibniz (1646 –1716)** was a German mathematician and philosopher. He became one of the most prolific inventors of mechanical calculators. While working on creating automatic multiplication and division on Pascal's calculator, he was the first to describe a pinwheel calculator in 1685. He also invented the Leibniz wheel, used in the arithmometre, the first mass produced mechanical calculator.

The operation of machines of this type was accomplished using pulling levers or knobs to set up the desired number. All arithmetic operations, namely addition, subtraction, multiplication and division, were accomplished using revolving drums.

iii. **Charles Babbage (1791 –1871)** was an English mathematician, philosopher, inventor and a mechanical engineer who is best remembered for initiating the concept of a programmable computer. He is considered as the father of the computer. Babbage is credited with inventing the first mechanical computer that eventually led to more complex designs.

iv. **William Seward Burroughs I (1857 – 1898)** was an American inventor, a son of a mechanic who worked with machines throughout his childhood. His father desired that his youngest son should choose a gentleman's vocation. Therefore, after graduating, William entered the National Bank of Auburn as a clerk, where he spent long hours adding numbers.

As a clerk at the National Bank of Auburn, Burroughs became interested in solving the problem of creating an adding machine. Thus, he invented a calculating machine designed to ease the monotony of clerical work. To add a new list of numbers and arrive at a total, the user was first required to "*ZERO*" the machine, which means to reset all numbers to zero. Then, to add sets of numbers, the user was required to press numbered keys on a keyboard, which would remain depressed (rather than immediately rebound like the keys of a modern computer keyboard or typewriter). The user would then pull the crank which caused the numbers to be shown on rotary wheels and keys to be released in preparation for the next input. Subtraction was impossible, except by adding the complement of a number. Multiplication was a simple process of keying numbers in one or more columns to the

left and repeating the addition process. He introduced the first commercially successful mechanical adding machine of which a million were sold by 1926.

v. **Herman Hollerith (1860 – 1929)** was an American statistician and inventor who developed a mechanical tabulator based on punched cards to rapidly tabulate statistics from millions of pieces of data. He was the founder of the tabulating machine company that was later merged with other companies to become the International Business Machine (IBM). Hollerith is widely regarded as the father of modern machine data processing. His invention of the punched card evaluating machine marked the beginning of the era of automatic data processing machines. His draft of this concept dominated the computing landscape for nearly a century.

vi. **Howard Aiken (1900 – 1973)** was an American computer engineer and a mathematician. He was educated at the Universities of Wisconsin and Chicago, before becoming a member of faculty at Harvard, where he spent most of his professional career (1939 – 1961). With his colleagues at Harvard and with some assistance from IBM, he built the world's first program-controlled calculator**,** called Harvard Mark I by 1944. This was an early form of a digital computer which was controlled by both mechanical and electrical devices. It was based on relays (operate in milliseconds) as opposed to the use of gears. It required 3 seconds for a multiplication. Although Harvard Mark II (1947) and other computers were still being built, they were soon made obsolete by more advanced electronics.

vii. **John William Mauchly (1907 – 1980)** was an American physicist who, along with J. Presper Eckert (1919 –1995), an American electrical engineer and computer pioneer, designed the Electronic Numerical Integrator and Computer (ENIAC), the first general purpose electronic digital computer for military computations. The computer used vacuum tubes which were completely electronic as opposed to the relay which was electromechanical.

It weighed 30 tons, used 18,000 valves, and required more than 140 kilowatts of power. It was 1,000 times faster than Harvard Mark I, multiplying in 3 milliseconds. They also designed Electronic Discrete Variable Automatic Computer (EDVAC), Binary Automatic Computer (BINAC) and Universal Automatic Computer (UNIVAC) I, which is the first commercial computer

made in the United States. Together, they started the first computer company, the Eckert-Mauchly Computer Corporation (EMCC). They pioneered fundamental computer concepts including the stored programme, subroutines, and programming languages.

viii. **John von Neumann (1903 - 1957)** was a Hungarian-American pure and applied mathematician, physicist, and polymath. He formulated plans with Mauchly and Eckert for a new computer (EDVAC) which was to store programs as well as data. This is called the stored programme concept, and von Neumann is credited with it. Almost all modern computers are based on this idea, and they are referred to as von Neumann machines. He also concluded that the binary numbering system was suitable for computers since switches have only two values 0 and 1 or ON and OFF. He went on to design his own general purpose computer at Princeton.

ix. **Alan Mathison Turing (1912 - 1954)** was a British mathematician, computer scientist and philosopher. He was highly influential in the development of computer science, giving a formalisation of "algorithm" and "computation" concepts with the Turing machine, which can be considered as a model of a general-purpose computer. Turing is widely considered to be the father of theoretical computer science and artificial intelligence. Alan Turing also made significant contributions to the early development of computing, especially to the theory of computation. He developed an abstract theoretical model of a computer called a Turing machine. The machine was used to capture the notion of computable and in-computable problems. However, not all problems could be solved by the Turing machine.

Early computing devices

(a) The Abacus

The Abacus emerged about 5,000 years ago in Asia Minor, and it is still in use today. It may be regarded as the first computer. This device allowed users to make computations using a system of sliding beads arranged on a rack as shown in Figure 3.1. Early merchants used the Abacus to keep trading transactions. But as the use of paper and pencil spread, particularly in Europe, the Abacus lost its importance. However, it took several centuries for the next significant advance in computing devices to emerge.

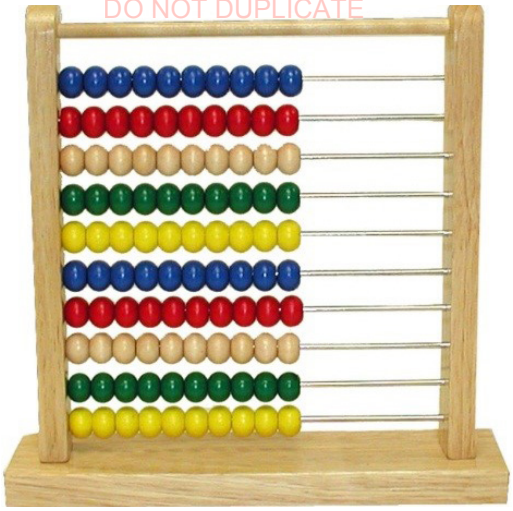


Figure 3.1: *Abacus*

Sourse: *https://www.crossfitleyland.co.uk/smart-goal-setting/abacus/*

(b) Numerical wheel calculator

The numerical wheel calculator was developed by Blaise Pascal in 1642 to help his father with his duties. This brass rectangular box in Figure 3.2 was also called a Pascaline. It used eight movable dials to add up to eight figures long. The Pascaline device used a base of ten to accomplish this. For example, as one dial moved ten notches or one complete revolution, it moved the next dial which represented the ten's column one place. When the ten's dial moved one revolution, the dial representing the hundred's place moved one notch and so on. The main drawback of the Pascaline was its inability to do division.

Figure 3.2: *Numerical wheel calculator*

(c) Mechanical multiplier

The mechanical multiplier was developed in 1694 by a German mathematician and philosopher Gottfried Wilhelm von Leibniz. He improved the Pascaline by creating a machine that could also multiply. It worked by a system of gears and dials. Figure 3.3 shows a mechanical multiplier.

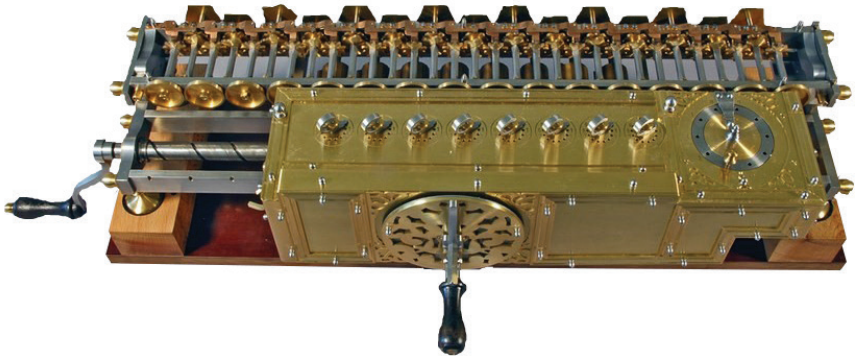


Figure 3.3: *Mechanical multiplier*

Adapted from: *https://3quarksdaily.com/3quarksdaily/2014/07/leibnizs-stepped-reckoner-and-a-clock-for-the-next-10000-years.html*

(d) Arithmometre

The arithmometre was invented to perform four basic arithmetic functions. It presented a more practical approach to computing because it could add, subtract, multiply and divide. The arithmometre is illustrated in Figure 3.4.

Figure 3.4: *Arithmometre*

Source: *https://www.historyofinformation.com/detail.php?id=448*

Computer generations

Computer generations refer to a series of improvements in the development of computers. The term is also used to describe different advances in computer technology. With each new generation, the computer became smaller and more advanced than the previous generation, while its speed, power, and memory

proportionally increased. These new discoveries are constantly being developed. Such discoveries affect the way we live, work and play. The first noted significant development of computers started at the end of the second world war in 1945, namely the first generation of computers. It used vacuum tube technology. Today, we are in the fifth generation of computers, characterised by artificial intelligence and parallel processing.

First generation of computers (1945 – 1956)

The first generation of computers used vacuum tube technology, punched cards for data input, paper tape for output, machine language for writing programs, and magnetic tapes and drums for external storage. Each computer had a different binary coded program written in a machine language that controlled its operation. The concept of *Operating System* was not known at that time. Figures 3.5 (a), (b) and (c) show some components of the first generation of computers.

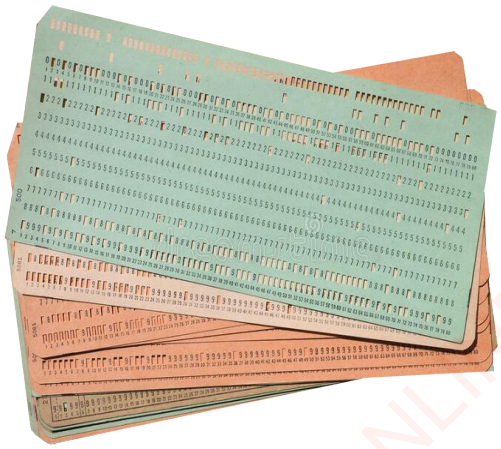


Figure 3.5 (a): *Punched card*

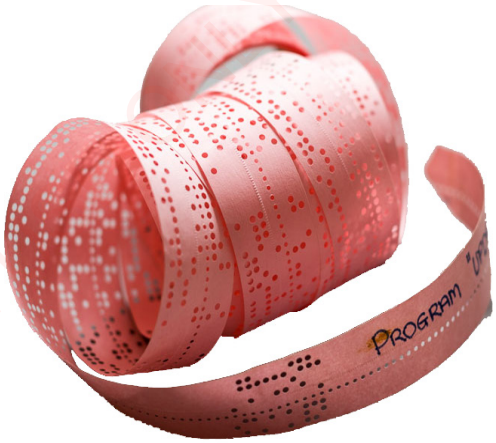


Figure 3.5 (b): *Paper tape*

Figure 3.5 (c): *Vacuum tubes*

Source: *https://www.nutsvolts.com/magazine/article/vacuum_tube_inits_100th_year*

Examples of the first generation computers include Mark I, Atanasoff-Berry Computer (ABC), ENIAC, EDVAC and UNIVAC I.

Mark I

This was the first fully automatic calculating machine. It was designed by Howard Aiken of Harvard University in collaboration with IBM. This machine was an electronic relay computer. Electromagnetic signals were used for the movement of mechanical parts. Mark I could perform the basic arithmetic and complex equations. Although this machine was extremely reliable, it was very slow, complex and large.

Atanasoff-Berry Computer (ABC)

This computer, developed by John Atanasoff and Clifford Berry, was the world's first general purpose electronic digital computer. It used vacuum tubes for internal logic and capacitors for storage.

Electronic Numeric Integrator and Calculator (ENIAC)

The first computer to be made by only electronic components was produced by a partnership between the US Government and the University of Pennsylvania. It was built using 18,000 vacuum tubes, 70,000 resistors and 1,500 relays and consumed 160 kilowatts of electrical power. The ENIAC computed about thousand times faster than Mark I. However, it could store and manipulate only a limited amount of data. Program modifications and error detection were also difficult. Figure 3.6 shows the ENIAC.

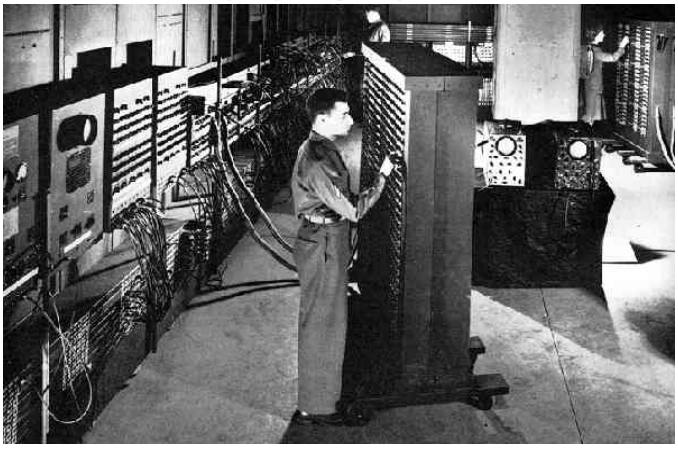


Figure 3.6: *Electronic Numeric Integrator and Calculator (ENIAC)*

Source: *http://www.computersciencelab.com/ComputerHistory/HistoryPt4.htm*

EDVAC

This was designed by John von Neumann in 1940. Electronic Discrete Variable Automatic Computer (ADVAC) could store both program and data. This was the first machine that used the stored program concept. It had five distinct units: arithmetic, the central control, memory, input and output. The key element was the central control. All functions of the computer were coordinated using this single source called the central control. The programming of the computer was done using machine language.

UNIVAC I

Remington Rand designed this computer specifically for business data processing applications. The Universal Automatic Computer (UNIVAC) was the first general-purpose, commercially-available computer. Figure 3.7 shows the Universal Automatic Computer.

Figure 3.7: *Universal Automatic Computer*

Source: *http://www.computersciencelab.com/ComputerHistory/HistoryPt4.htm*

Characteristics of first generation computers

i. They used vacuum tubes.
ii. Data were stored using magnetic drums and tapes.
iii. They were unreliable.
iv. They were big.
v. They consumed a lot of electrical power.
vi. They supported machine language only.
vii. They were overheating.

Second generation of computers (1956 – 1963)

In this generation the computer was made up of transistors that replaced vacuum tubes (see Figure 3.8(a)). As a result, these computers were smaller, faster, more reliable and more energy efficient than the first generation. The first large scale machines that took advantage of the transistor technology were the early supercomputers, such as Stretch by IBM and Livermore Advanced Research Computer (LARC) by Sperry Rand. These computers were mainly developed for atomic energy laboratories. Typical computers of the second generation were the IBM 1400 shown in Figure 3.8 (b), 7000 series, Honeywell 200 and General Electric.

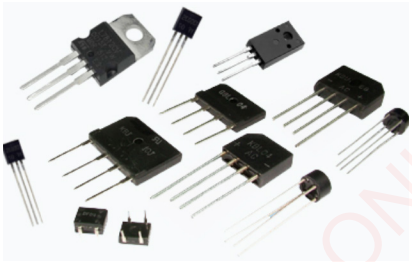


Figure 3.8 (a): *Electronic transistors*

Figure 3.8 (b): *Second generation computer*
Source: *https://www.pinterest.com/pin/722687071441646458/*

IBM 1400 was universally accepted throughout the industry, and the largest businesses routinely processed financial information using the second generation computers. Machine language was replaced by assembly language. Thus, the long and difficult binary code was replaced with abbreviated programming code, which was relatively easy to understand. The stored program concept and programming languages gave computers flexibility. Consequently, they were more cost effective

and productive for business use. The stored program concept implied that the instructions to run the computer for a specific task were held inside the computer's memory and could quickly be modified or replaced by a different set of instructions for a different function.

Activity 3.1: First and second computer generations

1. Explain why the first generation computers were large, over-heating and power inefficient.
2. In a tabular form, compare the characteristics of the first generation and second generation computers.

Hint: *You may use the Internet or other reference resources, or you may discuss them with your peers.*

Third generation of computers (1965 – 1971)

Third generation computers were characterised by integrated circuits (IC) which combined electronic components onto a small chip which was made from semi-conductor materials, as shown in Figure 3.9 (a).

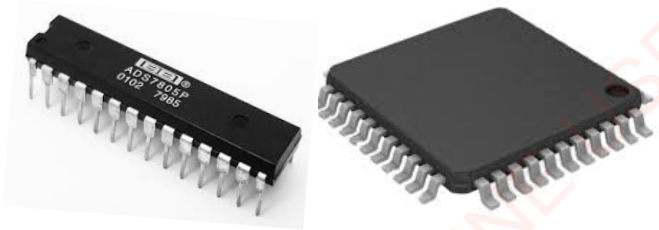


Figure 3.9 (a): *Integrated circuits*

Figure 3.9 (b): *Third generation computer*

The use of small chips further reduced the size of computers. The weight and power consumption of such computers decreased and their speed increased significantly. The development of software was given heavy emphasis compared to operating systems. Operating systems were developed to allow the machine run many programs simultaneously. The OS monitored and coordinated the computer's memory. Multiprogramming was made possible; the machine could thus perform several tasks at the same time. Computers achieved speeds of executing millions of instructions per second, and commercial production became easier and cheaper.

Examples of third generation computers were IBM 360 series (see Figure 3.9 (b)) and Honeywell – 6000 series.

Characteristics of third generation computers

i. They employed Integrated Circuit (IC) technology.
ii. They were more reliable and smaller than the previous generations.
iii. They consumed less electricity and generated less heat.
iv. They maintained high speed and efficiency.
v. Users interacted through keyboards and monitors, interfaced with an operating system.
vi. They used remote processing, time-sharing, real-time, multi-programming operating systems.
vii. They used high-level programming languages.

Activity 3.2: Third generation computers

1. Identify at least three examples of third generation computers.
2. In a tabular form, compare the characteristics of second and third generation computers.

Hint: *You can browse on the Internet for answers.*

Fourth generation of computers (1971 – 1980)

The general features of the fourth generation computers were the use of Very Large Scale Integration (VLSI) technology, the invention of microcomputers, the introduction of personal computers, and the use of networking and fourth generation languages. Figure 3.10 (a) shows an example of a VLSI microprocessor, and Figure 3.10 (b) is an example of a microcomputer.

Figure 3.10 (a): *Very Large Scale Integration microprocessor*

Figure 3.10 (b): *Pentium III computer*

As mentioned previously, the third generation computers used 'Integrated Circuits' that had 10 – 20 components on each chip, which was known as Small Scale Integration (SSI). In contrast, the fourth generation realised Large Scale Integration (LSI) which could fit hundreds of components in one chip and Very Large-Scale Integration (VLSI) which squeezed thousands of components into one chip. The Intel 4004 chip located all the components of a computer (the central processing unit, memory, input and output controls) on a single chip, leading to the introduction of microcomputers. Higher-capacity storage media, such as magnetic disks were developed in this generation. Fourth generation languages emerged and the application software started becoming popular. In 1981, IBM introduced its personal computer for use in office, home and schools. Likewise, Apple introduced a Macintosh computer in 1984. Shared interactive systems and user-friendly environments characterised these computers. As computers continued to become more and more powerful, they could be linked together or networked to share not only data but also memory space and software.

Characteristics of fourth generation computers

i. They had microprocessor-based systems that use Very Large Scale Integrated (VLSI) circuits.
ii. Microcomputers became more affordable in this generation.
iii. Processing speed, accuracy and reliability increased.
iv. Memory capacity increased.
v. The physical size of computer devices decreased, and such devices were owned by individuals.

Fifth generation of computers (1988 – to date)

The advancement of Computers Science and technology led to the design of fifth generation computers. These computers are characterised by the use of Artificial

Intelligence (AI) and parallel processing. With AI, computers are made to think and reason like human beings, such as using voice recognition software. AI is used in areas such as robotics, game playing, and expert systems. Robotics are designed and built to perform tasks faster and more efficiently than human beings. By using robots to automate manufacturing processes, industries have remarkably improved speed, efficiency and production. In parallel processing, multiple CPUs work together to perform complex tasks that require high processing power in a short time. Fifth generation computers are also characterised by advancements in the superconductor technology that allows the flow of electricity with little or no resistance; hence, they are more energy efficient, and they increase data flow rate.

Characteristics of fifth generation computers

i. They use multiprocessor-based systems.
ii. They use artificial intelligence.
iii. They consume less power than their predecessors.
iv. They are more reliable and less prone to hardware and software failures than their predecessors.
v. Computers have faster and larger primary and secondary storage components as compared to their predecessors.

Activity 3.3: Fifth generation computers

Identify at least three examples of fifth generation computers and explain what they can do differently from the previous generations of computers.

Exercise 3.1

1. Match the following:

A	B
i. Second generation computers	(a) Very Large Scale Integration
ii. Fifth generation computers	(b) Vacuum tube technology
iii. Fourth generation computers	(c) Transistor technology
iv. First generation computers	(d) Superconductor technology
v. Third generation computers	(e) Semiconductor technology

2. Write TRUE for a true statement and FALSE for a false statement.
   i) The world's first general purpose electronic digital computer was the Abacus.
   ii) The first generation computers used machine language for programming.
   iii) Charles Babbage designed the Analytical Engine.
   iv) The Personal Computer (PC) was developed in the first generation.
   v) Charles Babbage is considered as the "father of computers."
   vi) The numerical Wheel Calculator was used for both additions and subtractions.
   vii) Third generation of computers was marked by the use of integrated circuit technology.
3. What is the name of the first computer made in 1944 which had both mechanical and electronic parts? Who invented it?
4. What does ENIAC stand for?
5. Compare the performance of ENIAC to computers today.
6. Explain why Neumann was popular in the development of computers.
7. What is the contribution of the following people to the development of computers?
   i) Blaise Paschal
   ii) Gottfried Wilhelm von Leibniz
   iii) Charles Babbage
   iv) William Seward Burroughs
8. Briefly describe the following early forms of computers.
   i) Mechanical calculator
   ii) Mechanical computer
   iii) Von Neumann machine
9. Providing one example for each, briefly explain the following generations of computers considering their technologies and characteristics:
   i) First generation of computers
   ii) Second generation of computers

iii) Third generation of computers
iv) Fourth generation of computers
v) Fifth generation of computers

10. What new technology was used by the third generation computers?
11. Explain the concept of *Artificial Intelligence*.
12. State the major distinction between the first and third generation computers.
13. Highlight five achievements in the fifth generation computers.
14. Explain the relationship between the fourth generation computers and the second-generation computers.

Chapter Four

Computer hardware and software

Introduction

A computer consists of hardware and software that work together to perform various tasks. In this chapter, you will learn about computer hardware, software and use. The competencies developed will enable you to use computer hardware and software applications for different purposes.

Introducing a computer

A computer is an electronic device that receives and processes data following specified instructions to produce results which can be stored for future use. It functions by handling a series of input, process, output, and storage activities, similar to the information processing cycle.

Computers can be characterised by the following:

(a) Speed

A computer performs tasks faster than a human being.

(b) Accuracy

A computer performs its operations accurately. Usually, when it operates inaccurately, it might be due to errors committed by users in feeding the data or experts in developing the application program.

(c) Storage

A computer is capable of storing a large amount of data in its memory or external storage devices. The stored data can also be retrieved when needed.

(d) Tirelessness

Unlike human beings, computers never get tired or bored by doing the same tasks repeatedly. For example, if a computer has to do millions of calculations, it will work from the first to the last with the same speed and accuracy.

(e) Automation

Computer programs allow processes to take place with little or no human control. They can be executed several times to repeat the same processes; they can thus be used to automate machines.

(f) Functionality

A computer is capable of performing different types of tasks in a step-by-step and logical manner. In the present digital age, almost every person in the world uses a computer of some kind. For example, people use computers to process data, play and produce music and movies, control security systems and print documents.

After describing the characteristics of a computer in the preceding part, this chapter presents the main concepts about computers in the following parts. These are computer hardware and computer software.

Computer hardware

Computer hardware refers to the physical parts of the computer; those which you can see and touch. It consists of interconnected electronic devices used to control the computer's operations. These parts include the system unit, mouse, keyboard and monitor. Computer hardware parts are categorised based on their operations, namely input, processing and output. For a computer to perform a particular task, relevant data should be entered into it. Thereafter, data are processed and results are displayed through output devices. This process through which the computer accomplishes its work is called an Input-Process-Output (IPO) system. This system is illustrated in Figure 4.1.

Figure 4.1: *Input, Process and Output system*

Computer operation

In performing a task, a computer operates in a series of steps, namely inputting, processing, main memory, storing and outputting data. The processes involve different devices which facilitate the operation. A complete computer operation is depicted in the block diagram shown in Figure 4.2.

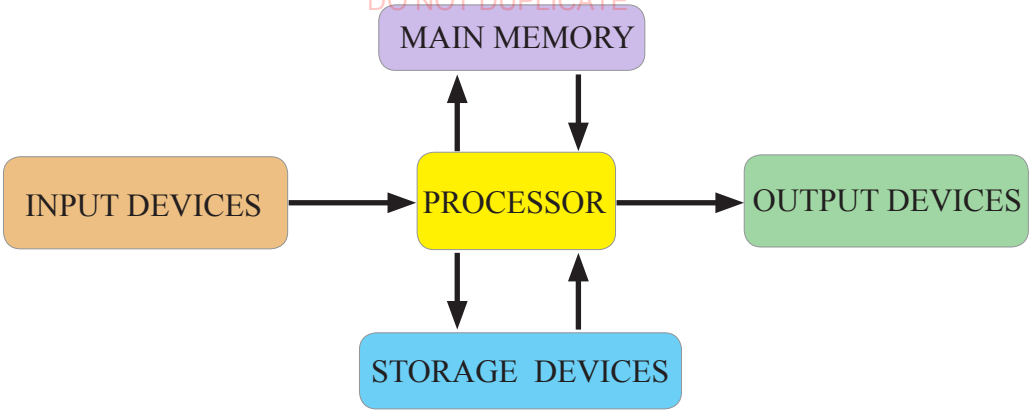


Figure 4.2: *Block diagram of a computer*

Input devices

Like any other machine, a computer cannot produce results unless raw materials (data) have been fed into it. Devices used for entering data into a computer are called *input devices*. Input devices convert user input, which is in human readable form, to machine readable form that the computer can understand. Examples of input devices include keyboards, mice, scanners, joysticks, digital cameras, microphones, light pens and touch screens.

Keyboard

A computer keyboard is an input device used to enter data into the computer system by pressing buttons or keys. It contains keys for individual letters, numbers and special characters, as well as keys for specific functions and punctuation marks. The keyboard is connected to the computer system using either a cable or a wireless connection. On mobile devices, such as tablets and smartphones, keyboards are virtually available. Figure 4.3 shows an example of a keyboard and its layout.

Figure 4.3: *Standard physical keyboard and its layout*

Keyboard keys are grouped as follows:

(a) Function keys

The keys, F1 through F12, are known as function keys. They may have various uses, depending on the installed operating system. A computer program that is currently opened may also change how each of these keys operates. A piece of software may use function keys independently or combine function keys with other keys, such as the ALT or CTRL keys. For example, when you press ALT + F4 (that is, press and hold the ALT key and then press the F4 key) in Microsoft Windows, the active program closes.

(b) Special keys

These keys perform special functions. Examples are *Tab, Caps Lock, Shift, Control (Ctrl)*, *Alt, Pgdn, Home* and *Enter*.

i. **The Tab key:** 

A key that moves the cursor several spaces at once or advances the cursor from one menu or button to the other in an open program. This key can also move focus between selectable items in a dialog box.

ii. **The Caps lock key:** 

A key that enables or disables all letters from being typed in uppercase. For example, if you want to type "see me" when this key is enabled, the keyboard types "SEE ME" and when it is disabled, the keyboard types "see me". For some keyboards, on the right corner of this key, there is a status light that turns on when the caps lock key is enabled and turns off when disabled.

iii. **The Num lock key:** 

The key that is on the top-left corner of the keyboard's numeric keypad, which is used to enable and disable the numeric keypad.

iv. **The Shift key:** 

This is the modifier key on the keyboard that performs different functions. For example, pressing and holding the shift key while pressing the letter a key would generate a capital A. The shift key is commonly located on both the left and the right-hand sides of the keyboard for typing efficiency.

v. **Control keys:** 

This key is found on standard computer

keyboards in the button left and button right portions of the keyboard. It is mostly not used alone but in combination with other keys to perform some functions or commands. For example, **Ctrl + Alt + Del** on a Windows computer opens the task manager application that enables you to terminate a process and active programs or to reboot the computer.

Mouse

A computer mouse is a hand-held input device that controls cursor movement in a Graphical User Interface (GUI). It can be moved and used to select text, icons or files, folders and menu items. For desktop computers, the mouse is placed on a flat surface such as a mouse pad or the desk. Figure 4.4 shows a mouse and its parts.

Figure 4.4: *Parts of a mouse*

Types of mouse

Many types of mouse are in use. They are categorised based on their transmission media, operation and connectivity means to the computer.

Based on transmission media

i. **Wired mouse**: This is a mouse that has a cable to connect to a computer, as seen in Figure 4.4.

ii. **Wireless mouse**: This is a mouse that connects to a computer without a cable or wire. The wireless mouse uses radio signal to communicate with the computer. Figure 4.5 illustrates a wireless mouse.

Figure 4.5: *Wireless mouse*

Based on operation

i. **Mechanical mouse:** This is a mouse that uses a rubber ball to detect scrolling motion. Figure 4.6 is an example of the mechanical mouse.

Figure 4.6: *Mechanical mouse*

ii. **Optical mouse:** This is a mouse that uses a light emitting diode (LED) and detects movement by sensing the reflected light. An optical mouse is shown in Figure 4.7.

Figure 4.7: *Optical mouse*

Based on the means of connectivity

i. **USB mouse:** This is a wired mouse which has a Universal Serial Bus (USB) cable to connect to a computer. Figure 4.8 shows a USB mouse.

Figure 4.8: *USB mouse*

ii. **PS/2 mouse:** This is a wired mouse similar to a USB mouse but with a different end connector shape. It has a round connector with aligned pins. The challenge of PS/2 mice is that they need great care when connecting them to a computer because the pins can easily bend or break. The PS/2 technology is obsolete. Hence, PS/2 mice are no longer produced. Figure 4.9 shows PS/2 mouse connectors.

Figure 4.9: *PS/2 mouse connectors*

Working with the mouse

The mouse needs to be placed on a flat surface with its front part pointing towards the computer. Most people find it easier to position the mouse beside the keyboard. To hold the mouse, you rest your hand on it, place the index finger on the left button, and rest your thumb on its side. Figure 4.10 shows how to the mouse is held.

Figure 4.10: *Holding the mouse*

Note: *When using the mouse, make sure that it is moving on a surface. Do not hang it because it will fail to move the pointer or cursor.*

The mouse is used by moving it on a surface, moving the pointer or cursor on the computer screen. The cursor will change its shape depending on what you are doing, as shown Figure 4.11.

Shows the computer is busy

Shows selection of objects

Appears when pointing to a link

Figure 4.11: *Computer mouse pointer signs*

The mouse can be used to do various tasks such as selecting text; opening or closing files; and moving files, folders or text. When you want to open a folder, file or program on a computer, you should click the left button of the mouse twice in a quick succession. This action is known as *double click.* Figure 4.12 is illustrative.

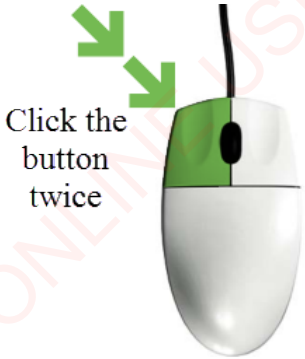


Figure 4.12: *Double click*

Activity 4.1: Selecting and opening a file

i. Point the cursor over a file.
ii. Click once with the left button, and the file will be selected or highlighted.
iii. To open a program or a file, double click its icon using the left button of the mouse.

Scanner

When studying at school, working in an office or at home, you may have paper-based documents that you would like to convert into a electronic (digital) format. In this context, one of the devices that can assist you in doing so is a scanner. The scanner is an input device that captures data from a printed format and converts it into a digital format. For example, photos, original artwork, drawings and text can all be scanned. The process of converting a printed format into a digital format is called *scanning*.

Types of scanners

Scanners come in different shapes and sizes. They can be categorised into four: hand-held scanners, flatbed scanners, drum scanners and sheet-fed scanners.

i. **Hand-held scanners:** These scanners are held in the hand and moved over the material being scanned. They are small, portable and cheap. They improve efficiency at shopping places such as supermarkets and bookshops. They are generally used with barcodes, such as on books in bookshops and libraries and on groceries in supermarkets. Figure 4.13 shows a hand-held scanner.

Figure 4.13: *Hand-held scanner*

ii. **Flatbed scanners:** These scanners provide a flat glass surface to hold a sheet of paper, book or other documents for scanning. These are the most commonly used scanners in homes and offices. The document to be scanned is placed face down on the glass surface of the scanner. The scanning head and the light source under the glass automatically scan the document at a constant speed. Scanners can be multi-purpose as they

can scan flat originals of various sizes. They can also be connected to a document feeder to scan multipage documents. Figure 4.14 illustrates a flatbed scanner.

Figure 4.14: *Flatbed scanner*

iii. **Drum scanners:** These are special scanners used to scan reflective and transparent materials at extremely high resolutions. These scanners give high resolutions, detailed features, dynamic range, and colour interpretation of the materials being scanned. Figure 4.15 presents a drum scanner.

Figure 4.15: *Drum scanner*

iv. **Sheet-fed scanners:** These are digital imaging systems specifically designed for scanning loose sheets of paper. They work as flatbed scanners, except that a document is fed through the scanner and moves along the beam to be read. These types are not useful for books but for single sheets only. See Figure 4.16.

Figure 4.16: *Sheet fed scanner*

Advantages of scanners

1. They produce accurate and high-resolution images.
2. Scanned images can easily be shared, added to an electronic document or edited.

Things to consider

1. Based on the type of scanner used, scanned images may lose their original quality.
2. A scanned image file can be very large and take up large memory space.
3. The quality of original documents affects the quality of scanned image.

Joystick

A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. A joystick, also known as the control column, is the principal control device in many civilian and military aircraft, either as a centre stick or a side stick. Often, it has supplementary switches to control various aspects of the flight.

Joysticks are also used to control video games. They usually have one or more push buttons whose state can also be read by a computer. A popular variation of joysticks used in modern video game consoles is the analog stick. Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles, wheelchairs, surveillance cameras, and zero turning radius lawn mowers. Miniature finger controlled joysticks have been adopted as input devices for smaller piece of electronic equipment such as mobile phones. Figure 4.17 shows examples of joysticks.

Figure 4.17: *Examples of joysticks*

Digital camera

The term *camera* comes from the Latin word *camera obscure* which means "dark chamber", which was an early mechanism for projecting images. Camera technology has evolved with the advancement of technology in other fields. In their old technology, cameras used films to capture images, and printed photos were produced using special machines known as Darkroom Equipment. Most modern cameras use digital technology. They capture images as film cameras do, but images are stored in digital form. Images are mostly stored on memory cards, instead of being printed on films. They can then be copied to computers for editing, storing, printing or uploading to websites and other online applications. Digital cameras are also embedded or integrated in many devices such as smartphones and speed radar used by the traffic police. Figure 4.18 shows a digital camera.

Figure 4.18: *Digital camera*

Activity 4.2: Digital cameras

Use the Internet or other reference resources to outline different uses of digital cameras in social-economic development.

Advantages of digital cameras

1. They instantly produce images.
2. Images can be shared immediately with other devices or uploaded online.
3. A photo or image may be viewed or discarded if not needed.
4. They are environmentally friendly because one does not need to use toxic chemicals to develop films and produce printed photos.

Things to consider

1. The quality of images is limited by the resolution of the digital camera.
2. Some digital cameras have limitations when taking photos in places with poor light.

Voice input

Sound is recorded using microphones and transferred to storage devices such as computers for storage or transmitted to public address systems. Sometimes the word *microphone* is informally being referred to as a mic. The microphone may be connected to a computer or other devices using a cable or wirelessly using a sound card. "Some computers, such as laptops, have inbuilt microphones." Figure 4.19 presents different microphones.

Figure 4.19: *Microphones*

Touch screens

Smartphones, tablets and touch screen computers have keyboards embedded in their systems. One does not need a physical keyboard connected to these devices since a digital keyboard appears when needed. The interaction with these devices

is made possible by touching their screens. A touch screen is an electronic visual display that the user can control through simple or multi touch gestures by touching the screen with a special stylus pen or fingers. Some touch screens use ordinary or specially coated gloves to work, while others use a special stylus pen only. One can use the touch screen to react to what is displayed and to control how it is displayed, such as zooming in and out.

Touch screens consist of infrared light crisscrossing behind it. When a user touches a location on the screen, the finger interrupts the infrared light, and the output is displayed on the screen. Touch screen devices are mostly used in retail stores and restaurants as well as in supermarkets and airports. Figure 4.20 shows an example of a touch screen display of a laptop.

Figure 4.20: *Computer with a touch screen display*

Connecting input and output devices to a computer

Input devices are connected to a computer through connecting cables or wireless connection. Computer ports are connection points or interfaces with other peripheral devices. Such ports connect peripheral devices to a computer through a cable and a socket. Computer ports include a Personal System/2 (PS/2) keyboard and mouse port, USB port, High-Definition Multimedia Interface (HDMI) port, parallel ports and Ethernet port. Figure 4.21 (a) shows different connection ports, and Figure 4.21 (b) shows connecting cables for the computer system unit.

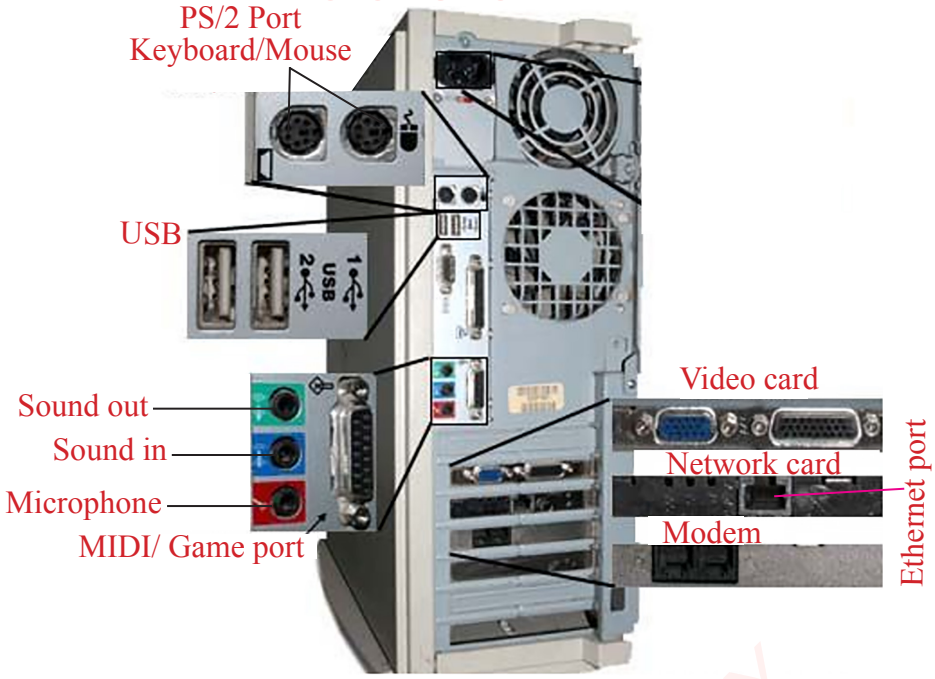


Figure 4.21 (a): *Back view of a system unit showing different connection ports*

Figure 4.21(b): *Connecting cables*

Use Figure 4.21 to connect input and output peripheral devices such as a mouse, keyboard and scanner to the system unit and test to see whether they work.

The Central Processing Unit (CPU)

Data entered into a computer are of no use if they are not processed. The part of the computer that manipulates all data is called the Central Processing Unit (CPU). The CPU, also known as the processor, is the most important component of the computer. It is regarded as the brain of the computer because all processing activities are carried out in it. Arithmetic and logical operations are done by the

CPU. The task is called *processing*. The CPU takes data and instructions from the main memory and processes them based on the instructions given and the types of data provided. The CPU performs four basic tasks, namely fetching, decoding, manipulating and outputting. In microcomputers, the CPU is housed inside the system unit on the motherboard, as shown in Figures 4.22 (a) and (b).

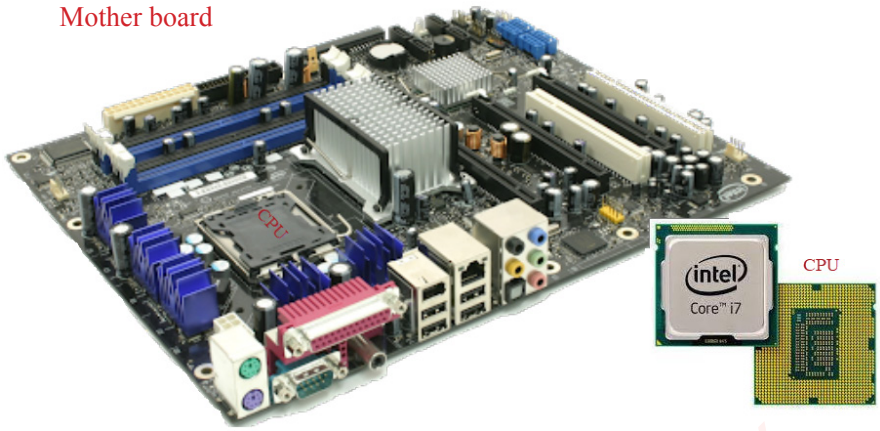


Figure 4.22 (a): *Motherboard*

Figure 4.22 (b): *Top and bottom view of the CPU (processor)*

Parts of the CPU

The CPU consists of three main parts, namely the Control Unit (CU), Arithmetic and Logic Unit (ALU) and Memory Unit (MU). Figure 4.23 shows a block diagram of the CPU.

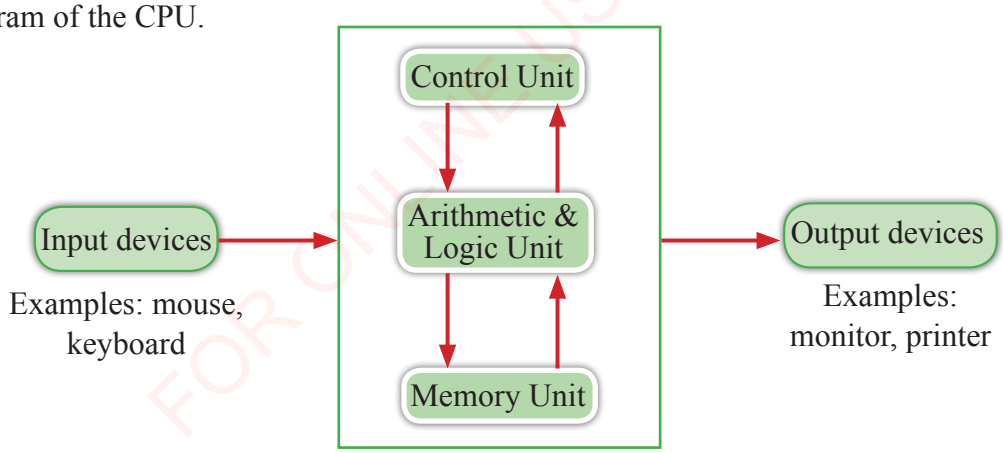


Figure 4.23: *Block diagram of the CPU*

Control Unit (CU)

The control unit coordinates all processing activities in the CPU as well as input, storage and output operations. It determines which operation or order of instructions should be executed. To coordinate these activities, the control unit uses a system clock. The system clock sends electric signals as its means of

communication, just like what traffic signals or traffic officers do at a junction to direct motorists and other road users. The number of pulses per second determines the speed of the microprocessor. The faster the clock pulses, the faster the CPU, and therefore the faster the computer in processing data. In summary, the CU has the following functions:

a. It directs the entire computer system to carry out stored program instructions;
b. It communicates with both the Arithmetic Logic Unit (ALU) and main memory;
c. It instructs the Arithmetic Logic Unit which logical or arithmetic operation is to be performed; and
d. It coordinates the activities of the ALU and memory as well as all peripherals and auxiliary storage devices linked to the computer.

Arithmetic and Logic Unit (ALU)

All arithmetic and logic operations are carried out in the ALU. The basic arithmetic operations include addition, subtraction, multiplication and division. The logic operations compare two or more values. The ALU does all of the mathematical and logical operations in a computer. The following are some common logic operations:

a. = equal to
b. < less than
c. > greater than
d. <= less than or equal to
e. >= greater than or equal to
f. ≠ not equal

The ALU processes data via special temporary storage locations called registers. These hold data just before processing and keep results after processing.

Cache memory

A cache memory is an area in the CPU where frequently accessed data and instructions are held. This is the fastest available memory in the computer. When the CPU requires data during the execution of programs, it first looks in the cache memory. This speeds up the execution process because data and instruction are accessed quicker from cache memory than from RAM.

Activity 4.4: Memory unit

Imagine you are walking alone in the forest. As you walk, you see different types of trees, flowers, and birds; you feel relaxed. Suddenly, halfway through the forest, you see a big snake dropping from the tree in front of you. You start running while screaming, and you lose your way back home. Discuss the following:

i. When you reach the edge of the forest, are you likely to remember all kinds of trees you saw in the forest? Why?

ii. Which tree are you likely to remember and why?

NB: *Discuss this in reference to short and long term memory in human beings and relate it to the computer memory unit.*

Computer memory

Computer memory is a physical device that is capable of storing information. There are two ways of categorising computer memory: volatile and non-volatile memory as well as primary and secondary memory. Volatile memory is a temporary memory that loses its contents when the computer or hardware device loses power. Random Access Memory (RAM) and Cache Memory are some examples of volatile memory. That is why, when a computer freezes or reboots, all working programs lose information that was not saved. Non-volatile memory (NVM) is the memory that keeps its contents even if power is lost. Read Only Memory (ROM) and hard disks are examples of NVM. Table 4.1 differentiates between volatile and non-volatile memory.

Table 4.1: *Differences between volatile and non-volatile memory*

Volatile memory	Non-volatile memory
i. Content is stored temporarily. ii. It is fast. iii. It is readable and rewritable.	i. Content is stored permanently. ii. It is slow. iii. It is readable and can be rewritable.

Primary memory

Primary memory (main memory) is a computer memory that the CPU can access directly. Examples of primary memory are Random Access Memory (RAM) and Read Only Memory (ROM). Most new computer users wrongly use the term *memory* for *hard disk*. Note that both the hard disk and RAM are considered as memory devices.

Random Access Memory (RAM)

Random Access Memory (RAM) is a working memory in which operating system application programs and data in current use are kept for quick access by the processor. When the computer is turned off, RAM loses its data. Figure 4.24 shows RAM modules.

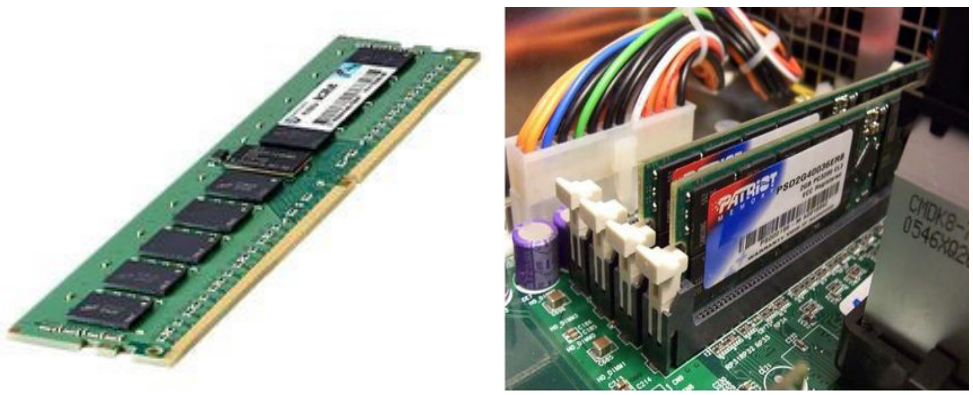


Figure 4.24: *Random Access Memory modules*

Read Only Memory (ROM)

Read Only Memory (ROM) is a permanent non-volatile memory. The information stored on ROM remains even if the power is lost. ROM is where Basic Input and Output System (BIOS) instructions and other firmware of the computer are stored.

The firmware is the computer's essential software which contains programs to perform a Power On Self-Test (POST) when the computer is turned on to determine whether it functions properly. The BIOS is the part of ROM that starts the computer. It allows the microprocessor to control data between RAM and input or output devices such as the keyboard, monitor, printer, modem and disk drives. The ROM chip is illustrated in Figure 4.25.

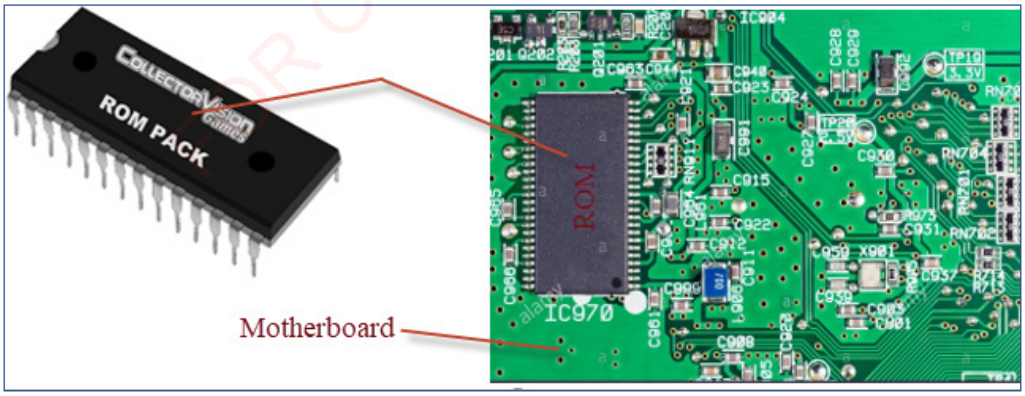


Figure 4.25: *ROM chip*

Characteristics of primary memory

Primary memory is also known as the main memory, and it has the following characteristics:

i. It is the working memory of the computer and
ii. It is faster than secondary memory.

Secondary memory

Secondary memory refers to an auxiliary storage or external memory devices that provide permanent storage for programs, data and information. They store data and programs even when the computer is off. These storage devices are considered to be secondary because they are not directly accessible to the CPU. They allow storage of large amount of data that may not fit in the main memory. This storage keeps virtually all data and applications stored on a computer, including the operating system. It can be internal or external such as a hard disk drive, compact disk drive, flash disk and floppy disk. Secondary memory is slower than primary memory. Hence, the CPU does not access these memory components directly, except via input or output routines. Contents from secondary memory or storage are first transferred to primary memory for the CPU to access them.

Characteristics of secondary memory devices

Secondary memory devices have the following characteristics:

i) They are mostly magnetic and optical;
ii) They may have very large storage space;
iii) They store data permanently, even if power is switched off; and
iv) They are slower than primary memory.

Example of secondary storage devices

(a) Floppy disk

A diskette or floppy disk is a removable, flexible plastic disk, coated with magnetic material. The disk is contained in a hard plastic case to protect it from dust and grease. Data are stored as magnetised spots on concentric tracks. Each track is divided into sectors which are separated by inter sector gaps. To read and write data on a floppy disk, the computer system must have a Floppy Disk Drive (FDD). Floppy disks were widely used between the 1970s and the early 2000s. They are currently outdated, and they have been replaced by other storage devices with larger storage capacity. Figure 4.26 shows floppy disks.

Figure 4.26: *Floppy disks*

(b) Hard disk

Hard disks or hard drives are thin but rigid metal, glass or ceramic platters, covered with a substance that allows data to be held in the form of magnetic spots. They are firmly enclosed inside the system unit, making it part of the system. This is the main storage of installed programs and processed data on the computer. The disk provides relatively quick access to data on an electromagnetically charged surface or set of surfaces. Hard disks have larger capacities, and they can store and retrieve information much faster than floppy disks. Figures 4.27 (a) and (b) show the top and inside view of a hard disk.

Figure 4.27 (a): *Top view of a hard disk*

Figure 4.27 (b): *Inside view of a hard disk*

(c) Compact Disk (CD)

A Compact Disk (CD) is a type of optical disks with a larger storage capacity than that of a floppy disk but smaller than that of a hard disk. The most commonly used CD has 700MB of memory. Compact disks come in three types:

i. Compact Disk Read Only Memory (CD-ROM)
CD-ROMs are mostly used for commercial content because users cannot change the data on them.

ii. Compact Disk Recordable (CD-R)
CD-R stands for compact disk recordable. It can be written on once but can be read many times. CD-R is used to create custom music CDs and to archive data. It is possible to copy data from CD-R, but it is not possible to modify it.

iii. Compact Disk Rewritable (CD-RW)
Data on this disk can be written and edited multiple times. CD-RWs are used to create, edit or replace larger content. Figure 4.28 shows an example of CD-RW.

Figure 4.28: *Rewritable compact disks*

(d) Digital Versatile Disk (DVD)

DVDs have more storage capacities than CDs. They are available as DVD-ROM, DVD-R and DVD-RW. DVD-ROM stands for Digital Versatile Disk Read Only Memory. They cannot be written or erased by the user. They are used to distribute theatre-quality video and sound. DVD-R stands for Digital Versatile Disk Recordable; they are written once. DVD-RW stands for Digital Versatile Disk Rewritable. Data can be written, edited or replaced on DVD-RW multiple times. Figure 4.29 shows DVDs.

Figure 4.29: *Digital Versatile Disk*

(e) Flash disk

A flash disk is a non-volatile removable disk used to store data and transfer files. It is smaller, faster and it has more storage capacity than floppy disks, CDs or even DVDs. Flash disks use solid state technology to store data. Therefore, they have no moving parts.

Advantages of secondary storage

There are several advantages of secondary storage:

i. It is used to store and transfer data or information.
ii. It is a large storage capacity and can retrieve information reasonably fast.
iii. It is used for backup and archiving data and information.

Things to consider

i. They may be damaged by heat, dust or magnetic field.
ii. They are easily damaged by stroking, dropping or hitting.
iii. They may easily be stolen, misplaced or accessed by unauthorised individuals.

Exercise 4.1

1. Briefly explain some of the considerations you will make in choosing an input device for a particular task.
2. Identify the ports labeled A-F in Figure 4.30 and explain which type of peripheral devices can be connected to them.

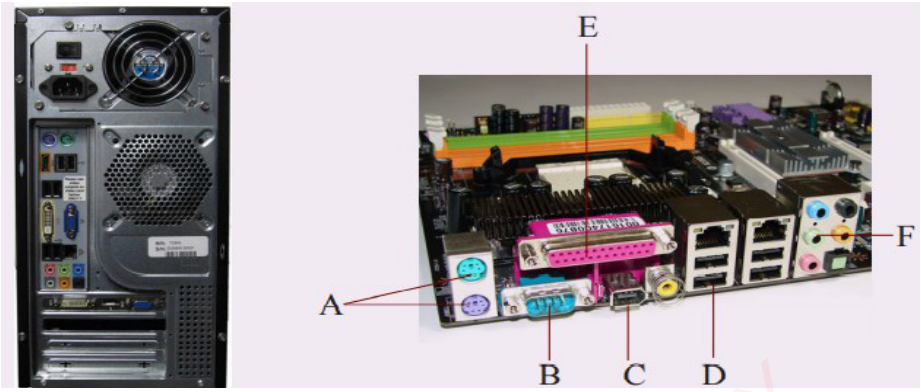


Figure 4.30: *Back view of the system unit and motherboard*

3. Explain the differences between primary and secondary storage devices.

Measuring memory capacity

All data and information in the computer is handled using electrical components such as integrated circuits and semiconductors, which recognise only two states, presence or ON and absence or OFF of an electrical signal. These two states are represented by two numbers 0 and 1, known as Binary Digits (Bits) which are the smallest unit of data on a computer. Bits can be combined into larger units to hold a greater range of values. This is because computers do not work with bits individually, but it groups eight bits together to form a byte. Each byte maintains one eight-bit pattern. Bytes are used to quantify the amount of data digitally stored or transmitted. The storage capacity of any secondary device is evaluated by the amount of data stored on them. A group of N bits can be arranged in different patterns.

Generally, a byte is a data measurement unit commonly used for computer storage. It appears in a sequence of eight bits put together to create a single computer alphabetical or numerical character. Table 4.2 shows different memory units and their relationship to a byte.

Table 4.2: *Memory capacity chart*

Data measurement	Size
Bit	Single binary digit (1 or 0)
1 Kilobyte (KB)	1,024 bytes
1 Megabyte (MB)	1,048,576 bytes
1 Gigabyte (GB)	1,073,741,824 bytes
1 Terabyte (TB)	1,099,511,627,776 bytes
1 Petabyte (PT)	1,125,899,900,000,000 bytes

That is, 1 byte = 8bits, 1KB = 1024B, 1MB = 1024KB, 1GB =1024MB and 1TB = 1024GB.

Output devices

After data have been processed, results should be displayed to users to show what has taken place. The devices responsible for displaying such results are called output devices. Therefore, output devices can be defined as peripheral devices that the computer uses to give out information after processing operations. Some of the output devices include monitors, projectors, and printers. These are described in more detail below.

Monitors

A monitor, also known as the Visual Display Unit (VDU) or the screen, is used to display information in the form of text, pictures and video. The monitor enables the user to interact with and monitor the tasks performed by the computer. It forms images using tiny dots, called pixels, which are arranged in a rectangular form. The sharpness of the image depends on the number of pixels in the monitor. The smaller the pixels, the better the image clarity or resolution. It takes more than one million illuminated pixels to form the whole character, such as the letters in the word "help." A finite number of characters can be displayed on the screen at once. The screen can be divided into a series of character boxes, a fixed location on the screen where a standard character can be placed. There are two types of monitors, which are classified based on the display technology. These are

i. The Cathode Ray Tube (CRT) monitor and
ii. The Liquid Crystal Display (LCD) monitor.

Cathode Ray Tube (CRT) monitor

The Cathode Ray Tube (CRT) monitor is made up of small picture elements, called pixels. Figure 4.31 shows a CRT monitor.

Figure 4.31: *CRT monitor*

Some disadvantages of CRT monitors include their large size, weight and high-power consumption.

Liquid Crystal Display (LCD) monitor

The Liquid Crystal Display (LCD) monitor refers to a class of video devices that has reduced volume, weight and power requirement compared to the CRT monitor. It can be hanged on the wall or worn on the wrist. Current uses of the flat-panel displays include calculators, video games, monitors, laptops and graphic displays. LCD displays are divided into three categories:

i. **Non emissive displays:** They use optical effects to convert sunlight or light from some other source into graphics patterns. An example of non-emissive displays is an LCD screen that beams light through a colour filter, as shown in Figure 4.32 (a).

ii. **Emissive displays:** These are devices that convert electrical energy into light. Examples of emissive displays are plasma panels and Light-Emitting Diodes (LED), as shown in Figure 4.32 (b).

iii. **Thin Film Transistor (TFT LCD):** It is an advanced variant of LCD with improved image quality.

Figure 4.32 (a): *LCD monitor*

Figure 4.32 (b): *LED monitor*

Image projectors

Image projectors are used to display output from a computer onto a plain white screen such as a wall or whiteboard. It is a creative way of presenting computer output to an audience. This technology has almost replaced the traditional overhead projector, which projected enlarged images printed on transparent materials on to a wall or screen using an overhead mirror. Figure 4.33(a) is an overhead projector, and Figure 4.33 (b) is an image projector.

Figure 4.33 (a): *Overhead projector*

Figure 4.33 (b): *Image projector*

Printers

A printer is an output device that produces text and graphics on a physical medium such as paper. Printed information is often called a hard copy because the information exists physically, and it is a more permanent form of output than that presented on a Visual Display Unit (VDU). Its printing speed is usually expressed in pages per minute (ppm). The printer's resolution is often expressed in dots per inch (dpi); the larger the number of dpi the printer has, the higher the resolution. Printers can be grouped into impact and non-impact printers, as described below.

i. Impact printer

An impact printer forms characters and graphics on a piece of paper by a striking mechanism against an ink ribbon that physically contacts the print medium, such as paper. Examples of impact printers are dot matrix and daisy wheel printers. Figure 4.34 shows an impact printer.

Figure 4.34: *Impact printer*

ii. Non-impact printer

A non-impact printer forms characters and graphics on print media without actually striking the paper. Examples of non-impact printers are inkjet, thermal and laser printers. Figure 4.35 shows an example of non-impact printers.

Figure 4.35: *Non-impact printer*

Plotters

A plotter is large type of hard copy output devices, as shown in Figure 4.36. It is mostly used for printing geographical, architectural and engineering drawings such as maps and advertisement posters to be placed on billboards and machine parts.

Figure 4.36: *Plotter*

Speakers

Speakers are devices attached to a computer to give out sound. Most laptop computers and some desktop computer monitors have built-in speakers, while other computers come with separate wired or wireless speakers. Figure 4.37 shows speakers.

Figure 4.37: *Speakers*

Exercise 4.2

1. What is computer hardware?
2. What is the importance of the CPU?
3. Explain the functions of the following parts of the computer.
   a) CU
   b) ALU

4. Describe five input and five output computer devices.
5. List examples of the following:
   a) Primary storage devices
   b) Secondary storage devices
6. Describe the function of the following:
   i) RAM
   ii) ROM

Computer software

Software is a set of instructions that a computer requires to perform various tasks. Software manages hardware components; allows users to write letters, reports, and other documents; develops multimedia presentations; designs web pages and apps; creates images and diagrams; enhances audio and video clips; prepares tax bills; plays games and composes instant messages. Software drives hardware to perform several functions. It is possible to interact with software through command lines or its interface known as Graphical User Interface (GUI).

Computer software categories

There are two types of computer software, namely system and application software.

(a) System software

System software is a set of instructions that controls and manages computer operations. It is designed to control operations and extend the processing functionalities of the computer system. It helps application programs to run correctly. Furthermore, system software serves as the interface between the user, application software, and computer hardware. Examples of system software are operating systems, device drivers and utility programs.

(b) Application software

Application software is a set of programs that carry out operations for a specific task. For example, word processing, spreadsheet, database, presentation and web browsers are examples of application software. Other types of application software include software for information system management, note taking, project management, accounting, and document management. Likewise, application software can be used for computer aided design, audio and video editing, multimedia authoring, web

page authoring, legal and tax documents preparation, electronic learning, payroll preparation, and entertainment. Figure 4.38 shows various icons of application software, and Table 4.3 shows the differences between system software and application software.

Figure 4.38: *Examples of icons of application software*

Table 4.3: *Differences between system software and application software*

System software	Application software
i. It is general purpose software.	i. It is designed for specific tasks or purpose such as creating documents.
ii. It starts running when the computer system is powered ON and continues until it is powered OFF.	ii. It runs only when a user starts it and stops when the user stops it.
iii. It can run independently as it does not depend on application software.	iii. It cannot run independently as it depends on system software.

Relationship between software and hardware

To effectively manipulate data and produce useful results, the computer's hardware and software must work together. Therefore, software cannot be used without hardware. Likewise, without software, computer hardware is useless. Hence, software and hardware are interdependent.

Operating systems

The most important software on a computer is the Operating System (OS). An OS is system software that carries out the computer's essential functions. It

allows hardware and software to work together. Therefore, it can be defined as a collection of programs that controls the operation of the computer system. It acts as an intermediary between the user and the computer hardware. Moreover, it is regarded as a complex collection of many programs that keeps the hardware and software components of the computer system coordinated and functioning. Common operating systems include MS Windows, Macintosh (Mac), and Linux.

Types of operating systems

Operating systems can be categorised based on their functions, the number of users or affordability to users.

Operating systems categories based on functions

Based on functions, OS are categorised into general purpose and dedicated operating systems.

(a) General-purpose operating systems

General purpose operating systems allow running several programs, such as games, word processing, business applications and program development tools. One example of a general purpose OS is Microsoft Windows 10.

(b) Dedicated operating systems

Dedicated operating systems usually run just one program that is permanently kept on memory called Read Only Memory (ROM). They perform specific purposes such as controlling the environment in a building, controlling a petrol pump, or opening and closing an automatic door. The dedicated operating system cannot be used to run other types of programs, such as games or business software.

Operating systems categories based on the number of users

There are two categories of OS based on the number of users: single user and multi-user operating systems.

(a) Single-user operating systems

Single-user operating systems provide access to computer systems by a single user at a time. If another user needs access to the computer system, he/she must wait for the current user to exit. Examples of single user operating systems are Windows OS, such as Windows 8 and Windows 10, and Macintosh OS, such as Mac OS 10.12 to 14.

(b) Multi-user operating systems

Multi-user operating systems allow more than one user to access the computer system at once. Access to the computer system is normally provided via a network so that users access the computer remotely using a terminal or another computer. Today, these terminals are generally personal computers and use a network to send and receive information to the multi-user computer system. Its advantages include allowing many users to share resources such as hardware and software, which are normally expensive. This means the cost is divided amongst the users. However, the multi-user OS presents several challenges. For example, as more users access it, its performance decreases; it requires a lot of memory and disk space; and the software costs more than the single-user OS software. Examples of multi-user operating systems are UNIX, Virtual Memory System (VMS), and Windows servers.

Operating system categories based on affordability to users

There are two categories of OS based on their availability to users: open source and proprietary operating systems.

(a) Open source operating systems

These are OS freely available to users. They can be downloaded and customised depending on a user's specific requirements. Examples of open source operating systems are Linux (mostly for laptops, desktops and mainframe computers) and Android (mostly for mobile devices).

(b) Proprietary operating systems

These are types of operating systems which users need to purchase before using them. Their prices differ based on the vendor and the version of the OS. Examples of proprietary operating systems are MS Windows and Mac OS.

Operating system platforms

There are four commonly used operating system platforms: Windows, Macintosh (Mac), Linux and Android.

(a) Windows Operating System

The Windows family of operating systems is developed by Microsoft Corporation to run on personal computers, servers, smartphones and embedded devices. It is the most commonly used operating system in the world. Windows provides a Graphic User Interface (GUI), virtual memory management, multitasking, and support for many peripheral devices. The development of Windows OS has gone through different versions and will

keep on changing as the technology continues to advance. The versions of Windows OS from the early 1990s are shown in Table 4.4.

Table 4.4: *Progressive development of Windows OS versions*

S/n	Windows Version	Year of Release
1	Windows 10	2015
2	Windows 8	2012
3	Windows Server 2012	2012
4	Windows 7	2009
5	Windows Server 2008	2008
6	Windows Vista	2007
7	Windows Server 2003	2003
8	Windows XP	2001
9	Windows Server 2000	2000
10	Windows 2000	2000
11	Windows ME	2000
12	Windows 98	1998
13	Windows 95	1995
14	Windows NT family	1993-1996

Advantages of the Windows OS

1. Windows has an advantage over its competitors in the area of plug and play support for personal computer hardware because there is a wide variety of applications, drivers, games and hardware that work on Windows.
2. Since it is used by many users, technical support is ensured either through the Internet or offline.
3. The Windows OS is available at a relatively reasonable price compared to other proprietary OS.

Disadvantages of the Windows OS

1. Nearly all computer viruses target Windows-based computers because of their wide-spread use.
2. The Windows OS requires a lot of computer resources (memory, processor, disk space), and thus, it runs relatively slower.
3. The Windows OS is commercial software. Therefore, one needs to purchase a license to use it.

(b) Macintosh operating system (Mac OS)

The Macintosh Operating System (Mac OS) is developed by Apple Inc. It runs only on Apple computers. Both Mac OS and Windows OS are updated regularly, providing users with frequent improvements and upgrades. Table 4.5 shows the evolution of Mac OS, and Figure 4.39 shows a Mac desktop computer.

Table 4.5: *Evolution of Mac OS versions*

S/n	Mac OS version	Years of released
1	macOS 11	2021
2	macOS 10.15	2021
3	macOS 10.14	2020
4	macOS 10.13	2020
5	macOS 10.12	2019
6	OS X 10.11	2018
7	OS X 10.10	2017
8	OS X 10.9	2016
9	OS X 10.8	2015
10	OS X 10.7	2012
11	Mac OS X 10.6	2011

Figure 4.39: *Mac desktop computer*

Advantages of the Mac OS

1. Generally, Mac OS is not targeted by viruses.
2. Historically, Mac OS is more stable and have strong security features than Windows.

Disadvantages of the Mac OS

1. It is very expensive; the Mac OS and associated apple computers are more expensive than the Windows OS and its associated computers.

2. It is only available on Apple computers hardware.
3. Compatibility: The Mac OS has fewer compatible applications compared to Windows.

(c) Linux operating system

The Linux OS is a free and open source OS based on the UNIX operating system. Linux is mostly used through a command line by advanced users, but it provides a graphical Windows-like interface, which most experienced Windows users would not have trouble using it. The OS runs on most PCs from popular PC manufacturers. Linux OS has many distributions or types, and the majority of Linux distributions are freely available. Commonly used Linux distributions include Ubuntu, Linux Mint, Fedora, Red Hat and OpenSUSE. A Fedora desktop environment is shown in Figure 4.40.

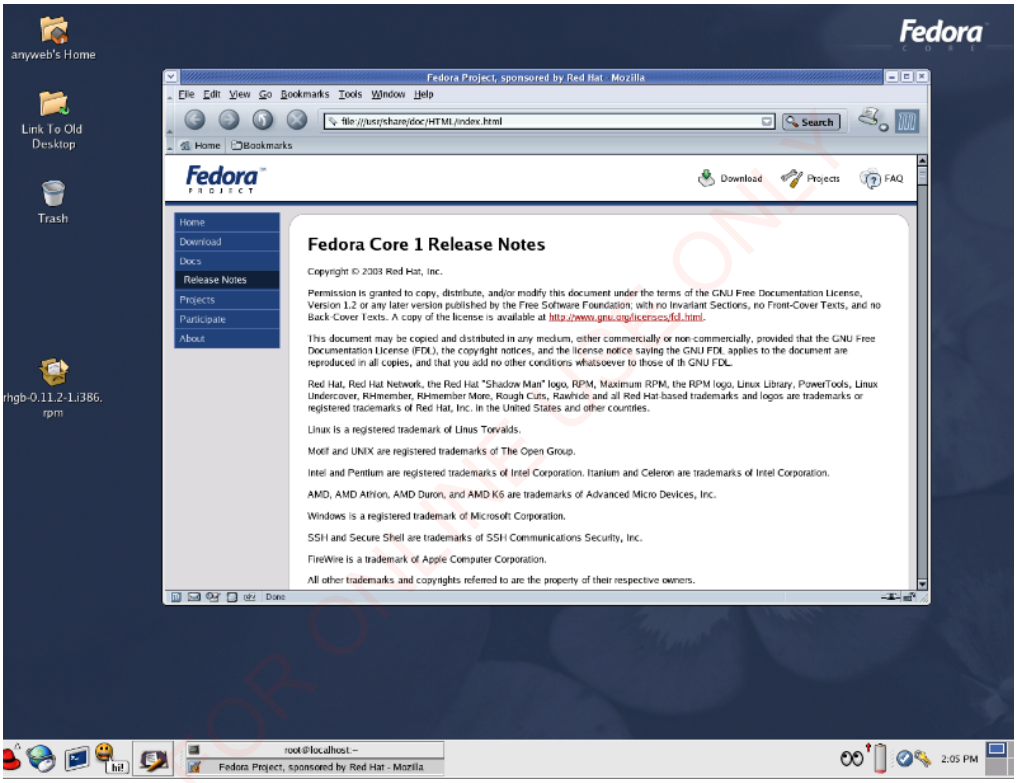


Figure 4.40: *Fedora desktop environment*

Advantages of the Linux OS

1. Price: Most Linux OS distributions can be freely downloaded, installed, used and modified.

2. Variety: The Linux OS has several distributions that can be used, depending on the context and users needs. The most popular ones include Ubuntu, Mint and Fedora.
3. The distributions have a wide communities of developers and user support.

Note: *Open source applications are pieces of software which are freely available on the Internet, and they can be modified by users to meet their specific requirements and distributed to other users.*

Disadvantages the Linux OS

1. Some of its distributions are quite easy to use, while others require a good computer knowledge to use.
2. Vendors: No Linux computers. Most of the time you need to install it yourself because is not common for computers to be pre-installed with Linux.
3. Few new computers come with Linux installed. Most of the time you need to install it yourself.

Functions of operating systems

Operating systems perform the following functions:

(a) File management

Files and programs are located in different parts in the hard disk. The operating system helps to find the location of files, data and programs in storage media. It also helps to move, rename and delete files.

(b) Task management

A computer can perform several tasks at once. The OS coordinates and allocates resources to running programs. The OS that allows performing multiple tasks at once is called a multitasking OS. In such an OS, one can use Microsoft Word, Microsoft Excel, movie player and game applications concurently.

(c) Hardware management

When programs run, they use computer memory, monitor, disk drive and other devices such as printers. The operating system is the intermediary between programs and hardware. It allocates resources such as memory and disk storage space to programs. The operating system responds on requests to use memory and other devices. It also tracks programs that need access to devices and coordinates everything the hardware does.

(d) Interrupt management

It ensures all activities do not overlap to overwhelm the computer and cause it to stop working. Sometimes, both input and output devices need to use computer resources. Therefore, they interrupt the CPU so that it can allocate resources to them.

(e) Error handling

The operating system constantly controls and monitors the computer system to detect errors and avoid malfunctioning of the computer system.

Security management

Several measures can be used to protect the operating system from threats, virus or data loss. One of the common security measures is to use passwords to protect data. Passwords also prevent unauthorised access to programs and data. During computer operations, any malware or intruder that wants to access the computer system is also blocked by security programs built in the OS. In addition, the OS manages installed security programs such as antivirus software to protect the computer against malware.

Using computer systems

Any computer needs electricity to work. A desktop computer must always be connected to a power source while mobile devices such as laptops, smartphones and tablets have internal batteries, which are charged when the device is connected to the power source. Hence the charged batteries allow them to operate on the stored power when not connected to the power source.

Switching the computer on

To turn the computer on, you need to look for the power button. A desktop computer has a power button on the front of the system unit. By pressing the button and then releasing it, you turn the computer on. The following are the steps to follow to switch the computer on:

(Note that, for the expository purpose, the rest of this chapter will use examples from Windows.)

Step 1: Make sure the system unit and the monitor are properly connected to the power source. Then, identify the *Power Button* on the system unit or on the laptop computer. These buttons look like the ones shown in Figure 4.41.

Figure 4.41: *Power buttons of computer systems*

Step 2: Push the *Power Button*.

On some computers, the button lights up when the computer is on. On some laptops, there is often a light on the button that comes on. You may have to keep pushing for a few seconds to make this happen. You might hear a sound like that of a fan or a vacuum cleaner and or status lights will appear on the front of the computer. For a desktop, switch on the monitor as well. If nothing happens after pressing the button, do the following:

(a) If you are using a laptop, the battery might be out of charge. Connect the charger to your laptop, plug it into the power source, and then switch it on again. The laptop charger will recharge the battery as you continue to use the laptop.

(b) If you are using a desktop computer, make sure all power cables and the HDMI or VGA cable connecting the monitor to the system unit are properly connected.

Step 3: Wait for the computer to boot until you see the *Login screen* or the monitor.

Step 4: If your computer is password-protected enter your current username and password. You will see a desktop such as in Figure 4.42.

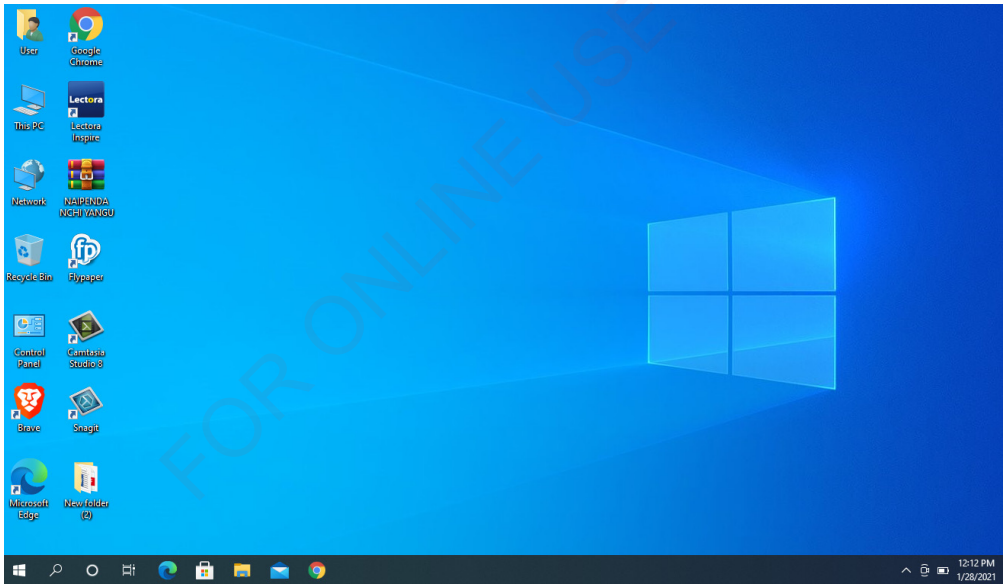


Figure 4.42: *Windows 10 desktop environment*

After seeing the desktop, you can start using the computer.

Activity 4.5: Shutting down a Windows 10 computer

To shut down the computer, follow the following simple steps.

1. Click on the **Start** button,
2. Click **Power** and
3. Click **Shut down** as shown in Figure 4.43.

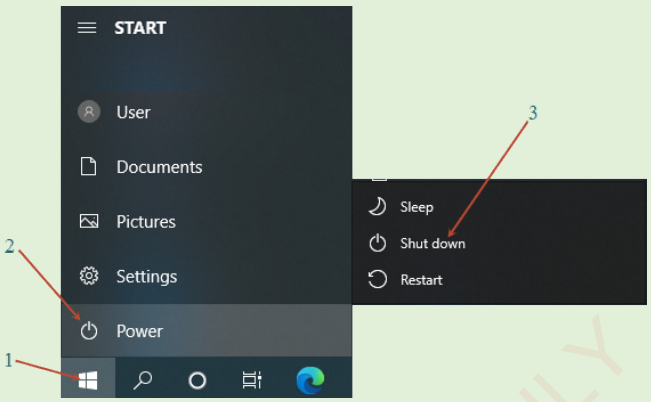


Figure 4.43: *Shutting down a Windows 10 computer*

Managing Files and Folders

Creating files

A file is a collection of data stored in one unit identified by name. It can be a document, picture, audio, video, application or other collection of data. There are different types of files, including data files, program files and system files. In the Windows OS, each file has an extension which is added to the end of the file name to help identify its type. A standard file extension following the names of files (.) can indicate whether a particular file is a system, program, or data. The period separates the extension from the filename itself. The most common file extensions include:

(a) .txt: a plain text file;
(b) .doc: data file created in a MS Word;
(c) .xls: data file created in MS Excel;
(d) .ppt: data file created in MS PowerPoint;
(e) .jpg, .jpeg, .gif, .bmp, .png, .tif: images in various formats and
(f) .pdf: Portable Document File.

(a) Renaming files

Activity 4.6: Creating Files on a desktop

The following steps show how to create a file on your computer desktop.

1. Right-Click on your computer desktop.
2. Select "New" from the pop up menu, as shown in Figure 4.44.

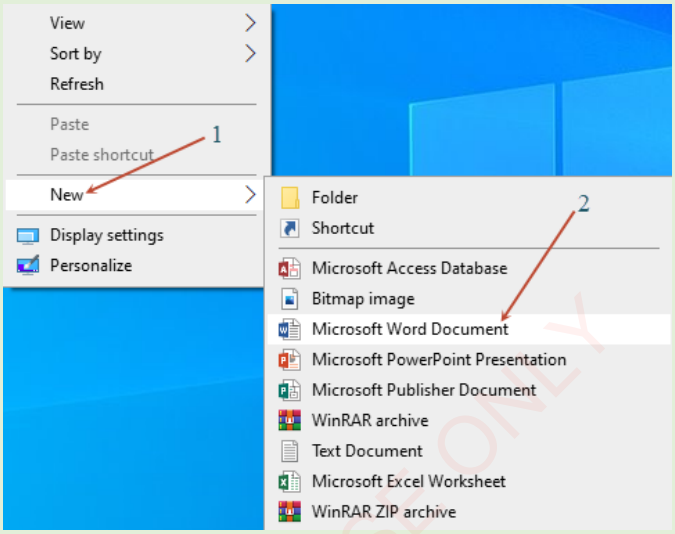


Figure 4.44: *Creating a new file*

3. Choose the application you want to create by clicking on the application type. In this example, choose Microsoft Word document file. The file created will appear automatically on the desktop, as shown in Figure 4.45.

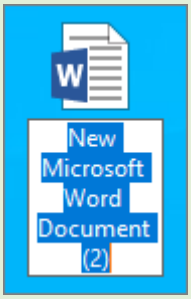


Figure 4.45: *Word document file*

4. Type a file name of your choice.

Activity 4.6: Renaming the created file

All files that are created by the user can be renamed. Renaming a file gives a new name. To rename a file on a Windows computer, follow the steps below:

1. Right-click on the file.
2. Click on "Rename", as shown in Figure 4.46.

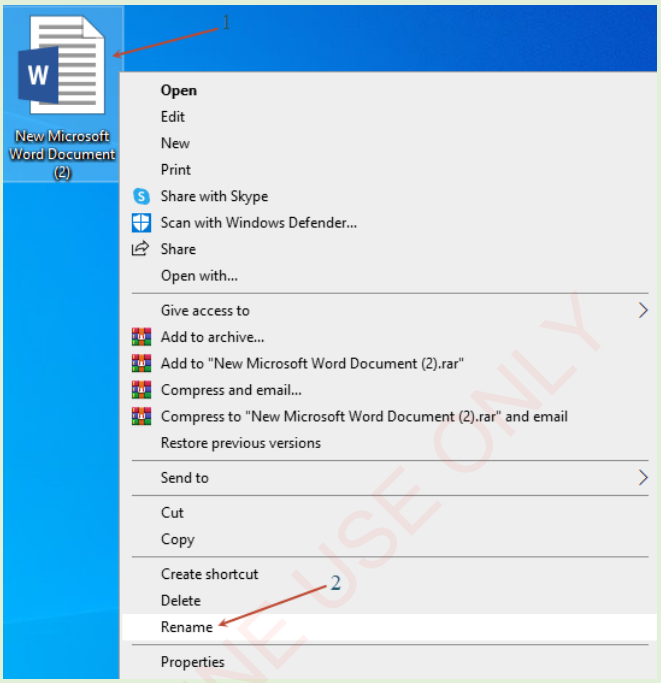


Figure 4.46: *Renaming the created file*

3. Type the name "ICS FORM ONE" or a new name of your preference, as shown in Figure 4.47.

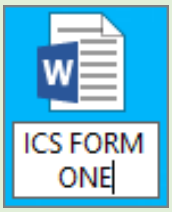


Figure 4.47: *Renamed file*

4. Click anywhere on the desktop or press "Enter."

(b) Copying files

Activity 4.7: Copying a file

When a file is copied, it creates its copy and keeps it on the clip-board. To copy a file, follow the following steps:

1. Right-click on the file.
2. Click on "Copy" as shown in Figure 4.48. The copy of the file will be kept in the main memory on the clipboard.

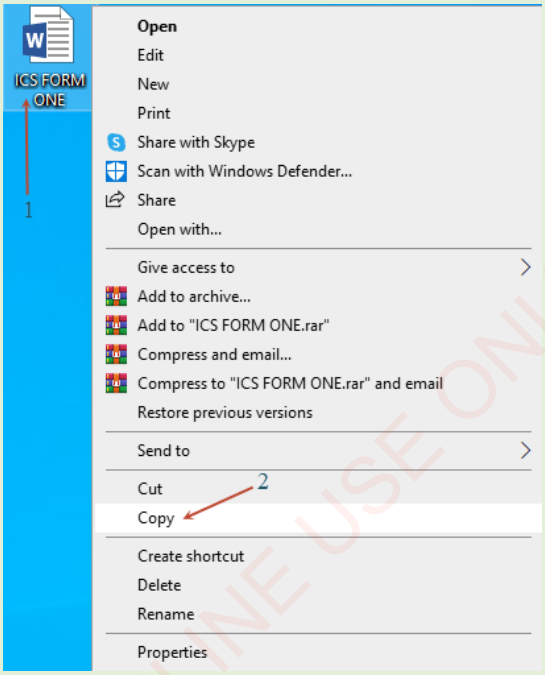


Figure 4.47: *Copying a file*

(c) Pasting files

Pasting means placing a copy of the file kept on the clipboard into a specified location.

Activity 4.8: Pasting a file

To paste a file, navigate to the location where you want to paste it and follow the following steps:

1. Right click on any blank part of the desktop.
2. From the pop up menu, select "Paste," as shown in Figure 4.49.

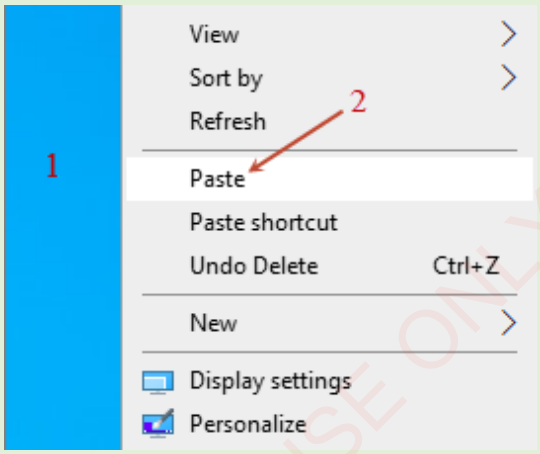


Figure 4.49: *Pasting a file*

(d) Working with folders

A folder is an electronic container used to store and organise files and data stored on a computer. These files can be documents, programs, scripts, libraries or any other kind of computer files. A folder can also store other folders, which may store more files and other folders.

Activity 4.9: To create a new folder on the desktop, follow the steps shown in Figure 4.49

1. Right-click on any blank part of the desktop.
2. From the pop up menu, click "New" and then "Folder," as shown in Steps 2 and 3 in Figure 4.50. A new folder will appear.
3. Type the name of the folder you want to use and then press "Enter."

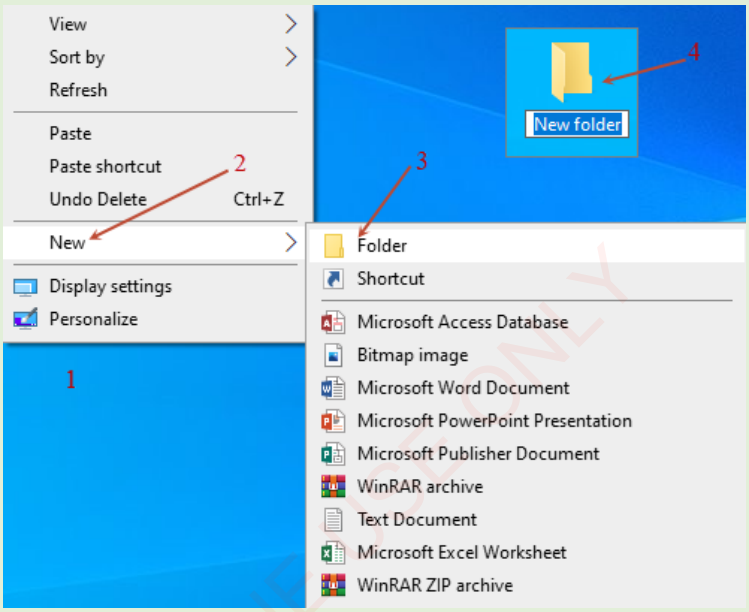


Figure 4.50: *Creating a folder on the desktop*

(e) Renaming a folder

You may need to change the name of the folder you created on your computer.

Activity 4.10: Renaming a folder

To rename a folder, follow the following steps:

1. Right-click on the folder.
2. Click "Rename" from the pop-up menu that appears, as seen in Figure 4.51.
3. Type a new name of the folder, such as "ICS" and press the Enter key.

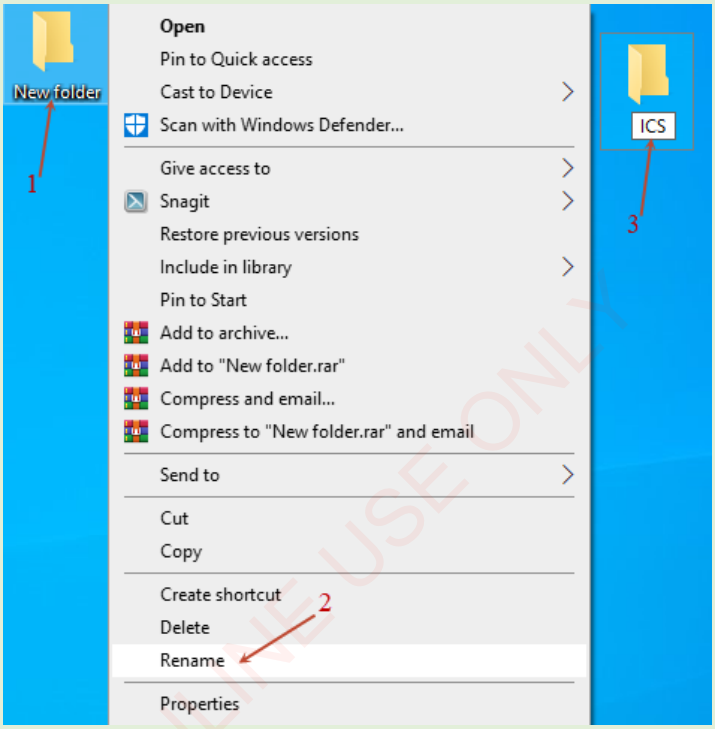


Figure 4.51: *Renaming a folder*

(f) Deleting a file or folder

Activity 4.11: Use steps in Figure 4.52 to delete a folder or file

To delete a folder or file, follow these steps:

1. Right-click on the folder.
2. Click "Delete" from the pop-up menu that appears.
3. The folder will be deleted. Click OK if the computer will ask you whether you want to delete it.

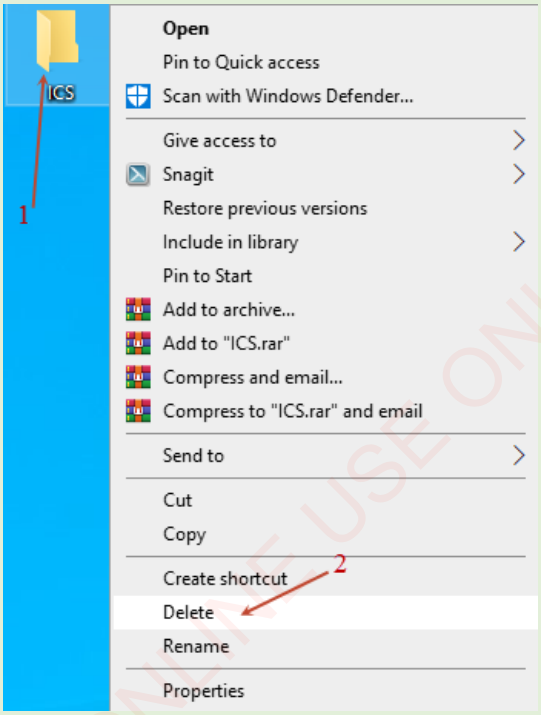


Figure 4.52: *Deleting a folder*

(g) Restoring deleted folder and files

Deleted folders and files are put in a special place in secondary storage called the *Recycle Bin* and can be restored to their original locations.

Activity 4.12: Restoring folders and file

To restore a deleted folder or file, use the following steps and refer to Figure 4.53:

1. Right-click on the Recycle Bin, and you will see a pop up menu.
2. Click on the word "Open"; you will see all deleted files and folders.
3. Right-click on the file or folder you want to restore.
4. Click on the word "Restore."

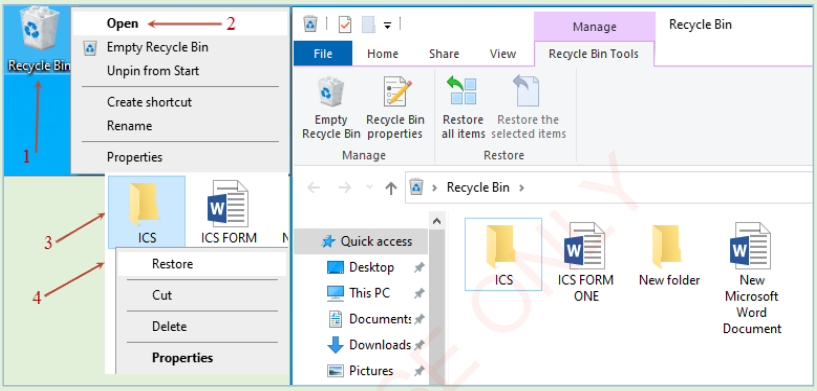


Figure 4. 53: *Restoring a folder or file*

Using search and help facilities

As you work with your computer, there will likely be occasions on which you forget where you saved certain folders or files. Windows helps you to quickly find the document you are looking for, no matter where it is stored on your computer.

(a) Searching from the Start Menu in Windows 10

In the task bar, click the search icon and the cursor is automatically placed in the search box. You can thus type a search word for a file or folder you want to search. Using the search box, you can find files and specific content within such files. You can even use it to quickly find and start programs. For example, if you click on the search icon and type "Word 2016" and press "Enter," as shown in Figure 4.54, the Word application appears on the list.

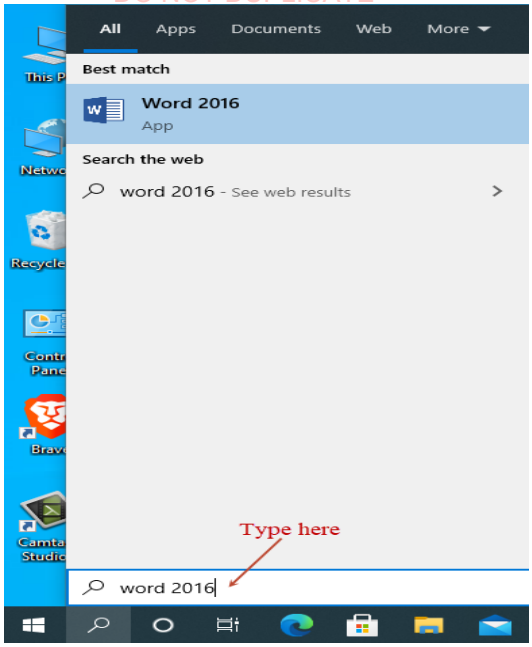


Figure 4.54: *Search box*

If you are looking for a system file or a document on an external storage device, you will need to search using File Explorer.

(b) Searching using the File Explorer

Use File Explorer to search a folder or storage device. In the upper-right corner of File Explorer, there is search box that you can use to type a keyword to search anything such as a folder, device, or file as shown in the contents pane in Figure 4.55. This option searches through file names, file properties, applications and file contents.

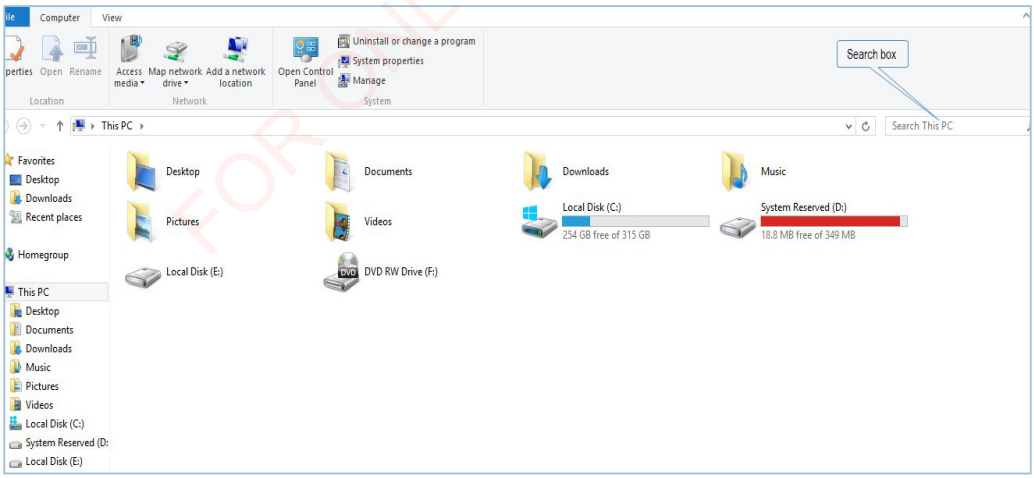


Figure 4.55: *File Explorer*

(c) Searching techniques

Here are a few tips to refine your searches:

i. Use quotation marks

Sometimes you can find a document by searching for a phrase it contains. If you start your search terms with a quotation mark (“), only examples of those words in the specified order will be returned. So, entering *High school* will return any documents with both words, whether or not they are together, while a search for **“***high school***”** will return only results with that exact phrase.

ii. Filter the search

You can refine your search by specifying things like date modified, file size, and file type. The filters available change depending on which files are in the unfiltered results. Searches are not case sensitive, even if quotation marks are used. That is, you can use either capital or small letters or mixing the two without any problem.

(d) Windows Help and Support

Learning to use an operating system like Windows can sometimes seem like a challenging task. However, the more you work with it, the easier it becomes. In addition, Windows provides several tools to help you find relevant information and solve problems such as in Figure 4.56.

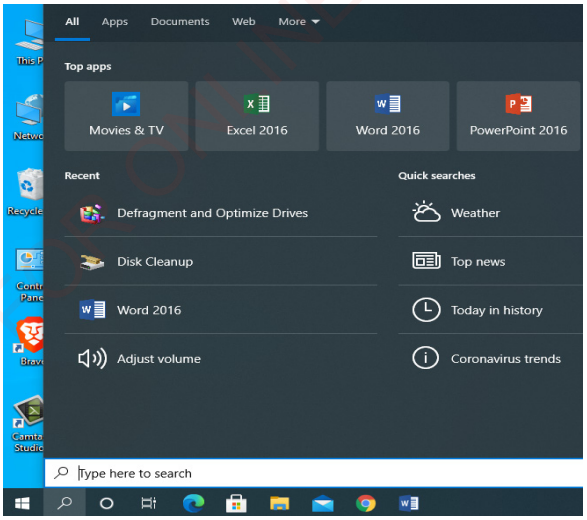


Figure 4.56: *Windows search functionality*

Windows 10 provides a search tool, as shown in Figure 4.56, that you can use to search for a program, hardware help, or broad topics.

Activity 4.13: Use Windows help and support to find answers and information.

1. Type the word "help"; you will see the help menu.
2. The search tool makes it easy to navigate the various Help topics. For example, you can search for apps, documents, web document and more by navigating around. The search menu will pop up as shown in Figure 4.57.

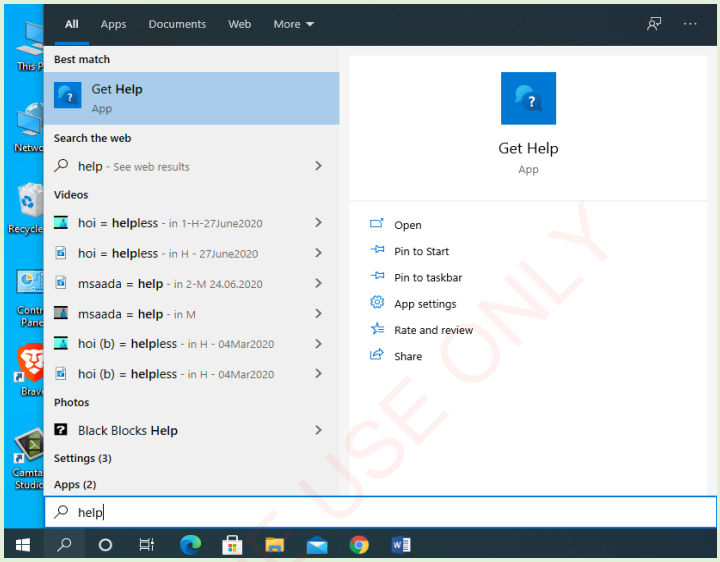


Figure 4.57: *Windows Help menu*

3. Enter keywords related to your particular search links to common support tasks, such as using Windows Update. Then, search options to help you get more precise information, as shown Figure 4.58.

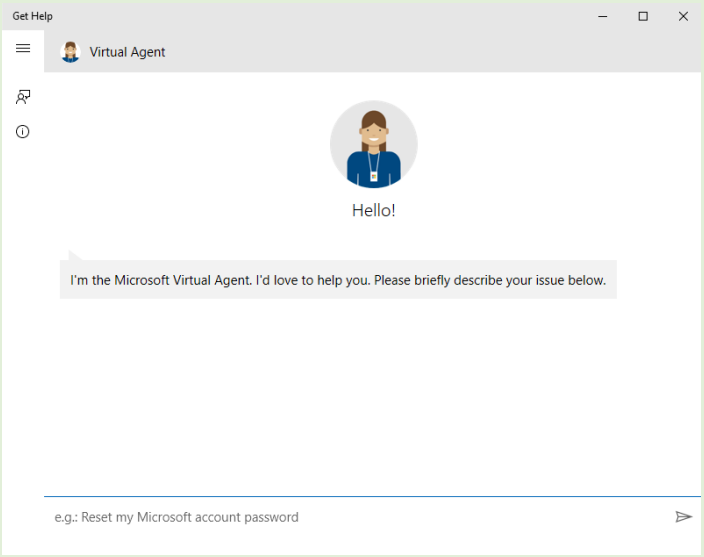


Figure 4.58: *Windows Help and Support*

4. Type the keyword you want on the search menu and press the Enter key.

Exercise 4.3

1. Choose the most appropriate answer and write its letter in the box provided.

i) The basic operations performed by a computer are
   a) Arithmetic operation
   b) Logical operation
   c) Storage and relative
   d) All of the above

ii) .....is the heart and brain of a computer.
   a) ALU
   b) Memory
   c) CPU
   d) Control Unit

iii) Which of these printers would be the most suitable for printing a large number of high quality black and white printouts?
   a) Laser printer
   b) Dot matrix printer

c) Plotter
d) All of the above

iv) Examples of secondary storage memory devices are .....
a) Floppy disk and ROM
b) Hard disk and RAM
c) ROM and RAM
d) Floppy disk and Hard disk

v) What is the most suitable input device for highlighting or selecting an object on the screen?
a) Joystick
b) Mouse
c) Keyboard
d) Touch screen

vi) Software which is installed on a new computer is called
a) Utility program
b) Operating system
c) Firmware driver
d) Application software

2. a) Identify other Input and Output devices of a computer, apart from those discussed in this chapter, and describe their functions.
b) State the purpose of data backup

3. Identify appropriate computer output device for each of the following tasks:
a) generating receipts where carbon copies are required
b) producing an architectural drawing where precision is required

4. a) Differentiate between primary memory and secondary memory.
b) Describe three uses of computers in our society.

5. Briefly describe five areas where computers are used to process data.

6. Give three reasons why a mobile phone is regarded as a computer.

7. Give two reasons why the computer is referred to as an electronic device.

Chapter Five

Classification and significance of computers

Introduction

The computer is one of the most revolutionary and powerful tools ever developed in the history of the modern world. It plays significant roles in different aspects of our daily lives. In this chapter, you will learn more about computers by focusing on their classification and significance in performing different tasks. The competencies developed will enable you to articulate the potential of computers and their use.

Classification of computers

Modern computers can be classified using different criteria. This section uses three main criteria to classify computers.

Classification based on performance capacity

Based on this criterion, computers are classified into personal computers, work-station computers, minicomputers, mainframe computers and super computers.

(a) Personal Computers

Personal Computers (PCs) are small computers designed for personal use. Their small size, capabilities and affordable prices make them useful and comfortable for personal use. Some software applications that are installed on PCs include word processing, spreadsheets, databases, web browsers and e-mail clients. Personal computers may be connected to a Local Area Network (LAN), Wide Area Network (WAN) and the Internet, using either a cable or a wireless connection. A personal computer may be a desktop computer or a laptop as shown in Figure 5.1.

Figure 5.1: *Desktop and laptop personal computers*

(b) Workstation computers

Workstation computers are desktop computers that are more powerful than normal PCs in terms of processing power. Workstation computers have very good graphics capabilities and large display screens (monitors). These computers are mainly used by engineers and scientists for demanding tasks which require high processing power and high quality images such as Computer Aided Design (CAD) used in engineering designs and Computer Aided Manufacturing (CAM) used to automate manufacturing processes. Figure 5.2 is an example of a workstation computer.

Figure 5.2: *Engineering workstation computer with multiple monitors*

(c) Minicomputers

Minicomputers are designed to support multiple users at a time. These computers have large storage capacity and operate at a higher speed. Minicomputers are used in multi-user systems in which multiple users work on the same computer simultaneously and large volumes of data are processed. Minicomputers can also be used as servers in Local Area Networks (LANs). Figure 5.3 shows examples of minicomputers.

Figure 5.3: *Minicomputers*

(d) Mainframe computers

Mainframe computers are computers which are very powerful. They also have a very large storage capacity, and they can handle workloads by many users. These computers are generally used in centralised databases and in controlling nodes in a Wide Area Network (WAN). The mainframe is the workhorse of the business world. It is the heart of a network of computers or terminals which allows hundreds of people to work at the same time on the same data. Mainframe computers are commonly used in business companies such as Google, Yahoo and Microsoft Network (MSN) which have millions of users using computers concurrently. Figure 5.4 shows a mainframe computer.

Figure 5.4: *Mainframe computer*

Activity 5.1: Mainframe computers

Describe how mainframe computers are used in large organisations such as banks, hospitals, and airlines.

(e) Supercomputers

Supercomputers are the most powerful and most expensive computers. They are used for jobs that take massive amounts of computational power like weather forecasting, engineering design such as aircraft design and testing, economic forecasting, biomedical research, and other tasks in science and technology. Supercomputers have higher processing speeds than all other computers. These computers use multiprocessing techniques, and they require a dust free, cool environment for optimal performance and maintenance. The main difference between supercomputers and mainframes is that supercomputers channel all their power into executing few programs as fast as possible, whereas mainframes use their power to execute multiple programs concurrently. Similar to mainframe computers, the high processing power of supercomputers and the need for cooling systems mean they require more electricity to operate. Figure 5.5 shows an example of a supercomputer.

Figure 5.5: *Supercomputer*

***Source*:** *http://itcoeict.dit.ac.tz/services/high-performance-computing*

Classification of computers based on the type of signals they use

Three classes of computers can be identified using this criterion: analog, digital and hybrid computers.

(a) Analog computers

An analog computer stores data in the continuous form of physical quantities and performs computations with the help of measurements. It can be a mechanical analog or an electronic analog computer. These computers are used in hospitals, music studios and aircraft for controlling equipment. The audio mixer is an example of analog computers. Figure 5.6 shows an audio mixer.

Figure 5.6: *Audio mixer*

Source: *https://www.elettroamici.org/en/computer-analogici/*

(b) Digital computers

Digital computers are the most common class of computers used on a daily basis. They perform computational and logical operations with quantities represented as numbers, usually in the binary number system which uses digits 0 and 1. When the data supplied is in text or numeric format, it is first converted to 0s and 1s before processing. Nowadays, when we use the word *computer*, we mostly refer to digital computers, such as those in Figures 5.7 (a) and (b).

Figure 5.7 (a): *Desktop computer*

Figure 5.7 (b): *Laptop computer*

(c) Hybrid computers

Desirable features of analog and digital computers can be combined to create a hybrid computer. This computer performs arithmetic operation and measure different phenomena. In other words, the output can be in the form of either numbers or specific units of measurement. An example of hybrid computers is the electrocardiogram (ECG), a device that records electrical changes of a patient's heart (Figure 5.8). The measurements of the heart from this device are converted into digital form and the digital device checks for abnormalities.

Figure 5.8: *Electrocardiogram machine*

Another example is a modem; It converts digital signals into analog signals, carries them along the telephone line and, at the receiving end, changes the analog signals back to digital signals.

Classification of computers based on the purpose of use

There are two types of computers according to their purpose.

(a) General purpose computers

These are computers designed to perform a wide variety of functions and operations because they can store and execute different programs in their internal storage. Most computers in use today are general purpose computers; they are built for various processing jobs. We can use them to accomplish different tasks. These include writing and editing documents; playing music; watching movies; doing scientific computations; and controlling organisation security systems, electricity consumption, and room temperature. Figure 5.9 shows a general purpose computer.

Figure 5.9: *General purpose computer*

(b) Special purpose computers

Special purpose computers are designed for specific tasks, and their job is to solve one particular problem. These computers are also known as dedicated computers because they are assigned to perform a single task over and over again. Examples of special purpose computers include computers designed to control washing machines, Electronic Fiscal Devices (EFD), elevators, aircraft, satellite, traffic light systems, navigational systems, oil exploration systems and automotive industries. Figure 5.10 shows an example of a washing machine, which is controlled by a special purpose computer.

Figure 5.10: *Washing machine controlled a special purpose computer*

Classification of computers based on portability

Using this criterion, we can classify computers into desktops, laptops, notebooks, palmtops, and tablet computers.

(a) Desktop computers

A desktop computer is a personal computer intended for regular use at a single location on a desk or table due to its size and power requirements. It is designed to fit conveniently on top of a typical office desk. In businesses and increasingly at home, desktop computers can be interconnected and can share resources such as printers by being connected to a Local Area Network (LAN) or a Wide Area Network (WAN) and the Internet using cables or a wireless network, also known as Wireless Fidelity (Wi-Fi). Figure 5.11 shows a desktop computer.

Figure 5.11: *Desktop computer*

(b) Laptop computers

A laptop is a portable personal computer, suitable for mobile use. Laptops are commonly used for various purposes such as work, education, and other personal tasks. A laptop is made up of components similar to those of the desktop computer, namely the display, speakers, keyboard, and the mouse combined into a single device. Most modern day laptops also have built-in web cameras (webcam) and pre-installed microphones for facilitating video conferencing and audio virtual meetings. Figure 5.12 presents a laptop with a webcam and microphone.

Figure 5.12: *Laptop computer*

(c) Notebooks

Notebooks are small computers enough to fit easily in a briefcase. Besides the size and portability, the main difference between a notebook computer and a personal computer, as well as a laptop, is the display screen. Notebook computers use various techniques, known as flat panel technologies, to produce a lightweight and non-bulky display screen. The quality of notebook display screens varies considerably. Figure 5.13 shows notebook computers.

Figure 5.13: *Notebook PCs*

(d) Palmtop

Palmtops are small computers that literally fit in your palm. Compared to full size computers, palmtops are severely limited in functionality; however, they are practical for certain functions, such as phone books and calendars. They are commonly known as Personal Digital Assistants (PDAs). Because of their small size, most palmtop computers do not include disk drives. Palmtops have small keyboards or specialised keypads tailored to specific industries. Palmtops use pens and keyboards for inputting data. Figure 5.14 shows different palmtops.

Figure 5.14: *Palmtops*

Due to the advancement of mobile technologies, the palmtop is being replaced with smartphones, which are even smaller. Smartphones are more

advanced in terms of processing power, storage capacity and multitasking. They are more convenient for personal and business use. Figure 5.15 shows different smartphones.

Figure 5.15: *Smartphones*

(e) Tablets

A tablet is a mobile computer with a touch screen display, circuitry processing unit and a battery integrated into a single unit. Tablets are equipped with sensors, cameras, microphones, accelerometers and touch screens, allowing to use the finger or stylus gestures instead of a mouse and keyboard. Tablets contain physical buttons which control basic features such as volume and power. Besides, tablets have ports for network communications and for charging batteries. An on-screen pop up virtual keyboard is usually used for typing. Figure 5.16 shows different examples of tablet computers.

Figure 5.16: *Tablet computers*

Activity 5.2: Project

Briefly describe the following types of microcomputers and their uses in school, home, business or work environments:

i. Desktop computers
ii. Notebooks or Laptops
iii. Tablets
iv. Palmtops
v. Smartphones

Exercise 5.1

1. Write T for a true statement and F for a false statement.
   i) Hybrid computers are commonly used to count and measure specific phenomena.
   ii) A desktop computer has a display, circuit and battery, all in a single unit.
   iii) A palmtop computer needs a large space to be used.

2. Choose the most correct answer and write its letter in the box provided.
   i. The following computers are classified based on power and speed, except.....
      a) Minicomputers
      b) Supercomputers
      c) Digital computers
      d) Mainframe computers

   ii. ..... are used in large business companies such as Google and Yahoo.
      a) Tablet computers
      b) Supercomputers
      c) Minicomputers
      d) Mainframe computers

   iii. Analog and digital computers are classified based on.....
      a) Power and speed
      b) Data type processed
      c) Purpose or application
      d) Portability

Significance of computers

Computers have greatly changed the way we live because they can work at a higher speed, accuracy and quality than humans. They are used in various key domains such as education, business, weather forecasting, heath, communication, offices, defense, entertainment and manufacturing. The significance of computers in these domains is described in more detail below.

(a) Computers in education

In the traditional methods of teaching and learning, people learn from other people such as parents, teachers and employers. Today, teachers and students use connected computers to assist them in teaching and learning. Many schools are installing computers in their laboratories and classrooms and, in some cases, connecting them to the Internet. Some schools require students to have a computer or mobile device to access the school's Local Area Network or the Internet. Students use software installed on computers or the Internet to assist them in learning. For example, chemistry, biology or physics experiments may be simulated using computer software. Thus, computers are continuously improving the quality of education. Figure 5.17 shows a student using a computer for learning.

Figure 5.17: *Student using a computer for learning*

(b) Computers in business

Connected computers have transformed the ways of doing business. Nowadays, customers do not need to travel long distances because they can order and pay for products and services using computers connected to the Internet. Advertisements have also changed from big, printed banners along streets to digital ones on big screens. Buyers can now negotiate, reach agreements with sellers and make payments online and receive items on their doorstep. There is also an increasing use of social media and websites for advertisements. This positive change in the business community is contributed by computers. Figure 5.18 shows a stock market officer presenting an annual report.

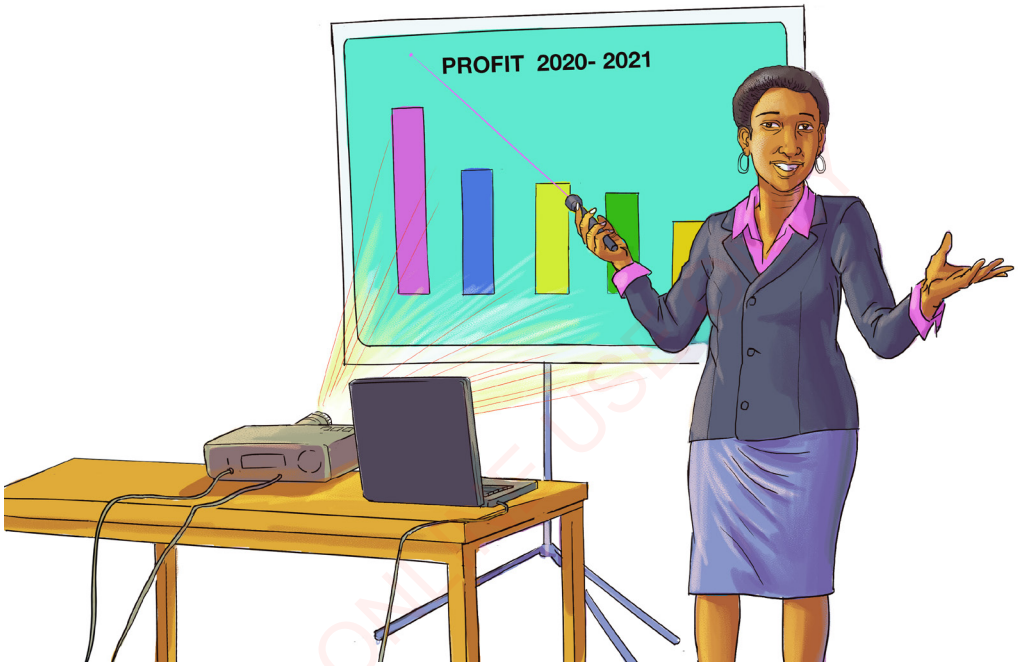


Figure 5.18: *Officer presenting a business report using a computer*

(i) Computers in banks

Bank operation have greatly changed due to the use of computers. Computers support banking operations such as data recording and processing. Using various means of digital transactions such as credit cards, debit cards, and mobile banking, people do not need to carry a large amount of cash. Digital transactions enable us to purchase goods and pay for services, such as water and electricity. They have minimized incidents of theft and robbery, improved the level of convenience in seeking goods and services, saved time and reduced transaction costs. Mobile banking services such as M-Pesa, Tigo Pesa, HaloPesa, Airtel Money, T-Pesa and EzyPesa have made transfer of money between people and banks easier and more convenient. Furthermore, long queues in banks have been considerably reduced by the introduction of special cash dispensing machines called Automatic Teller Machines (ATMs). These have enabled automation of cash deposits and withdrawals. Figure 5.19 shows a person withdrawing money from an ATM.

Figure 5.19: *Withdrawing money from an ATM*

(ii) Computers in shops

Shops use computers to keep records of goods and manage sales. In large shops such as supermarkets, computers are used to manage stock. Stock management systems, for example, keep accounts of goods in stock, goods sold and goods running out of stock. These computers automatically alert managers whenever items run out of stock and need to be restocked. Figure 5.20 illustrates the use of computers in a supermarket.

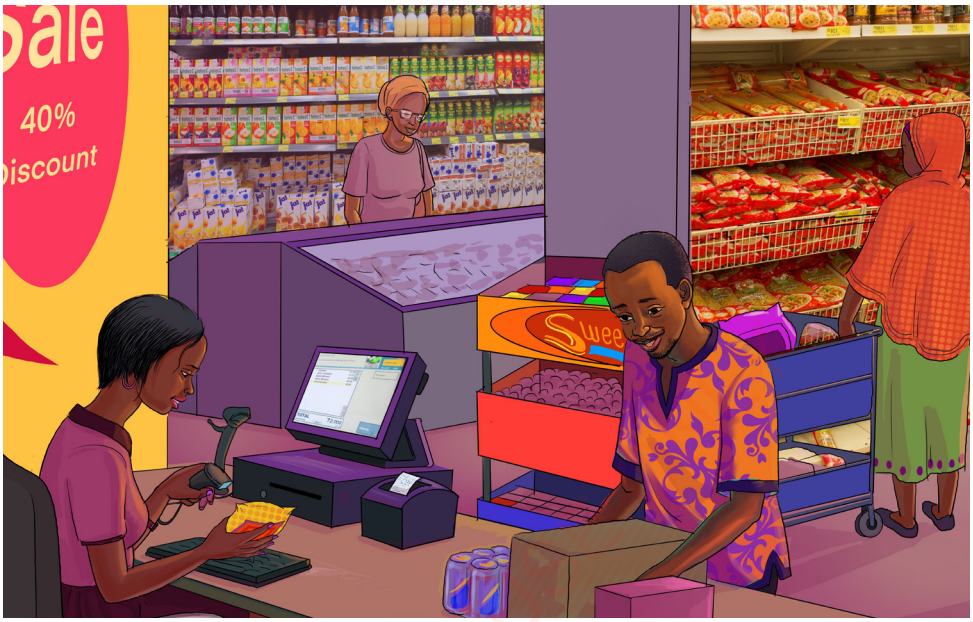


Figure 5.20: *Computer use in a supermarket*

(c) Computers in weather forecasting

Supercomputers are used to analyse phenomena such as predicting weather conditions, which need high computing power. Data are collected using different devices such as radar, satellites, and profilers. The data are then sent to computers which process them to provide useful information about the weather. For example, farming activities can be planned based on weather forecasting reports. Figure 5.21 shows computers used in weather forecasting.

Figure 5.21: *Computers used in weather forecasting*

(d) Computers in health

Computers in health facilities are used to capture, process, transmit and keep patients' records to facilitate the diagnosis of their conditions and treating them. Computerised medical devices are now used to get a cross-sectional view of patients' bodies, enabling health professionals to get and share accurate diagnosis of the affected body parts. Computers also control life-support machines in hospitals' Intensive Care Units (ICUs). Figure 5.22 shows a doctor examining a patient using a computer.

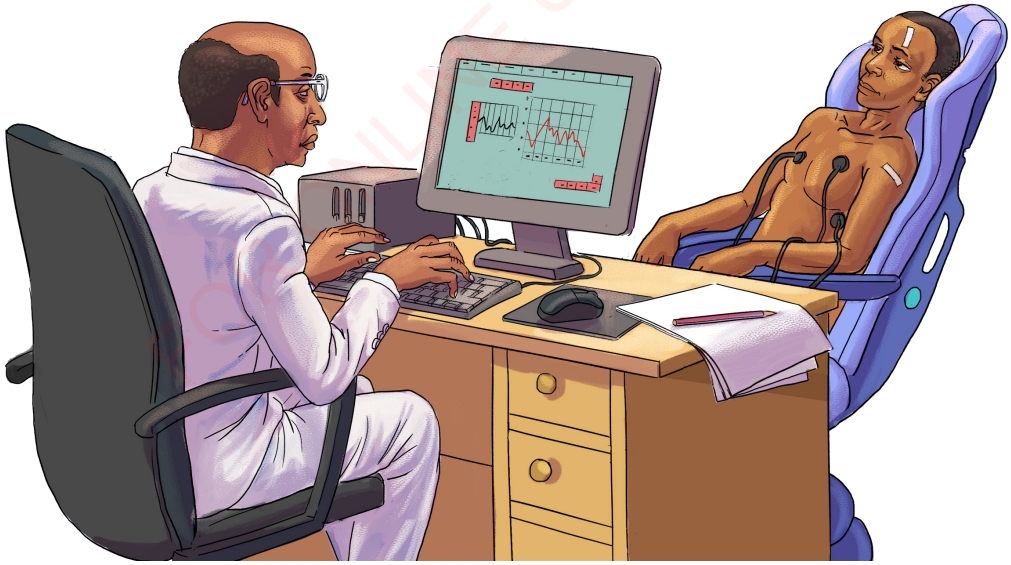


Figure 5.22: *Doctor examining a patient using the computer*

(e) Computers in communications

The integration of computers and communication facilities has made information transmission and reception to be fast and efficient. The speed with which information can be transmitted using computers through the Internet have made the world to become known as a global village communication. Some main applications of computers in communication include e-mail, social media networks and video and audio conferencing. Figure 5.23 shows people using computers to communicate over the Internet.

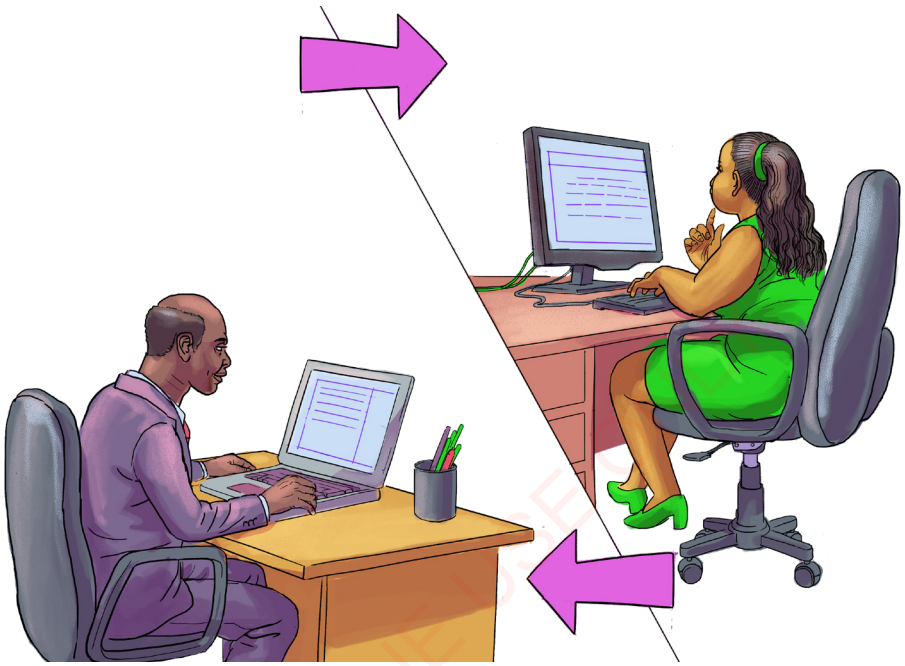


Figure 5.23: *People communicating over the Internet using computers*

(f) Computers in offices

Computers have increased efficiency in working places by reducing the time and effort needed to access and receive information. Most functions of modern offices are done using computers to speed up information processing and dissemination. Computers are also used to perform tasks such as documentation, record keeping and managing the movement of files in the office. They can be used to keep a large number of documents and enhance privacy of information. Figure 5.24 shows a person using a computer in the office.

Figure 5.24: *Person using a computer in the office*

(g) Computers in defense

Military personnel use computers for their crucial defense tasks such as guiding missiles to the right target and keeping records of military personnel, technology, and equipment. Figure 5.25 shows a soldier using a computer to determine the trajectory of a missile.

Figure 5.25: *Soldier using a computer to determine the trajectory of a missile*

(h) Computers in entertainment

Nowadays computers are used creatively to produce, share and play music. They are used to record, edit and control sounds and musical notes. Musical composers use special computer programs and musical instruments that can be linked to a computer to produce high quality and complex musical notes. Figure 5.26 shows a music composer using a computer and a mixer to produce music. Computers are also used to produce movies. In this application, computers are used for special effects and animation.

Figure 5.26: *Using a computer to create music*

(i) Computers in manufacturing

Computers are used in manufacturing industries for various purposes. For example, automated systems such as robots are used to improve and facilitate production processes. Robots can perform complicated and dangerous tasks like assembling cars, welding and painting in a consistent manner. For example, they enable near perfect painting in car manufacturing without wasting paint or skipping parts. Figure 5.27 shows a robot working in a car manufacturing plant.

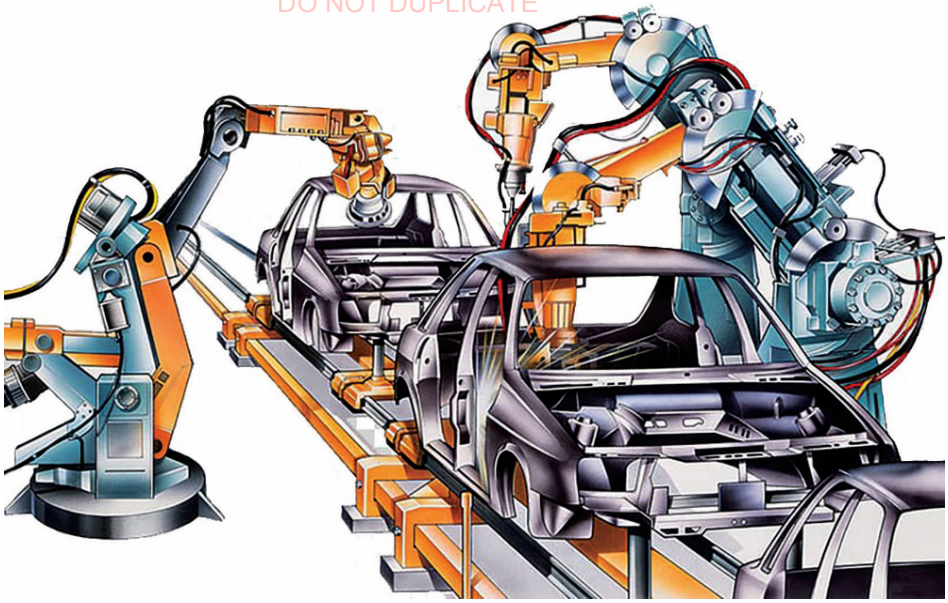


Figure 5.27: *Computer controlled robot in the car manufacturing industry*

(j) Computers in transport

Computers are essential in land, water and air transport. The main areas in which computers are used in transport include navigation, weather forecasting, online booking and passengers' handling in airports.

i) **Navigation:** Computers are used to guide cars and other vehicles in the navigation process. To archive navigation, they use special programs that enable them to communicate with a network of satellites known as the Global Positioning System (GPS). Self-driving cars use GPS and other computer systems to reach their destinations.

ii) **Mapping:** Computer mapping systems, such as Google Map, are very useful to identify locations and to find routes to destinations. The programs have maps which track vehicle movements, and they are needed to direct drivers. If you enter your destination address, the computer mapping application will give you a visual map with step-by-step directions to the destination, the distance, total estimated driving time and information about traffic conditions. Most smartphones have these mapping systems, which can guide users to their destinations. Figure 5.28 shows the GPS application in a car.

Figure 5.28: *Car with GPS or mapping application*

iii) Online booking: Computers are used for booking different types of transport. This practice is known as *online booking* because the computer needs to be connected to the Internet. This approach saves customers from moving long distances and from facing challenges in booking. Respective websites or portals may provide you the information you need to help you book online. For example, computers are used in airports to manage passengers and cargo. Airline companies use computers connected to the Internet to process payment of the booked tickets and check-in passengers. Figure 5.29 shows a customer service agent for an airline at the airport.

Figure 5.29: *Customer service agent for an airline company at the airport*

Activity 5.3: Applications of computers to daily life

Discuss positive and negative implications of computers in the following sectors:

i. Education
ii. Business
iii. Health
iv. Government
v. Entertainment
vi. Communication
vii. Security control
viii. Transport

Exercise 5.2

1. Briefly describe characteristics of a computer.
2. What are the major advantages and disadvantages of using computers?

Chapter Six

Computer handling

Introduction

Computers like other machines, have safety procedures for using them. These help to keep them from damages or malfunction. In this chapter, you will learn about computer handling, utility programs, data backup and computer security. The competencies developed will enable you to manage computer data and increase the lifespan of your computer.

The concept of computer handling

Computer handling means caring for the computer and its accessories so that they perform their work properly. Computer care measures include power management, using utility programs for backing up data and securing computers from virus and other malware.

Power management

Domestic appliances and office devices rely on electricity for their operation. Computers and appliances such as printers, televisions, refrigerators, microwave ovens and washing machines are common devices that rely on electricity to operate. These devices are vulnerable to power fluctuations (voltage), which can significantly reduce the equipment's lifespan.

Types of power fluctuations

Computers are delicate pieces of machinery that can be damaged by power fluctuations. When the power supplied to a computer is not steady, its components may not operate as expected. Changes in power over time are called *power fluctuations*. Therefore, we need to ensure a continuous and stable power supply to computers. The following types of power fluctuations can cause hardware failure, leading to data loss.

Brownout

This is a reduced voltage level of electric power that lasts for a time period. Brownouts occur when the power line voltage drops below 80 per cent of the normal voltage level. The normal voltage level for Tanzania ranges from 220V to

240V. Brownouts are common and can sometimes be detected by lights dimming often during heavy load periods or severe weather conditions. As power demands increase, the risk of brownouts increases. Figure 6.1 shows a dimming light.

Figure 6.1: *Dimming light*

Spike

This is a sudden increase in voltage that lasts for a short period and exceeds 100 percent of the normal voltage on a line. Spikes can be caused by lightning strikes or may occur when the electricity comes back on after a blackout.

Electrical surge

This is a drastic increase in voltage above the normal flow of voltage. An electrical surge lasts for a few nanoseconds, or one-billionth of a second. In some cases, repeated electrical surges can degrade the quality of the device over time. In unusual cases, electrical surges can lead to fires, which can affect the entire house. Figure 6.2 shows an electrical fire caused by power surges.

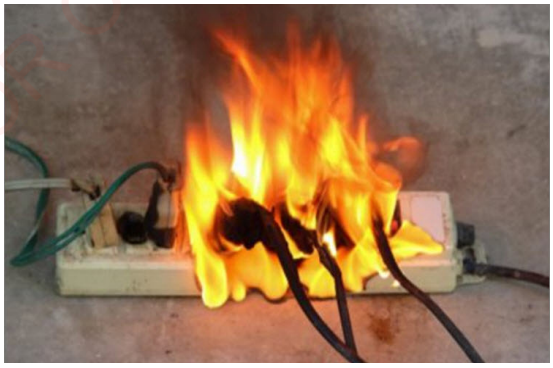


Figure 6.2: *Electrical fire caused by power surges*

Effects of power fluctuations

Most pieces of electrical and electronic equipment are designed to operate properly and within their specifications if the voltage supply varies within ±10% of normal value. However, some sensitive devices such as computers, refrigerators, televisions, and washing machines require stable incoming voltage for them to operate properly. The undesirable effects of power fluctuations on computers include the following:

i. Hardware failure which can cause data loss.
ii. Internal power supply failure, stopping the computer from starting.

To control power fluctuations, several devices can be used as described in the following sections.

Uninterruptible Power Supply (UPS)

Uninterruptible Power Supply or Uninterruptible Power Source (UPS) is an electrical piece of equipment that provides power backup when the input power source fails. UPS differs from an auxiliary or emergency power system or a standby generator since it provides near-instantaneous protection from input power interruptions via the energy stored in its batteries. The capacity of UPS varies; it ranges from a few minutes to a few hours. The aim is to give sufficient time to start a standby power source or save data and properly shut down the protected equipment.

UPS is typically used to protect hardware such as computers, telecommunication equipment or other electrical equipment where an unexpected power disruption could damage equipment, disrupt business or lose data. UPS units range in size from units designed to protect a single computer without a video monitor to large units powering entire data centres or buildings.

UPS contains batteries that *kick in* when the device senses a loss of power from the primary source. When a power surge occurs, the UPS intercepts it so that it does not damage the computer. If you are using computer when the UPS notifies you of power loss, you have time to save any data you are working on and exit gracefully before the UPS runs out of power. UPSs are illustrated in Figure 6.3.

Figure 6.3: *Uninterruptible Power Supply units*

Connecting a computer to the UPS

When connecting a computer to the UPS use suitable power cables.

Activity 6.1: Connecting a computer to the UPS

Steps:

1. Connect the UPS's input power cable to the power source.
2. Connect the UPS's output power cable to the input power port of the computer. For a desktop, you may also need to connect the monitor to the UPS.

NB: When all cables are safely connected, you can switch on the power supply and then switch on your computer safely. When there is no mains power, the UPS uses the stored charge to supply power to the computer. Figure 6.4 shows ports that are used to connect the computer to the UPS.

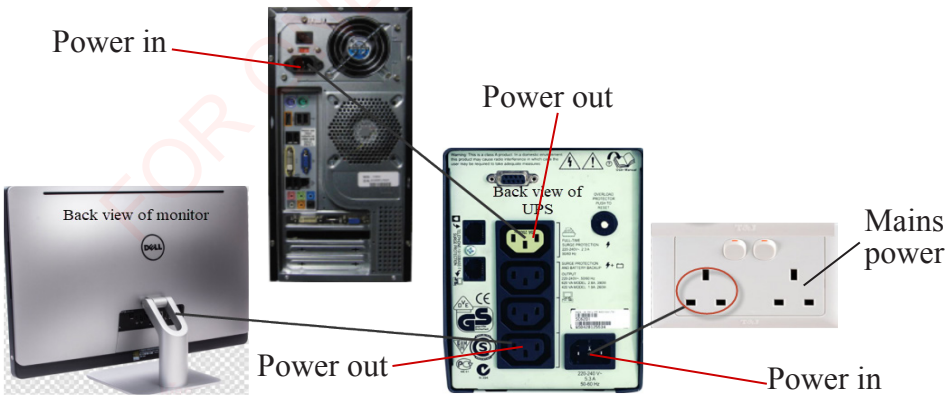


Figure 6.4: *Connecting the computer to the UPS*

Surge protector

A surge protector is an appliance designed to protect electrical appliances from voltage spikes and surges. It is also called a surge suppressor. A surge protector attempts to limit the voltage supplied to an electrical appliance by either blocking or by shorting current to reduce voltage below a safe threshold. Standard voltage for home and office buildings is 220V to 240V. Surge protectors are used to protect our office or home appliances from power damage when there is power fluctuation in the main power source. Figure 6.5 shows different extension cables with in-built surge protectors.

Figure 6.5: *Extension cables with in-built surge protectors*

It is recommended to use a surge protector when using a computer. The following steps guide you through connecting a surge protector to the wall socket to the computing equipment.

i. Connect the surge protector to the power supply (wall socket).
ii. Connect the UPS to one port of the surge protector.
iii. Connect the power cable of your computer to the outlet of the UPS.
iv. When all cables are safely connected, switch ON the main power supply and then switch on your computer.

Voltage Stabiliser or voltage regulator

A voltage stabiliser is an electrical appliance used to feed constant voltage to electrical appliances, such as refrigerators and computers. It protects them from damage due to voltage fluctuations. It works based on the transformer principle where the input voltage is connected to primary windings and the output is received from secondary windings. When there is a drop in incoming voltage, it activates electromagnetic relays which add to more number of turns in the secondary winding. Thus, it gives higher voltage which compensates the loss in output voltage. When there is a rise in the incoming voltage, the reverse happens and the voltage on the output side remains almost unchanged. Figure 6.6 exemplifies voltage stabilisers.

Figure 6.6: *Examples of voltage stabilisers*

Utility programs

Utility programs are designed to help analyse, optimise or maintain computer resources. Utility programs focus on making sure that computer hardware, operating systems and application software function properly. Operating systems come with several utility programs for managing disk drives, printers, and other devices. These programs are available to help you with the day to day tasks related to personal computing and to keep your computer running at peak performance. Some examples of utility programs include the following:

Antivirus software: It is used for scanning and removing computer viruses.

Backup and restore software: It is used to make copies of data stored on a disk on a separate disk and restore either all the data or part of it in case of disk failure or accidental deletion.

Disk cleaners: They can find files that are unnecessary to computer operation or take up considerable amounts of space. Disk cleaners help users to decide which files to delete when they need more disk space.

Disk compression utilities: These can compress the contents of a disk, thus increasing the available space on the disk.

Disk utilities: These can divide an individual drive into multiple logical drives, each with its own file system which can be treated as an individual disk drive.

File managers: They provide a convenient method of performing routine file management tasks such as deleting, renaming, cataloguing, moving, copying, merging, generating and modifying files. Figure 6.7 shows different file management options in the File Explorer. Other examples are as follows:

i. Data compression, such as WinZip and WinRAR
ii. Disk cleaner
iii. Network utilities

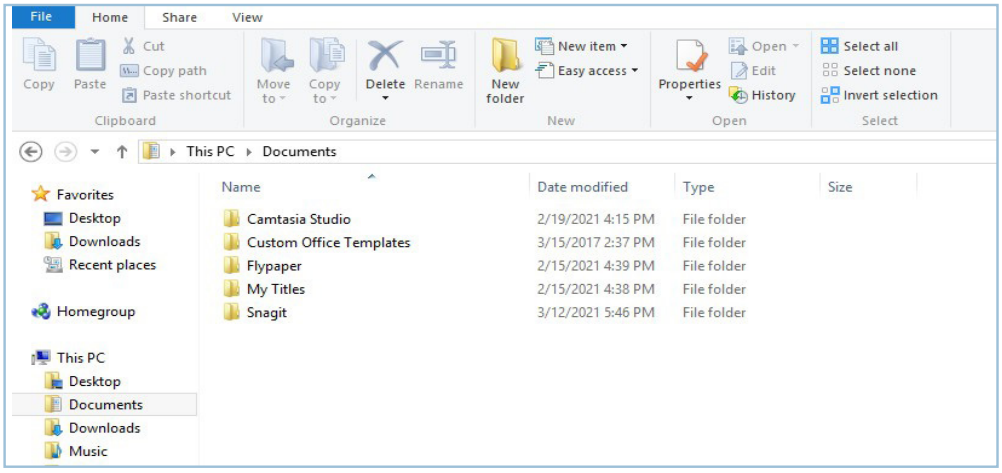


Figure 6.7: *File Explorer for Windows*

Memory testers: They check for memory errors.
Network utilities: They analyse the computer's network connectivity, configure network settings, and check data transfer or log network events.
System monitors: They monitor resources and performance in the computer system.

Using utility programs

Some computer problems may be beyond the ability of system repair programs to solve and may require a technician or an expert to fix. Other problems may be easily fixed with system repair software such as built in Windows utility programs. All Windows versions come with a built-in set of programs that can help to maintain the system and resolve simple system problems. While some of the included programs may require advanced knowledge of Windows operating systems, many are simple to use. One of the easy programs to use include the disk formatting tool. This prepares storage devices for storing data. Other important utilities are not part of Windows, but they can be downloaded and installed on the system.

Activity 6.2: Use the disk clean up utility to remove temporary files, file history and unimportant programs.

Steps: Refer to Figure 6.8

1. Click on the search box on the task bar and type the words "disk clean up" and you will see a pop up window,
2. Click **Open** on the pop up menu,
3. Click **OK**, a pop up window will appear,
4. Select "Temporary files,"
5. Click **OK** to start cleaning. All selected files will be deleted.

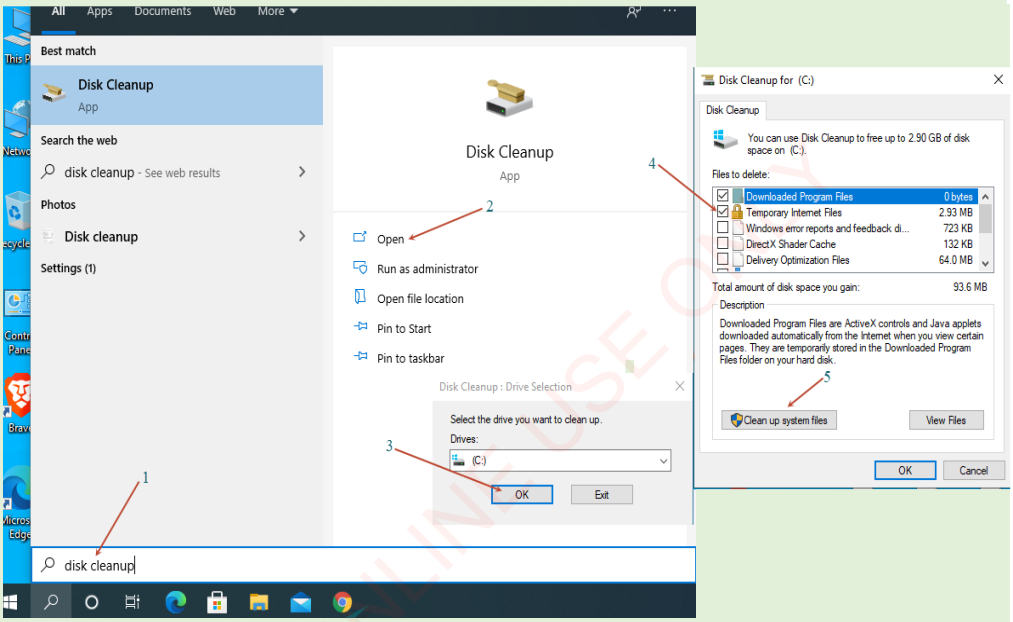


Figure 6.8: *Using Clean up utility to remove temporary files*

Computer malware

Computer malware is a malicious program which is written by people aiming to conduct unwanted operations such as damaging disks and deleting data. Examples of computer malware are computer viruses, trojan horses, worms and ransomware. Most people use the term *virus* to mean malware. Malware can spread through downloading attachments from emails, visiting an infected website, opening an infected program, viewing an infected advertisement and infected removable storage devices such as USB drives. These can transfer viruses between computers on which they were used.

Signs of computer malware infection

A computer user should be aware of some warning signs from a computer infected by malware. Some of the signs are low system performance**,** programs running on their own, files multiplying on their own**,** unexpected new files or programs in the computer and folders or programs getting deleted or corrupted.

Computer malware prevention

It is important to protect your computer from malware attacks. To do this, you should regularly do the following:

i. Update your antivirus software.
ii. Avoid opening email attachments from unknowing sources.
iii. Scan removable devices or media using antivirus software before opening them.
iv. Avoid visiting untrusted websites.

Data backup

Backing up data involves copying data to a second medium such as a hard disk or other storage media. Data loss can be a common experience among computer users. One of the cardinal rules in using computers is doing regular data backup. Data backup has two distinct purposes:

i. The primary purpose is to create a copy of data that can be used to recover data in case of loss, data deletion or corruption.
ii. The secondary purpose is to restore data from an earlier working state for reasons other than those mentioned in (i) above.

Backup devices

Many devices can be used for backing up data from your computer. These are like hard disks, CDs, DVDs, flash drives and cloud servers (computers on the Internet).

Types of data backups

There are three types of data backup, namely a full backup, incremental backup and differential backup.

A full backup is a type of backups in which all selected files and folders are backed up. When subsequent backups are run, the entire list of files and folders are backed up again. This backup is good and easy as the complete list of files are stored each time. With this backup, it is easy to maintain and restore different versions of the backed up data. Despite the advantages, backups can take relatively

long time to complete as each file is backed up again every time full backup is run.

An incremental backup is a type of backups which accommodates all changes made since the last full backup. The storage space used is much less than that of a full backup and a differential backup.

A differential backup is a backup of all changes made since the last *full* backup. With differential backups, one full backup is done first and subsequent backups run to include all the changes made since the last full backup. The storage space used is much less than that of the full backup but more than that of the incremental backup. Restoration is slower than with a full backup but usually faster than with a incremental backup.

Methods of data backup

1. Local data backup

A local or onsite data backup is any backup where the storage medium is kept close to the computer. Typically, the storage medium is plugged in directly to the computer being backed up or is connected through a Local Area Network to the computer being backed up as shown in Figure 6.9. Examples of local data backup devices include the following:

i. External hard drive
ii. Optical disk drives like CDs, DVDs and Blue Ray discs
iii. USB drives
iv. Network Attached Storage (NAS)

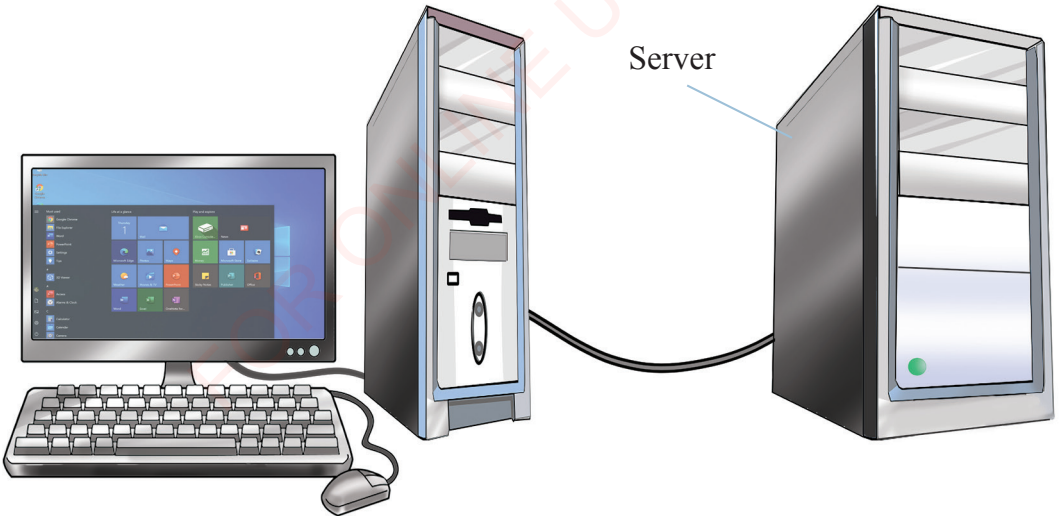
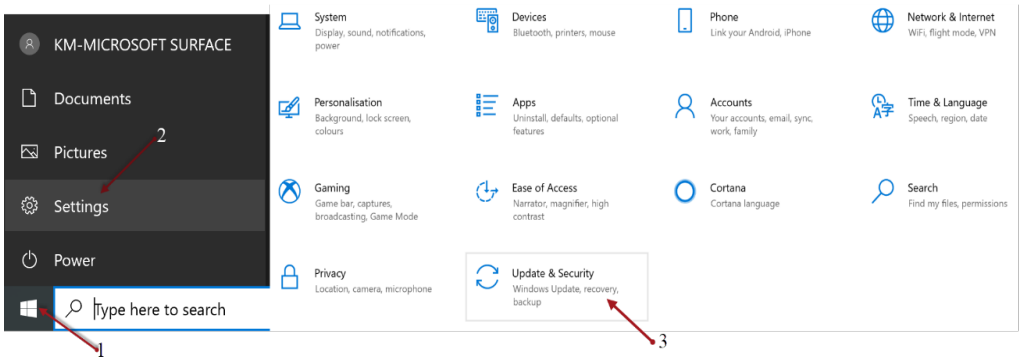


Figure 6.9: *Example of a local data backup system*

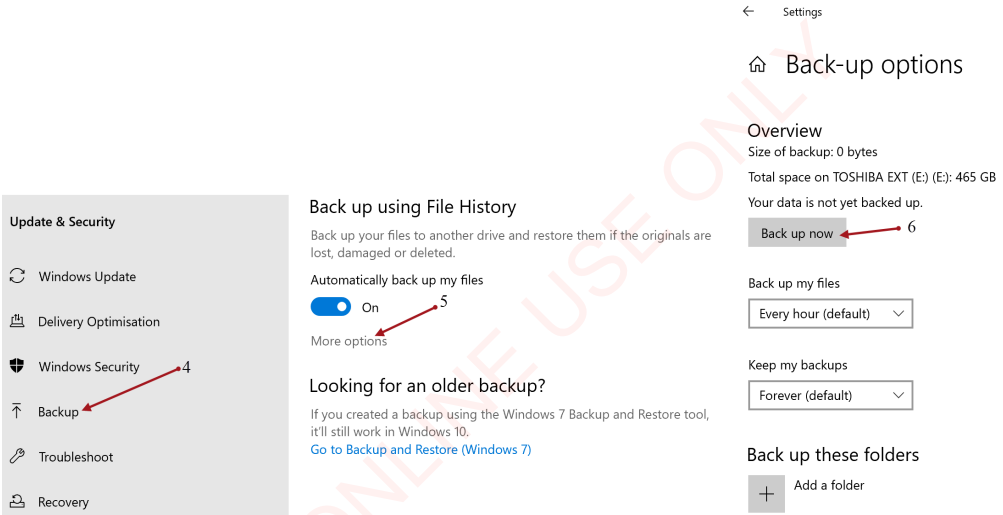
Activity 6.3: Data Backup and Restore on Windows 10

To backup files on Windows 10

Select Start > Settings > Update & Security



From the left pane, click “Backup” >; Add a drive from “More option;” choose “External drive,” and then click > “Back up now.”



Restoring files

To restore backup files, follow the following steps:

1. In the search box on the taskbar, type ‘‘restore files’’ and then select “Restore your files.”
2. Look for the file you need; then, use the arrows to see all its versions.
3. Select “Restore” to save it to its original location. To save it to a different place, right-click “Restore,” select “Restore to,” and then choose a new location.

Advantages of a local data backup

1. It offers good protection from hard drive failures, virus attacks, accidental deletion and sabotage of the source data.
2. It is very fast to backup and restore.
3. It is cost effective when appropriate storage media are used.
4. Data transfer cost to the backup storage medium may be negligible or low.
5. Since the backup is stored close by, it is conveniently obtained whenever needed for restoration.
6. It ensures full internal control over the data backup storage media.
7. There is no need to entrust the storage media to third parties. Therefore, it is more secure.

Disadvantage of local data backups

Since the backup is stored in the same environment as the source, it does not offer good protection against disasters such as fire, floods and earthquakes.

2. Cloud data backup

The term *cloud storage* refers to the backup storage facility accessible from the Internet. With proper login credentials, backup data can then be accessed securely from any other computer, tablet or smartphone with an Internet connection. "A cloud data backup" is also called an online data backup or remote data backup. An illustration of cloud data backup is shown in Figure 6.10.

Figure 6.10: *Cloud data backup*

Advantages of cloud data backup

1. Since this is an online data backup, it offers protection from fire, floods, earth quakes and other natural disasters.
2. It is easier to connect and access the backed up data from different devices with an Internet connection.
3. Data are replicated across several storage devices, and they are usually serviced by multiple Internet connections so the system is not a single point of failure.
4. When the service is provided by a reliable or credible commercial data centre, the service is managed and protected.

Disadvantages of a cloud data backup

1. It poses security risks since the data are managed by someone else (a third party).
2. It needs Internet connection.
3. It requires some expert skills to backup the data.

Disk formatting

Disk formatting is a process of preparing data storage devices such as a hard disk drive or USB flash drive for initial use. A hard disk, which is the main secondary storage device on your computer, needs to be formatted before use. Formatting the disk means preparing it into a format that the operating system can store information on it. Some storage devices, including USB disk drives and memory cards, might come preformatted by the manufacturer. CDs and DVDs use formats that are different from hard disks and other removable storage devices. Formatting can also be used to the re-initialise the storage device, a process that erases all existing files on the storage device.

Activity 6.4: Formatting a flash disk

Open **File Explorer**.

1. Click on "This PC" from the left pane.
2. Under the "Devices and drivers" section, right-click and from the pop-up menu select the "Format" option.
3. Use the "File system" drop-down menu and select the "NTFS" option. In the "Allocation unit size" drop-down menu, use the default selection.
   NB: In the "Volume label" field, type a label to quickly identify the flash drive in File Explorer. Such as My flash. Under the "Format options" section, select the Quick format option.
4. Click the "Start" button.
5. On the pop-up window that appears, Click the "Yes" button.

Computer security

Computer security means ensuring physical and system safety of computer resources against threats such as theft, unauthorised access and virus. It is crucial to protect your computer against theft, viruses, worms and intruders which can damage it. The data stored on the computer are important and sensitive. Therefore, if the computer is not well secured, strangers might access your data, use your computer to attack other systems, send forged emails from your computer, or examine personal information stored on your computer. Computer security is concerned with four main issues:

1. Authentication: Ensure the identity of the person with whom you are communicating.
2. Confidentiality: Only authorised users can access data and information stored on a computer.
3. Integrity: Assurance that authorised users can access or modify the data.
4. Availability: Data and resources should be available to the right users when needed.

The effects of dust, liquids, temperature and humidity on computers and other accessories

Computers and other accessories have to be kept in a clean and conducive environment to function properly. Environmental factors such as heat, cold,

dust and excessive humidity can damage and thus affect the performance of the computer. External and internal temperature can cause variations in performance, although the computer is more vulnerable to heat than it is to cold. The ideal environment for the computer should be dry, cool and clean.

Activity 6.5: Effect of dust, liquids and temperature on computers and other accessories

Outline the effects of dust, humidity and temperature on computers and other accessories.

Hint: You can use the Internet or other reference resources to search for answers

Computer security recommendations

To ensure the security of a computer system, do the following:

1. Back up computer files regularly.
2. Do not keep important data on portable devices only. Make several copies and save them on different devices.
3. Use strong passwords that cannot be easily guessed.
4. Make sure your computer has genuine and updated antivirus software.
5. Scan your computer regularly for viruses.
6. Do not install programs from untrusted sources.
7. Keep your computer in a clean environment with a regulated room temperature.

Exercise 6.1

1. What is power fluctuation?
2. What are the effects of power fluctuations on electrical equipment?
3. List types of power fluctuations.
4. List devices that are used to protect a computer from the effects of power fluctuations.
5. Explain how a voltage stabiliser functions.
6. Describe how to connect a computer to the UPS.
7. What is the difference between the UPS and voltage stabiliser?
8. What is a utility program? Give examples of utility programs and their usefulness.
9. What is a data backup and how important it is?
10. Describe the devices used to make data backups.
11. Differentiate between a local data backup from a cloud data backup.
12. What are the advantages of a local data backup?
13. Discuss possible risks the computer is likely to face if security measures are not observed.

Write **TRUE** for a true statement and **FALSE** for a false statement.

14. Blackout is a reduced voltage level.
15. Antiviruses are utility programs.
16. A computer is one of the backup devices.
17. A local backup stores data to a storage server or facility connected to the computer via the Internet.
18. When a disk is formatted, all the data contained in the disk will be permanently deleted.

Glossary

Automation	The application of technology to monitor and control the production and delivery of products and services without or with little human intervention. It involves the introduction of automatic equipment in manufacturing, another process, or facility.
Cathode	Is an electrode from which the current exits a polarised electrical device.
Cloud computing	Is the delivery of different computing resources and services through the Internet. These include tools and applications such as data storage, servers, databases, networking, and software.
Cloud server	Refers to servers that are accessed over the Internet, the software, and the databases that run on those servers. Cloud servers are located in data centres managed by third parties.
Computer Generation	Is a progression in technology of a computer. The term was initially used to distinguish between varying hardware technologies. Nowadays, computer generation includes both hardware and software, which together make up a computer system.
Computer workstation	A high-performance computer system that is basically designed for a single user and has advanced graphics capabilities, large storage capacity, and a powerful microprocessor.
Media	Refers to various means of communication, such as television, radio, and newspapers.
Motherboard	Is the main circuit board inside an electronic device such as a computer, tablet and mobile phone that connects different parts of the device to the rest of the computer. It also connects external devices for other uses.

Robot	A machine capable of performing certain tasks which are commonly performed by human beings, such as welding.
Server	A computer or computer program which manages access to a centralised computing resource or service in a network.
System unit	Is the part of computer that houses primary computer devices. It houses the motherboard, CPU, RAM and many other components.

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