COMPUTER EDUCATION

YEAR 11

2014

Technology and Employment Skills Training
Ministry of Education, Fiji.
28th November 2013

Preface

This text book has been written to cater for the new Year 11 Computer Education syllabus trialed in Fiji secondary school for the year 2014. It is a new text book and the first of its kind to be written locally.

It is hoped that this book will be useful in implementing the syllabus but it should be understood that it is not the syllabus. The syllabus is the framework for the teacher to follow while this text book is a resource for the student. Therefore departure to other resource materials for more information will be acceptable.

The text book is not the perfect piece of work as it has been prepared in a very short time, therefore suggestions for amendments will be welcomed. It is anticipated that this book will minimize the amount of time for teachers in lesson preparation and more time will be devoted to actual classroom teaching and learning.

There may be a variety of opinion about the content of the topics, but for the beginner it is the best which gives the time and opportunity to become familiar with the basics before pursuing further into the field of study in greater detail at the upper secondary level

Ministry of Education,
Suva.
Fiji Islands
28th November 2013.

Acknowledgement

This textbook for year 11 Computer Education has been produced by the Computer Education Section of the Technology and Employment Skills Training (TEST) section of the Ministry of Education.

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Every effort has been made to acknowledge all copy right.

Contents

Chapter 1

Structure and Functions of a Computer

"Hardware: the parts of a computer that can be kicked." ~ Jeff Pesis

After completing this chapter, you will be able to:

1. Explain the importance of computer literacy.
2. Define the term computer.
3. Identify the components of a computer system.
4. Compare the uses of various types of: input devices, output devices, and storage devices.
5. Describe the different categories of computers and their uses.

1.0 Introduction

A *computer* is an electronic machine designed for the processing and storage of data. The machinery is called **hardware**, and this highly sophisticated equipment needs equally sophisticated programs (called **software**) to become a working computer system.

Modern society has come to depend very heavily on the use of computer systems. Banks, businesses, government departments, industries, shops, people at home and school all rely on computer to play a vital role in their daily activities. These activities are centered on information.

In businesses, the computer system has been used a lot and has replaced filing cabinets as means of storing information, and clerical workers as a means of processing it. By storing and processing information on a computer system, these businesses can function more quickly and efficiently, because information can be identified and collated much faster.

Discovery Learning:

A computer was also called a data processor. Why?

1.1 Major Parts and Functions

A *Computer* is an electronic device that accepts input data, processes data, stores data and produces output as useful information. *Data* is a collection of raw unprocessed facts, figures and symbols. Computers process data to create information. *Information* is processed facts that is organized, is meaningful, and useful. Whereas a system would be described as a set of interrelated parts that performs different functions to achieve the same desired results.

A *computer system* is composed of Hardware and Software. *Hardware* refers to the physical equipment, which makes up a computer system such as monitor, keyboard, processor, printer etc. Hardware works under the control of software. *Software*, refers to computer program, a program is set of instructions, example: Spreadsheet (Excel), Word processing (Word), Database (Access) etc. The specific software needed depends on the tasks that have to be performed.

Discovery Learning:

Give examples of data and information you use or generate every day.

A computer system consists of three main components or parts and each part is responsible for the three major functions that constitute a computer. The parts are:

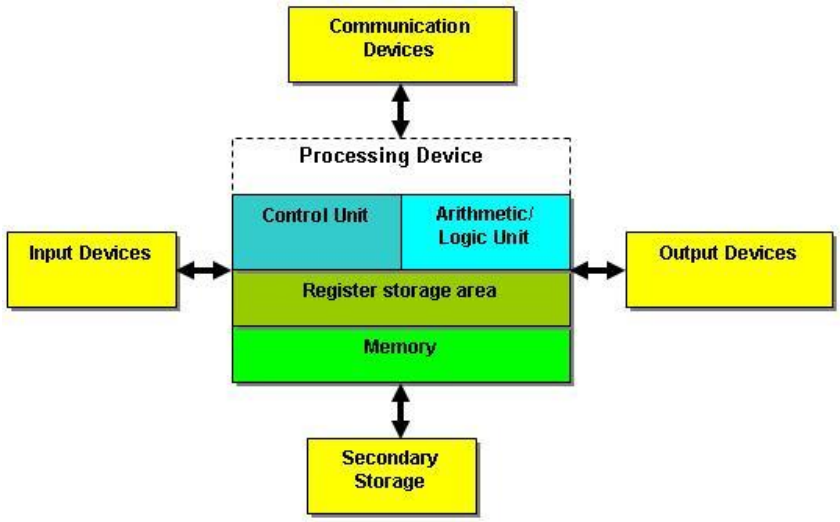


Figure 1.1a *Flow of information*

Components	**Function**
Input device	Put in the data
Processor	Process the data
Output device	To get the information out
Storage device	To file information for future use

Table 1.1 *Components and Function*

Parts of a computer system

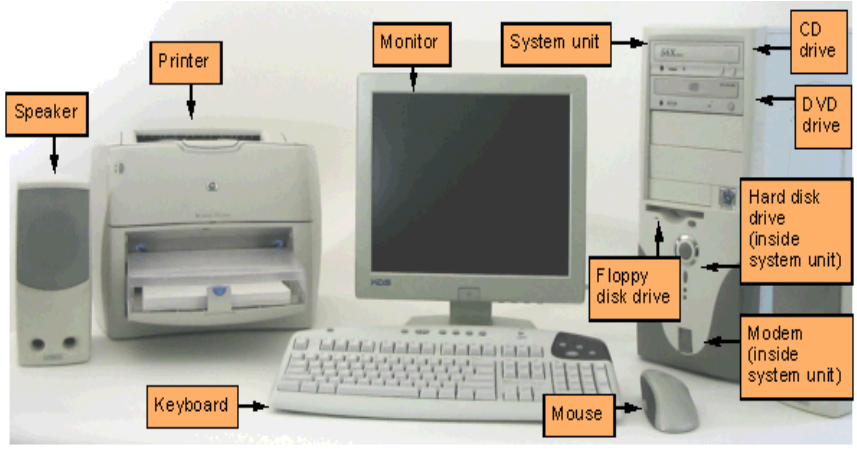


Figure 1.1b *Parts of a Computer System*

Discovery Learning:

What does it mean to be computer literate?

1.2 Hardware Components

1.2.1 Input Devices

The *input* function involves accepting data in machine-readable form and sending it to the Central Processing Unit (CPU) for processing. Input can be supplied by a person, by the environment or by another computer, devices or storage. Some examples of the kinds of input a computer can process are words and symbols in a document, numbers for a calculation, instructions for completing a process, pictures, audio signals from a microphones and etc. An *input device* gathers and translates input into machine language (a form that the computers can process).

Device Name	Description
Keyboard	Used for typing commands, messages and instructions and transmitting them to CPU for interpretation and action.
Mouse	Used for pointing at items displayed on the screen (selecting) and activating them by clicking the buttons or icons.
Scanners	Can read data off other common medium like paper for input into CPU for processing.
Readers	Can read data from magnetic tape, floppy and hard disks and other storage devices for input to the CPU for processing.

Table 1.2a *Input Devices*

Additional input devices include light pen, stylus, sensors, digital cameras and graphics tablets which are handy for working with graphical input. Microphones and electronic instruments provide input capabilities for sound and music.

Input devices are of two kinds *Keyboard Entry* and *Direct Entry*.

Keyboard Entry

Keyboard Entry is when data is entered through a keyboard. A standard keyboard is called a **QWERTY** keyboard because of the layout of its keys. That is, the first six leftmost letters on the top alphabetic line of the keyboard spell QWERTY.

a. Escape key – cancels a selection or a procedure
b. Typewriter keys
c. Function keys – (F1 – F12)
d. Numeric keypad – (enters numbers/arithmetic symbols/ control cursors or insertion point)
e. Windows key – displays the start menu
f. Space bar – enters blank spaces between characters

g. Navigation keys – control the cursor or insertion point on the screen
h. Multimedia control keys – controls the media player
i. Toggle keys – switches a feature on or off
j. Ctrl and Alt keys – provide additional and shortcut functions

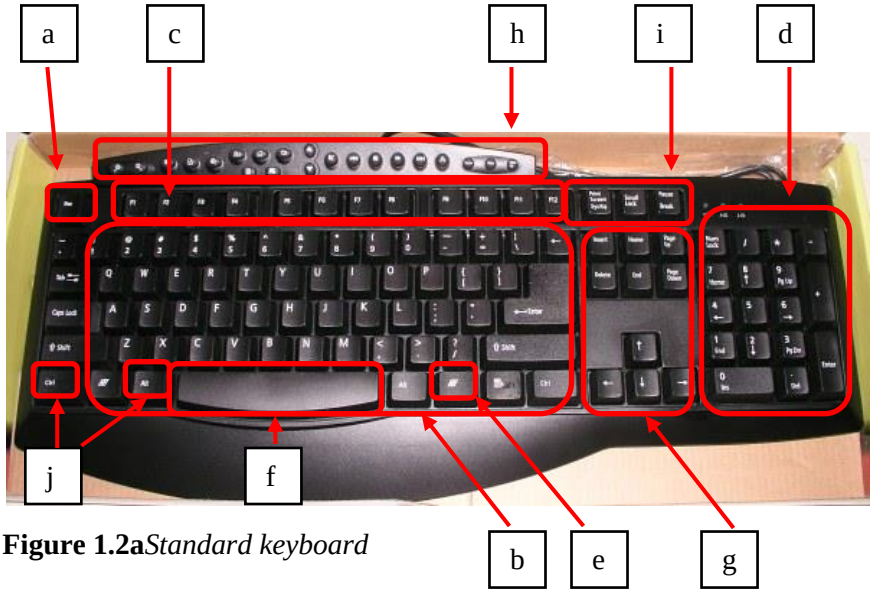


Figure 1.2a*Standard keyboard*

There are a wide variety of different keyboard designs. The most common type is *Traditional Keyboards* which are full-sized, rigid, rectangular keyboards that include function, navigational, and numeric keys. Some newer keyboard designs include the following:

Flexible Keyboards fold or roll up for easy packing or storage. They are designed to provide mobile users with a full-sized keyboard with minimal storage requirements.

Ergonomic Keyboards are similar to traditional keyboards. The keyboard arrangement, however, is not rectangular and a palm rest is provided. They are designed specifically to alleviate wrist strain associated with the repetitive movement of typing.

Wireless Keyboards transmit input to the system unit through the air. By eliminating connecting wires to the system unit, these keyboards provide greater flexibility and convenience.

Personal Digital Assistance (PDA) Keyboards are miniature keyboards for PDA used to send e-mail, create documents, and play games.

Figure 1.2b *Ergonomic keyboard (left) &Flexible keyboard (right)*

Direct Entry

A *Direct Entry* does not require data to be keyed by someone. Instead the direct entry devices create machine-readable data and feed it directly into the CPU. This reduces the possibility of human error and is an economical means of data entry. Direct entry devices may be categorized into these categories.

a. Pointing devices
b. Scanning devices
c. Image capturing devices
d. Audio-input devices

Pointing Devices

Pointing device is a device with which you can control the movement of the pointer to select items on a display screen. There is a wide variety of different pointing devices, including the mouse, joystick, touch screen, light pen, stylus, digitizer and pen-based computing.

Mice

A *mouse* is used for pointing at items displayed on the screen (selecting) and activating them by clicking on the buttons. The mouse pointer usually appears in the shape of an arrow. It frequently changes shape, however, depending on the application.

Although there are several different mouse types, there are three basic designs.

Mechanical mouse – has a ball on the bottom and is attached with a cord to the system unit.
Optical mouse – it emits and senses light to detect mouse movement,

Cordless or wireless mouse – is a battery powered device that typically used radio waves or infrared light waves to communicate with the system unit.

Figure 1.2c *from left to right – optical, wireless and mechanical mouse*

Joystick

A *joystick* is the most popular input device for computer games. You control game actions by varying the pressure, speed, and direction of the joystick

Touch Screen

A *touch screen* is particular kind of monitor screen covered with plastic layer. Behind this layer are crisscrossed invisible beams of infrared light allowing someone to select actions and or commands by touching the screen with a finger.

Figure 1.2d *Joystick (left) & Touch screen (right)*

Light Pens

A *light pen* is a light sensitive pen like device. The light pen is placed against the monitor. This closes a photoelectric circuit and identifies the spot for entering or modifying data. Engineers use light pens, for example, designing anything from microprocessor chips to airplane parts.

Stylus

A *stylus* is a pen-like device commonly used with tablet PCs and PDAs. A stylus uses pressure to draw images on a screen. A stylus interacts with the computer through handwritten recognition software. Handwritten recognition software translates handwritten notes into a form that the system unit can process.

Digitizer

A *digitizer* is a device that can be used to trace or copy a drawing or photograph. The shape is converted to digital data. A computer can then represent the data on the screen or print it out on paper.

Figure 1.2e *left to right – light pen, stylus, and tablet digitizer*

Pen-based Computing

A *pen-based computing* is a pen-based small computer that lets you use a stylus to write directly on the display screen, these devices contain software that can recognize a person's handwriting.

Scanning Devices

Scanners move across text and images. *Scanning Devices* are devices that use a magnetic or photo-electric source to scan and convert images into electric signals that can be processed by an electronic apparatus, such as a computer. Images that can be scanned and converted include colored or black and white texts, graphics, and pictures. Scanning device includes the following:

Optical Scanner

An *optical scanner* also known simply as a scanner accepts documents consisting of text and images and converts them into machine-readable form. The two types of optical scanners are flatbed and portable scanner.

Bar Code Reader

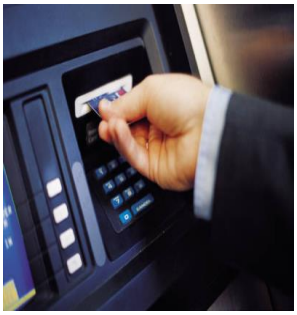
Bar code readers are photo electric scanners that read the bar codes or vertical zebra stripped marks printed on a product container. Supermarkets use a bar code called the Universal Product Code (UPC), which identifies the product to the supermarket computer. The computer has a description and the latest price of the product. It automatically tells the Point of Sale (POS) terminals the price and prints the price and product name on the receipt.

Figure 1.2f *left to right – flat bed scanner, barcode reader*

Character and Mark Recognition Devices

Character and mark recognition devices are scanners that are able to recognize special characters and marks. They are specialty devices that are essential tools for certain applications. Three types are

Figure 1.2g *MICR in ATM*



Magnetic ink character recognition (MICR) direct entry method used in banks. This technology is used to automatically read those futuristic looking numbers at the bottom of cheques. Special purpose machines known as reader/sorter reads characters made up of ink containing magnetized particles.

Optical character recognition (OCR) uses special pre-printed characters which are read by a light source and changed into machine readable code. A common OCR device is the hand-held wand reader.

*Optical mark recognition (OMR)*also known as **mark sensing**. An OMR device senses the presence or absence of marks such as pencil marks. Multiple answer sheet used in exam can be read using optical mark reader. The position of the marks is compared with the stored set making marking a very quick and accurate process.

Image Capturing Devices

Image capturing devices are devices that create or capture original images.

Digital camera is similar to traditional cameras except that images are recorded digitally on a disk or in the camera's memory.

Digital video camera unlike traditional video cameras, digital video cameras recorded digitally on a disk or in the camera's memory. Most have the capability to take still images as well. WebCams (Web Cameras) are specialized digital video cameras that capture images and send them to a computer for broadcast over the internet.

Audio Input Devices

Audio – input devices allow a user to send audio signals to a computer for processing, recording, or carrying out commands.

Voice input device converts person's speech into digital codes. Such systems must be trained to the particular user's voice. Spoken words are matched to patterns previously stored in a computer. Voice input systems enable users to keep hands free for other tasks. They are becoming an office advantage for physically challenged people. This system is also known as speech recognition device or voice recognition system device. The most commonly used voice input device is the *microphone*.

Musical instrument digital interface (MIDI) is a standard that allows musical instruments to connect to the system unit using a special MIDI port. MIDI devices are specialized musical instruments that provide input in the form of encoded digital signals representing musical sounds. MIDI devices can be used create, record, and play back musical compositions.

1.2.2 Output Devices

An *output device* is any peripheral device that converts machine-readable information into people-readable form such as a monitor, printer, plotter and voice output device. Output is either in *Soft copy* stored on any storage device and *Hard copy* is printed on a paper.

Monitors

A *monitor* or a *display* is an electronic visual display for computers. The monitor comprises the display device, circuitry and an enclosure. The display device in modern monitors is typically a thin film transistor liquid crystal display (LCD) thin panel, while older monitors used a cathode ray tube (CRT) about as deep as the screen size.

Cathode Ray Tube (CRT) is the most common type of monitor for the office and the home. The monitors are typically placed directly on the system unit or on the desktop**.** CRT offers an inexpensive and dependable computer display. They are bulky, however, and consume a fair amount of power.

Liquid Crystal Display (LCD) produces an image by manipulating light within a layer of liquid crystal cells. Modern LCD technology is compact in size and lightweight, and provides an easy-to-read display. LCDs are standard equipment on notebook computers. The advantages of LCD monitors include display clarity, low radiation emission, portability, and compactness. They are, however, more expensive than CRT monitors.

Plasma screen technology creates an on-screen image by illuminating miniature colored fluorescent lights arrayed in a panel-like screen. The name plasma comes from the type of gas that fills fluorescent lights and gives them their luminescence. Like LCD screens, plasma screens are compact, lightweight and more expensive that CRT monitors.

Figure 1.2h *LCD flat panel monitor (left)&CRT monitor (right)*

Printers

A printer is an essential peripheral device in any computer system. It provides the output in paper form which people can take away to read, analyze or store. There are many different types of printers available:

Impact printer's forms characters by some mechanical means of hitting the paper through an inked ribbon. Impact printers can produce carbon copies and are fairly loud, although covers are available to muffle the noise. Impact printers can produce a document, line or a character at a time.

Printer Category	Description
Line printers	Can produce only text, no graphics. E.g. Daisy Wheel Printers. Used by large computers.
Characters printers	Usually small printers, they can produce graphics as well as text. There are many type, the most common one is a Dot Matrix printer: this creates images using a dot pattern.
Page printer	Mechanism is same as other printers. Prints a page at a time.

Table 1.2b*Categories of impact printers*

Non impact printers are quiet because nothing presses on the page, a non-impact printer cannot produce carbon copies. These printers use latest technology and have gained popularity as with time, the prices are decreasing and nowadays, average people are able to afford them. Description of non impact printers are given in Table 1.2c.

Printer Type	Description
Laser printers	Work in the same manner as copy machines; a laser beam creates electrical charges that attract toner to form an image and transfer it to paper. These printers come in a variety of sizes. The best printers around yet.
Inkjet printers	Are less expensive than laser printers, quiet popular with microcomputers. Inkjets produce higher resolution output than dot-matrix printers. They also come in colors. More finely as the toner is sprayed onto the paper.
Thermal printers	Uses heat and electricity to form characters and to produce images on heat-sensitive paper. Uses heated dot-matrix wires to print output on specially treated paper. As the hot pins in a thermal print head press the ribbon against the paper, the wax melts and the ink is transferred to the paper.

Table 1.2c *Type of non impact printers*

Discovery Learning:

In relation to monitors and printers, Find what the following mean: refresh rate, dpi, pixel, dot pitch, resolution, TFT and HD.

Figure 1.2i *left to right – Dot matrix printer, mini dot matrix printer for printing receipts for POS, dot matrix paper.*

Figure 1.2j *Top: ink jet printer (left) & laser printer(right)*
Bottom: Thermal printers (both)

Plotters

A *plotter* uses pens to draw an image on paper. Architects and engineers who produce multicolor line drawings often use plotters. It is ideally suited for Computer Aided Design (CAD) application.

Pen Plotter creates plots by moving a pen or pencil over a drafting paper. These plotters are the least expensive and easiest to maintain. The major limitation is speed and the inability to produce solid fills and shadings. The *Richter scale* uses pen plotting technology to draw seismic activity.

Ink-jet plotter they form images like ink jet printer by spraying droplets of ink onto the paper. They can produce good quality solid-color output and are quicker than pen plotters. The major disadvantage of ink-jet plotter is that the spray jets can become clogged and require more maintenance. **Figure 1.2k** *Inkjet plotter*

Electrostatic plotters use electrostatic charges to create images made up of tiny dots on specially printed paper. The image is produced when the paper is run through the developer. They produce high-resolution images at a much faster rate than pen or ink jet plotters.

Direct image plotters or thermal plotters creates images using heat sensitive paper and electrically heated pins, is quite reliable and good for high volume work. It requires expensive specially treated paper.

Voice-Output Device

This device produces sound like human speech, but is actually prerecorded vocalized sounds. Voice output is used in the telephone information system, where the requested number is reported using a voice output system. For example, when a student enrolls courses using a telephone registration system, he or she hears voice output upon your request. Voice output is becoming common in voice messaging systems.

Figure 1.2l *Speakers*

Review Exercise1.2

True/False

a) Input devices translate symbols that people understand into symbols that computer can process.

b) A plotter is a device that can be used to trace or copy a drawing or photograph.

c) Banks use a method called magnetic-ink character recognition (MICR) to automatically read and sort checks.

d) Laser printers are highly reliable, but the quality of their output limits their use to rough drafts and in-house communications

e) Plotters are special-purpose drawing device.

Fill in the blank

a) _____ machines are popular office machines that can scan the image of a document to be sent.
b) The _____ printer is a reliable, inexpensive printer that forms letters by a series of small pins on a print head.
c) The _____ printer is the most widely used.
d) _____ a device makes sounds that resemble human speech.
e) The number of dots that form an image on a monitor or printer is referred to as _____

Short Answer Questions

a) What is the difference between keyboard entry and direct entry as a form of input?

b) What is a POS terminal? What are two input devices on it that represent the two methods of inputting data?

c) What is a bar code? How are bar code read?

d) What are the differences between personal and shared lasers?

1.2.3 The System Unit

The main part, processing unit and devices, of a microcomputer is a system unit. A system unit, also known as the *system cabinet* or *chassis*, includes a board called a motherboard Electronic circuitry is printed on the board and it connects between all components of the computer system. The motherboard is housed within the system cabinet.

Figure 1.2m*System cabinet*

A system unit is made up of the following parts.

- Motherboard
- Microprocessor
- Memory Chips
- System Clock
- Buses
- Ports/Sockets
- Expansion Slots and Cards

Discovery Learning:

Observe the system cabinet in your computer lab and notice that at least one side cover is grid like. Explain why?

Motherboard

A *Motherboard* or *system board* is the main printed, flat circuit board in an electronic device such as microcomputers. The board contains expansion slots (sockets) that accept additional boards (expansion Cards). In a microcomputer, the motherboard contains the microprocessor, the primary storage chips (or main memory cards), the buses, and all the chips used for controlling the peripherals.

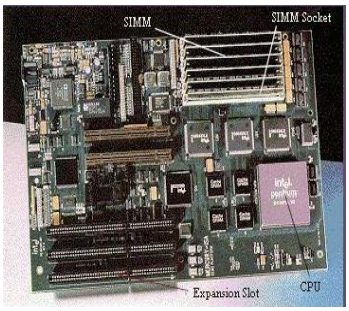


Figure 1.2n
Motherboard

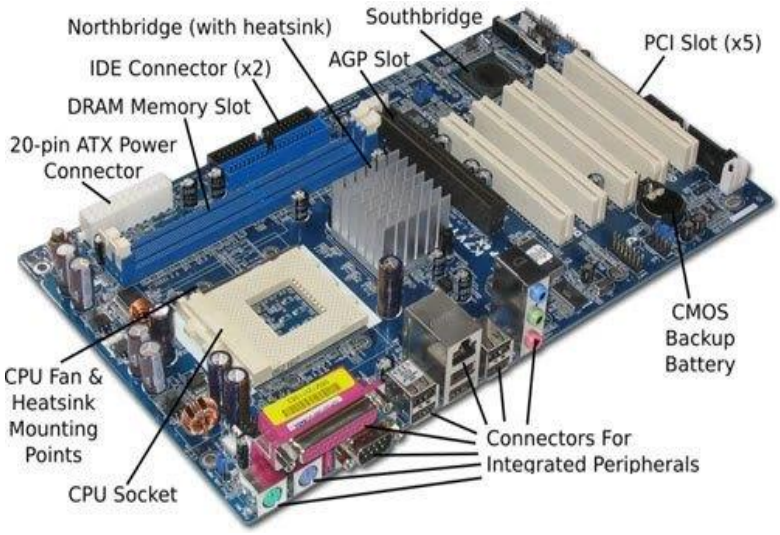


Figure 1.2o*Components on the motherboard*

Microprocessor

A *silicon chip* contains a Central Processing Unit (CPU). In the world of personal computers, the terms *microprocessor* and *CPU* are used interchangeably. At the heart of all personal computers and most workstations sits a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.

Figure 1.2p *Microprocessor*

Several important lines of microcomputers use some families of microprocessor chips. Intel and AMD are the major companies that produce important microprocessors for IBM compatible and Macintosh computers.

Microprocessor Capacity is the capacity of a microprocessor chip and is represented in word sizes. A word size is the number of bits (e.g. 8, 16, 32 or 64bits) that a CPU can process at a time.
If a word has more bits, the CPU is more powerful and faster. For example, a 16-bit-word computer can access 2 bytes (1 byte = 8 bits) at a time, while a 64-bit-word computer can access 8 bytes at a time. Therefore, the 64-bit computer is faster than the 32-bit computer.

Discovery Learning:

Identify and describe the uses of microprocessors in a range of devices? What is dual core or quad core processor?

The *central processing unit (CPU)* is the computing part of the computer that interprets and executes program instructions. It is also known as the **processor** or the **brain** of the computer. In a microcomputer, the CPU is contained on a single microprocessor chip within the system unit. The CPU has two parts: the *control unit* and the *arithmetic-logic unit*. Additional storage units called **registers** within control unit and arithmetic logic unit help make processing more efficient.

Control Unit is the functional unit of the CPU that is responsible for retrieving instructions from memory, determining their type and breaking each instruction into a series of simple, small steps or actions. It tells the computer system how to carry out the program instructions by directing the movement of electronic signal between memory (which temporarily holds data, and processed information) and the ALU. It also directs this control signals between CPU, input, output and communication devices.

The Arithmetic Logic Unit (ALU) is the component of the CPU that is responsible for performing arithmetic (+,-, /,*) and logic (comparisons such as <,>, =) operations.

Memory

A memory chip is a chip that holds programs and data either temporarily or permanently. Three major types of memory chips are RAM, ROM and CMOS.

Random Access Memory (RAM)

Random access memory holds the data or instructions that the CPU is presently processing. RAM is called temporary or **volatile storage** because everything in most types of RAM is lost as soon as the microcomputer is turned off or the power disrupted.

Whenever a CPU writes data or instructions to RAM, it wipes out the previous contents of RAM replacing it with the current content it is processing or processed but needs to be saved.

Types of RAM	Description
Cache memory or **RAM cache**	Improves processing by acting as a temporary high-speed holding area between the memory and the CPU.
Flash RAM or **flash memory**	Chips can retain data even if power is disrupted. This type of RAM is the most expensive and used primarily for special devices such as for cell phones, digital video cameras and portable computers.
Virtual memory	Is storage space on your computer's hard disk that Windows uses in conjunction with random access **memory** (RAM).If your computer lacks the random access memory (RAM) needed to run a program or operation, Windows uses virtual memory to compensate.

Table 1.2d *Common types of RAM*

Other types of RAM include DRAM, SDRAM, DDR, SDRAM and Direct RDRAM.

Read only memory (ROM)

A ROM chip is a memory chip that stores instructions and data permanently. Its contents are placed into the ROM chip at the time of manufacture and cannot be modified by the user. A CPU can read and retrieve the instructions and data from the ROM chip, but it cannot change the contents in ROM. ROM chips usually contain special instructions for computer operations such as ROM BIOS. ROMs are also called **firmware.** The variations on the ROM chip include PROM, EPROM and EEPROM.

Complementary Metal Oxide Semiconductor (CMOS)

CMOS chip provides flexibility and expandability for a computer system. It contains essential information that is required every time the computer system is turned on. The chip supplies such information as the current date and time, amount of RAM, type of keyboard, mouse, monitor, CPU and disk drives used.

Primary Storage (Memory)

Primary storage (*internal storage*, *main memory*, *RAM* or *memory*) is the computer's working storage space that holds data, instructions for processing, and processed data (information) waiting to be sent to secondary storage. Physically, primary storage is a collection of RAM chips. The contents are held in primary storage only temporarily.

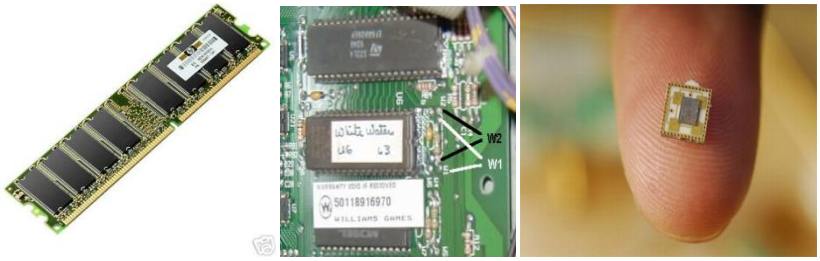


Figure 1.2q *left to right – RAM, ROM & CMOS chips*

System Clock

The *clock* is a device that generates periodic, accurately spaced signals used for several purposes such as regulation of the operations of a processor or generation of interrupts. The clock circuit uses the fixed vibrations generated from a quartz crystal to deliver a steady stream of pulses to the processor. The *system clock* controls the speed of all the operations within a computer. The *clock speed* is the internal speed of a computer and is expressed in *Hertz*. 33 MHz means approximately 33 million cycles per second can be processed. A computer processor's speed is faster if it has higher clock speed. For example, a 2.5 GHz processor is capable of processing approximately 2.5 billion instructions per second.

Buses

A *bus* is a data pathway between several hardware components inside or outside a computer. It not only connects the parts of the CPU to each other, but also links the CPU with other important hardware. The other important hardware includes memory, a disk control unit, a terminal control unit, a printer control unit, and a communications control unit. The capacity of a bus is expressed as bits. A larger capacity bus is faster in data transfer. For example, a 32-bit bus is faster than an 8-bit bus.

Discovery Learning:

Identify how storage capacity is determined and the difference between capacities like KB, MB GB, TB, and so on…

Identify the difference between the microprocessor speeds like MHz, GHz, THz and so on…

Ports

A *port* is an external connecting socket on the outside the computer. This is a pathway into and out of the computer. A port lets users plug in outside peripherals, such as monitors, keyboards, mouse, scanners and printers.

Standard Ports

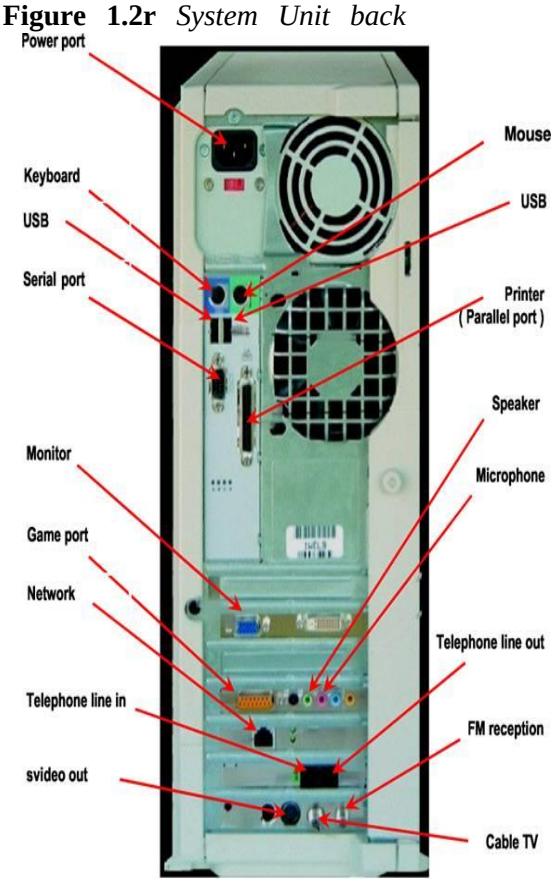
Serial ports are external I/O connectors used to attach modems, scanners or other serial interface devices to the computer. The typical serial ports use a 9-pin DB-9 or a 25-pin DB-25 connector. Serial ports transmit bits one after another on a single communications line. Serial lines frequently are used to link equipment that is not located close by.

Parallel ports are external I/O connectors on a computer used to hook up printers or other parallel interface devices. The parallel port uses a *DB-25* connector. This port transmits several bits simultaneously. Parallel lines move information faster than serial lines do.

Universal serial bus (USB) ports are gradually replacing serial and parallel ports. They are faster, and one USB port can be used to connect several devices to the system unit.

FireWire ports also known as **high performance serial bus** (HPSB)**,** are as fast as USB 2.0 ports and provide connections to specialized FireWire devices such as camcorders.

Figure 1.2r *System Unit back panel with ports*



Specialized Ports

There are numerous specialty ports including MIDI, SCSI, and IrDA ports.

*Musical instrument digital interface (MIDI***)** ports are a special type of serial port for connecting musical instruments like an electronic keyboard to a sound card. The sound card converts the music into a series of digital instructions. The instructions are converted

to music by a **synthesizer** either located on a chip on the system board or on an external device.

Small computer system interface (SCSI) ports are a special type of high speed parallel port for connecting a series of input and/or output SCSI devices to a single SCSI controller card. This arrangement allows several devices to communicate with the system unit through a single slot on the system board.

*Infrared Data Association (IrDA***)** ports are also known as fast infrared (FIR) ports. IrDA ports provide a wireless mechanism for transferring data between devices. Instead of cables, the IrDA ports from each device are directly aligned and infrared light waves are used to transmit data.

Expansion Slots

Expansion slots are receptacles inside a system unit on which printed circuit boards (expansion boards) are plugged into. Computer buyers need to look at the number of expansion slots when they buy a computer, because the number of expansion slots decides future expansion. In microcomputers, the expansion slots are directly connected to the bus.

Expansion Boards

Expansion boards are also called *expansion cards*, *controller cards*, *plug-in boards*, *adapter cards*, or *interface cards*. Expansion boards are printed circuit boards that have many electronic components including chips. They are plugged into expansion slots. Expansion boards are connected to peripherals through *ports* located on the edge of expansion boards. Expansion boards include memory expansion cards (e.g., SIMM), I/O controller cards (e.g., SCSI Card), video display card, sound cards, communications cards, etc. Look back at Figure 1.2o.

Review Exercise1.2.3

True/False

a) Hardware consists of monitor, a keyboard, and software.
b) In a microcomputer, the CPU is located on a single chip called the microprocessor.
c) RAM temporarily stores data and a hard disk permanently stores data.
d) Another name for the system board is the processor board.
e) Memory is also known as primary storage.

Fill in the blank

a) Data and instruction are stored in memory at locations known as _____.

b) _____ memory is directly accessible above 1MB.

c) The system clock controls the _____ of operations within a computer.

d) The system clock speed is expressed in _____.

Short Answer

a) What does random access mean?

b) What does volatile mean?

c) What is the purpose of the CPU?

d) Describe the two basic components of the CPU?

e) What is the difference between open and closed architecture? Give some examples of devices that have open and closed architecture.

1.2.4 Secondary Storage

Secondary storage, sometimes called *auxiliary storage*, is all data storage that is not currently in a computer's primary storage or memory. An additional synonym is external storage.

Secondary storage also holds data and programs permanently. That is, the data or programs remain even after the electricity power is turned off. Secondary storage devices are located outside of the central processing unit, although they may still be built into the system unit cabinet. This storage device includes a hard disk, optical disk, magnetic tape and other portable drives.

A *hard disk* is a magnetic disk made of metal and covered with a magnetic recording surface. Hard disks come in removable and fixed forms that holds from several hundred megabytes to several gigabytes. They are tightly sealed to prevent any foreign matter from getting inside which can cause head crash. A **head crash** happen when the surface of the read/write head or particle on its surface contact the magnetic disk surface destroying some or all of the data on the disk.

Hard Disk Drive

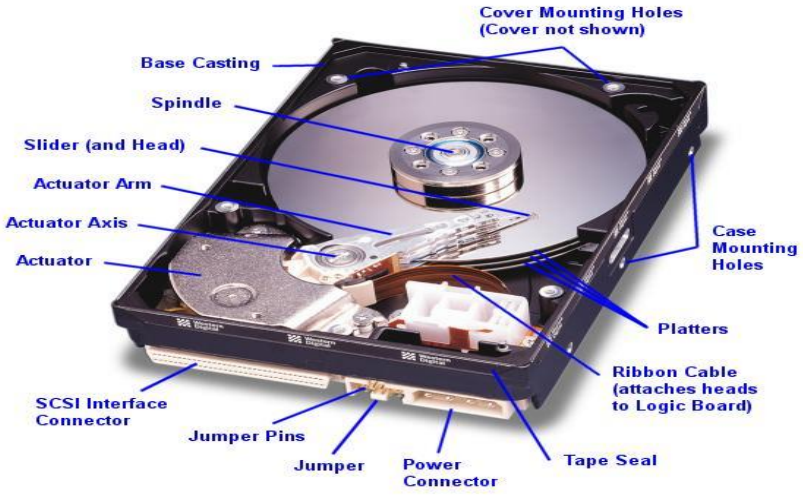


Figure 1.2s *Hard Disk Drive*

Types of Hard Disks

Internal Hard Disk (Figure 1.2s**)** is made up of several metallic platters, a motor, an access arm and read-write heads sealed inside a metal container. Internal hard disks have advantages over other disks. They have high *capacity*, *speed* and are *protected* inside a metal casing. The disadvantage of internal hard disks is that they have only a fixed amount of storage and cannot be easily removed.

External Hard-Disk Drives is not built into the system cabinet of microcomputers. External hard disk drives are treated as peripherals. Using external hard disk drives, we can expand the hard disk capacity when all available drive bays are occupied.

Hard Disk Cartridges have advantage being as easy to remove as a cassette from a video cassette recorder. They give micro-computer system fast access to very large quantities of data.

Removable Drives with Cartridges allows a new form of removable storage. This technology combines the function of the hard disk drive and the convenience of the hard disk cartridge. This form consists of a removable drive and several cartridges.

Hard disk packs are removable storage devices to store massive amounts of information. Hard-disk packs have multiple recording platters aligned one above the other. Their capacity far exceeds the other types of hard disks.

Figure 1.2t *from left to right – hard disk pack, hard disk cartridge and external hard drive*

Optical Disks

Optical disk is a disk written and read by laser beam. This optical disk has a great impact on today's storage technology. Optical disk does not need to move access arms and read/write heads, because a laser beam can be moved electronically.

The capacity of the storage is considerably greater than their magnetic disk counterparts, and optical disk storage may eventually replace all magnetic tape and disk storage. To write data, a laser beam burns tiny cavities into the surface of a disk to mark bits for data. To read the data, a laser beam scans these areas. One important characteristic of optical disc drives is their **rotational speed**. This speed is important because it determines how fast data can be transferred to and from the CD. The two most commonly used optical discs are CD and DVD with the *Blu-ray* disc slowly emerging in the market.

Figure 1.2u *Optical disk drive*

Discovery Learning:

Compare and contrast the storage capacities of the CD, DVD and the Blu-ray Disc.

Compact Disc (CD)

A CD is the one of the most widely used optical discs which is available in a variety of formats such as: CD-ROMs, WORMs or CD-R and CD-RW.

Read-only optical disks also known as CD-ROMs or Compact Disk Read-Only Memory and cannot be written on. The most common applications of CDROM are in the storage and retrieval of multimedia images and sound along with text. It can store up to 650MB on a single side and up to 72minutes of VHS-quality video.

Write-once and read many optical disks also called WORMs or CD-R (CD-Recordable) and are blank disks that are recorded by the user. To write data, a powerful beam of laser

light burns tiny spots into the coating that covers the surface of these disks. Once burned in, the spots are not erasable. To retrieve the data, a less powerful laser is used to read the pattern of spots.

Erasable optical disk also known as CD-RW (Compact Disk rewritable) use lasers to read and write information to and from the disk but also use a magnetic material on the surface of the disk and a magnetic write head to achieve eraser ability. Up to 20MB can be stored n this type of disk.

Digital Versatile Disc (DVD)

DVD discs and DVD disc drives are very similar to CDs except that more data can be packed into the same amount of space. The DVD drives can store 4.7 gigabytes on one side of a DVD disk – more than seven times the capacity of a CD. Many DVD drives can store data on both sides of the disk, thereby doubling the capacity.

Digital Versatile Disk- Read Only Memory can provide over two hours of very high quality video and sound comparable to that found in motion picture theaters.

Blu-ray Disc (BD)

Blu-ray Disc is an optical disc storage medium designed to supersede the DVD format. The plastic disc is 120 mm in diameter and 1.2 mm thick, the same size as DVDs and CDs. Blu-ray discs contain 25 GB per layer, with dual layer discs (50 GB) being the norm for feature-length video discs.

Figure 1.2v*High Density Optical Discs*

Other types of Storage Devices

Solid State Storage

Solid state storage is portable, provides fast access to data, and uses very little power, so it is an ideal solution for storing data on mobile devices and transporting data from one device to another. It is widely used in consumer devices, such as digital cameras, MP3 music players, notebook computers, PDAs and cell phones.

There are several types of solid state storage devices. A *USB flash drive* is a portable storage device featuring a built-in connector that plugs directly into a computer's USB port. A USB flash drive requires no card reader, making it easily transportable from one computer to another.

Flash memory cards are credit card-sized solid-state storage devices widely used in notebook computers. Flash memory also is used in a variety of specialized input devices to capture and transfer data to desktop computers. Flash memory is also used to record MP3/4 music files and to transfer those files to computers and other devices.

Key chain flash memory devices are so compact that they can be transported on a key ring or necklace. Key chain hard drives conveniently connect directly to a computer's USB port to transfer files.

Compact Flash (CF) cards are about the size of a matchbook and provide high storage capabilities and access speeds. Compact Flash cards include a built-in controller that reads and writes data within the solid state grid.

Multimedia cards (MMC) offer solid state storage in a package about the size of a postage stamp. Initially used in mobile phones, use of Multimedia cards has spread to digital cameras and MP3 players.

Figure 1.2w *Solid State Drives*

Magnetic Tape

A magnetic tape is a tape coated with a magnetic material on which data can be stored. This is a sequential storage device that is usually used for a backup purpose. A magnetic tape is slower than direct access storage such as disk, because it is sequential access storage. The biggest advantage of magnetic tape is the cost. It is much cheaper than magnetic disk and optical disk. An advanced tape backup technology (DAT) is available these days.

Figure 1.2x *Magnetic tape inside a tape drive*

Cache (Cache memory)

A cache is a specially designed buffer storage used to improve computer performance by reducing access time. It holds instructions and data that are likely to be needed for next operation by the processor. The cache copies frequently accessed data and instructions from primary storage (main memory) or secondary storage (disks).

Review Exercise 1.2.4

True/False

a) The most inexpensive storage medium for the microcomputer is the hard disk.
b) Secondary storage holds information within the CPU.
c) CD-R disks can be erased and used over and over again.
d) Hard disk packs are inside the computer system.
e) Magnetic tapes are mostly used for backup.

Fill in the blank

a) Secondary storage is also known as _____ memory.
b) The amount of time it takes the device to locate an item on a disk is called _____ time.
c) A type of storage that is volatile is called _____.
d) A _____ is an extremely high capacity compact disc capable of storing 4.7GB to 17GB of data, instruction and information.
e) Data on an optical storage medium, such as a DVD is stored as a pits and _____.

Short Answer Questions

a) What is a head crash?
b) Describe the three types of hard disks?
c) Describe three ways to improve hard disk performance?
d) Give two reasons why the use of USB is becoming more popular than CD ROMs.
e) What is the impact of using DVDs as storage device?

1.3 Categories of Computer

There are different categories of computer in the market today. Different types are designed for different purposes.

Microcomputer

A *microcomputer* is also known as **personal computer** or PC, are computers mostly used in homes and for small business. A microcomputer usually costs about $1,000 and its processor performs about 1 billion operations per second. Microcomputers generally carry out their own processing tasks and come in many sizes and shapes. These are as follows:

*Desktop PC*s it's on a desk like the ones in schools today. The display screen is usually placed on the top of the horizontal desktop case. Of the desktop micros, the most common ones in Fiji today are the IBM (international Business machines) compatible.

Figure 1.3a *Desktop computer*

Notebook computers also known as **laptops**, are portable, lightweight, size of a large reference book, usually have their own carrying bags.

Figure 1.3b*Notebook computers*

Handheld computers are the smallest and are designed to fit into the palm of one hand. It is also known as **palmtop computer**.

Personal digital assistants (PDA) are the most widely used handheld computer.

Figure 1.3c *PDA*

Discovery Learning:

Can notebook computers be connected to the network? If yes, explain how?

Server

A *server* is a hardware system dedicated to running one or more such services as a host, to serve the needs of users of the other computers on the network.

Servers are important components of networks. They provide shared access to services on the network. A server is a software and hardware package that provides access to particular services. Depending on the computing service that it offers it could be a database server, file server, mail server, print server, web server, or other. These servers may be dedicated computers or one computer may provide a number of these services. Some of the server software is specialized.

Figure 1.3d *Facebook datacenter server in Prineville Oregon, USA*

Supercomputers

Supercomputers (Figure 1.3f) are the largest, fastest and most expensive types of computer. Unlike microcomputers and servers, supercomputers are not designed to optimize processing for multiple users. Instead supercomputers use their significant processing power to solve a few very difficult problems such as predicting the weather, modeling nuclear reactions and oil/space exploration. The speed of a supercomputer has reached one quadrillion instructions per second. Supercomputers are mostly used by researchers and scientists.

Discovery Learning:

Find out the types of servers used by organizations like USP, FINTEL, Telecom, ANZ, FMF and some other big companies in Fiji. Also find out the storage capacities and speed of these servers.

Figure 1.3e*K Computer is currently world's fastest Supercomputer*

Note: the supercomputers are continuously upgraded in the race to be the fastest supercomputer by competing nations like USA, Japan, China and the European Union. The Top list changes every six months at the time of the writing of this book, the world's fastest supercomputer was Japan's K Computer shown in Figure 1.3f. You can now check these websites for the latest fastest supercomputer.

1. http://www.top500.org/
2. http://money.cnn.com/galleries/2011/technology/1111/gallery.fastest_supercomputer/index.html

Year	Supercomputer	Peak speed (Rmax)	Location
2009	CrayJaguar	1.759 PFLOPS	DoE-Oak Ridge National Laboratory, Tennessee, USA
2010	Tianhe-LA	2.566 PFLOPS	National Supercomputing Center, Tianjin, China
2011	FujitsuK computer	8.162 PFLOPS	RIKEN, Kobe, Japan
2011	FujitsuK computer	10.51 PFLOPS	RIKEN, Kobe, Japan

Table 1.3f. *List of Supercomputers and their speed.*

Review Exercise 1.3

True/False

a) The term microprocessor is a synonym for the term microprocessor.

b) Most computer included a network card designed to connect a computer to the internet using standard telephone line

c) Supercomputer is the fastest type of computer in the world.

Short Answer Questions

a) List two ways computers are used in special education in Fiji.

b) There are three types of computer and one of which is supercomputer. What is a supercomputer?

c) Name the categories of computer which is mostly used by businesses to centralize storage, process and manage large amount of data.

1.4 Ergonomics

Ergonomics is the study of the relationship between people and their working environment. While working with computers, factors have to be considered which may impact on the health of those who operate these machines.

Avoiding eyestrain and headache: Our eyes were made for most efficient seeing at a distance. However, monitors require using the eyes at closer range for a long time, which can create eyestrain, headaches, and double vision. To make the computer easier for the eyes, take a 15 minutes break every hour or two. Avoid computers screens that flicker. Keep computer screens away from windows and other sources of bright light to minimize reflected glare on the screen. Special antiglare screen coating and glare shields could be used. Keep everything you're focusing on at about the same distance. Clean the screen of dust from time to time.

Avoiding back and neck pain: Work at monitors and keyboards that are in improper position can result in the pains in the back and neck. To avoid these problems, make sure equipment is adjustable and flexible.

Avoiding repetitive strain injury: *Repetitive strain injury (RSI)* also called *repetitive motion injury* and *cumulative trauma disorder* is the name given to a number of injuries. These result from fast, repetitive work that can cause neck, wrist, hand, and arm pain. One particular type of RSI, *carpal tunnel syndrome*, found among heavy computer users, consists of damage to nerves and tendons in the hands.

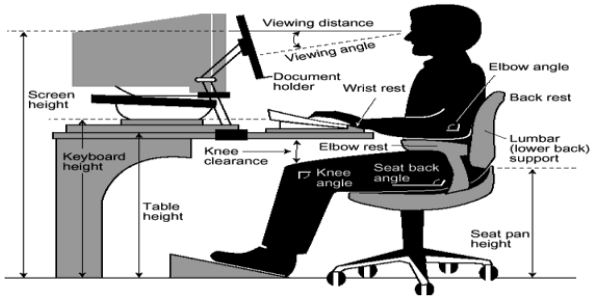


Figure1.4*Correct sitting posture when using a computer*

Review Exercise 1.4

Fill in the blank

a) The new word _____ is used to describe harmful stress associated with computer use.
b) Computer _____ are guidelines for the morally acceptable use of computer in our society.
c) Keep computer screens away from windows and other sources of bright light to minimize reflected _____ on the screen.
d) _____ emissions can travel through a person's body.
e) A repetitive strain injury that causes damage to nerves and tendons in the hands is due to _____.

Short Answer Questions

a) What is ergonomics?

b) Why ergonomics is important?

c) State three things a computer user could do to avoid eyestrain and headache.

d) Define the phrase “Repetitive strain injury”.

e) Discuss some of the most significant physical concerns created by frequent computer use and how they can be avoided.

1.5 Summary

1. A computer is an electronic machine that operates under the control of instructions stored in its own memory.
2. Computer accepts data (input), manipulate the data according to specific rules (process), produce results (output), and store the results for future use (storage).
3. Data is a collection of unorganized facts, figures, and symbols.
4. Computers process data to create information. Information is data that is organized, meaningful, and useful.
5. Data entered into a computer is called input. The processed results are called output.
6. The cycle of input, process, output, and storage is called the information cycle.
7. Hardware is the physical part of the computer system.
8. Supercomputer, mainframe, server and microcomputer are categories of computers. Microcomputers can be desktop, notebook (laptop), tablet Pc, or handheld (palm). PDAs are the most widely used handheld computer.
9. The system unit, sometimes called a chassis contains the electronic circuitry, including the microprocessor and memory (primary storage, random access memory [RAM], temporary storage).
10. Input/output devices are translators for humans and computers. Input devices include the keyboard and mouse. Output devices include monitors and printers.
11. Secondary storage holds data and programs. A storage device records and retrieves data, information, and instructions to and from storage medium. Common storage devices are a hard disks, optical disks (CD, DVD), USB flash dive and tapes.
12. Ergonomics is the study of human factors related to things people use, including computers.

Key Terms

- adapter
- adapter card
- data-processor
- arithmetic operation
- binary system
- bit
- bus
- bus line
- byte
- cache memory
- chassis
- chip
- clock speed
- control unit
- desktop
- expansion card
- ergonomics
- fireWire port
- firmware
- gigahertz
- graphics card
- integrated circuit
- interface card
- laptop computer
- main board
- memory
- microprocessor
- motherboard
- MIDI
- nonvolatile memory
- parallel port
- Petaflops
- port
- RAM
- RAM cache
- ROM
- semiconductor
- serial port
- silicon chip
- slot
- socket
- sound card
- synthesizer
- system board
- system clock
- system unit
- supercomputer
- volatile storage

Review Questions – Multiple Choice

1) The term "**information**" is frequently used in computing to refer to
   a. the input to the computer.
   b. the process of computation.
   c. unprocessed facts and figures.
   d. facts that have been processed into a more usable form.

2) Which of the following chips contains information that is required every time the computer system is turned on?
   a. ALU
   b. ROM
   c. RAM
   d. CMOS

3) Which of the following hardware is responsible for the clock speed of the computer system?
   a. hard disk
   b. microprocessor
   c. CD-ROM
   d. motherboard

4) Which of the terms below represents 1000 000 000?
   a. Kilobyte
   b. Terabyte
   c. Gigabyte
   d. megabyte

5) Which of the following types of error occurs as a result of wrong input or misspelling?
   a. input error
   b. syntax error
   c. content error
   d. software error

6) An example of a non-impact printer is a
   a. line printer
   b. dot matrix
   c. thermal printer
   d. chain printer

7) Which of the following chips contains information that is required every time the computer system is turned on?
   a. ALU
   b. ROM
   c. RAM
   d. CMOS

8) A user plans to run multiple tasks simultaneously on a computer. Which computer component is essential to accomplish this?
   a. NIC
   b. RAM
   c. video card
   d. sound card

9) Keyboard keys, such as caps lock, that turns a feature on or off is called a _____ key.
   a. power
   b. toggle
   c. control
   d. function

10) A hard disk stores which of the following?
   a. software programs permanently
   b. software temporary
   c. data files temporary
   d. data files permanently

Review Questions – Short Answers

1) Describe the functions of the three main components of a computer system.
2) Many people use microcomputers for personal and business users. Give two characteristics of microcomputers.
3) Why it is important for a large organization to have an unlimited power supply unit and a surge protector in its computer system?
4) What are the four commonly used units of measurement to describe memory capacity?
5) What kind of activities can you perform to avoid computer-related eyestrain, headaches, and back and neck pain?

Chapter 2

Software

"Before software can be reusable it first has to be usable" ~ Ralph Johnson

After completing this chapter, you will be able to:

1. Describe the difference between system software and application software.
2. Discuss the various type of system software.
3. Understand how system software interacts with application software.

2.0 Introduction to Software

The software is a series of instructions or a special program that performs a particular task and is recorded in some form on a computer disk. Simply, the software is an abstract collection of instructions for computers to perform specific tasks. It is also referred to as a program or software program. Computer software has two major categories. It is typically classified into system software and application software as shown in Figure 2.0 below.

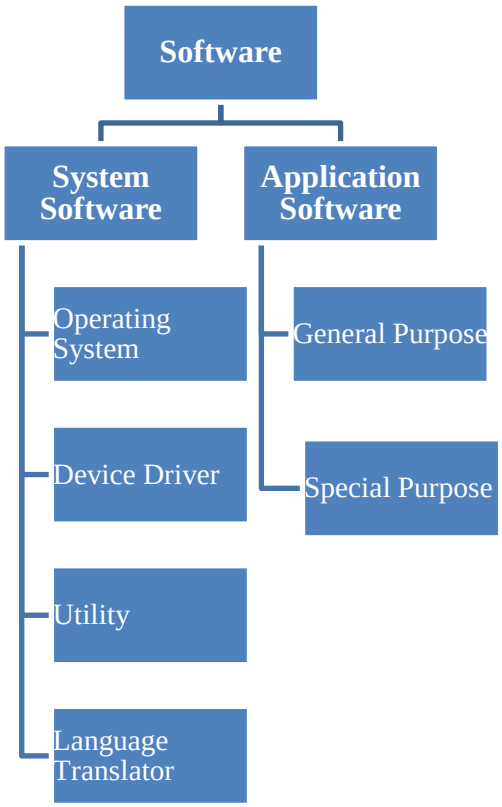


Figure 2.0 *Categories of Software*

2.1 System Software

System software is a set of programs that manage or control a computer's resources. System software acts as the interface between the user, the application software, and the computer's hardware. System software is made up of four control programs which include the following:

Operating systems – coordinate computer resources, provide an interface between the users and the computer and run applications.

Utilities– also known as service program, perform specific tasks related to managing computer resources.

Device drivers – are specialized programs that allow particular input, output or communication devices to communicate with the rest of the computer system.

Language translators– convert the programming instructions written by programmers into a language that computers understand and process.

Figure 2.1*Using software(Internet Explorer)*

2.1.1 Operating System(OS)

An **OS** manages the overall operation of the computer system. It is a set of programs that instructs and controls the hardware functions of the computer system. Operating system software interacts between applications software and the computer hardware.

The three main functions of an OS include:

- The *provision of the user interface* that allows users to interact with the computer systems for example Microsoft Windows provides menus, toolbars, dialog boxes and icons that are used for a variety of tasks.
- *Running applications*.In a multitasking operating system where multiple programs can be running at the same time, the operating system determines which applications should run in what order and how much time should be allowed for each application before giving another application a turn.
- *Managing internal resources*. It manages the sharing of internal memory among multiple applications. It handles and monitors input and output to and from attached hardware devices, such as hard disks, printers, and dial-up ports. It sends messages to each application or interactive user (or to a system operator) about the status of operation and any errors that may have occurred. It can offload the management of what are called *batch* jobs (for example, printing) so that the initiating application is freed from this work. On computers that can provide parallel processing, an operating system can manage how to divide the program so that it runs on more than one processor at a time. File management including the creation, deletion, copying, naming and storing of files. Navigation through disks, folders and files and switching between applications. Printing and installing printers. Font management and use. Control the display of the monitor, including the resolution and size and starting, restarting and shutting down the computer and networking.

Operating System Features

Booting the Operating System means turning on the Computer and having the Operating System loaded. There are two types of booting.

1. Cold Booting
2. Warm Booting

Cold Booting is switching the computer on from the power source.

Warm Booting is restarting the computer either by pressing the reset button on the system unit or by pressing Ctrl + Alt + Delete or by selecting restart option from the start menu.

Users interact with the operating systems through either a command line interface (CLI) or graphical user interface (GUI). Most provide a place, called the **desktop**, which provides mean of access to computer resources. Operating systems interfaces have several features in common with application programs as shown in the table below.

Features	**Function**
Icons	Graphics representations for a program or function.
Pointer	Controlled by a mouse and changes shape depending upon its current function.

Windows	Rectangular areas for displaying information and running programs.
Menus	Provide a list of options or commands.
Dialog boxes	Provide information or request input.
Help	Provides online assistance for operating system functions and procedures.
Command line	Prompts users to enter command to perform an action.

Table 2.1.1a*Operating System Features*

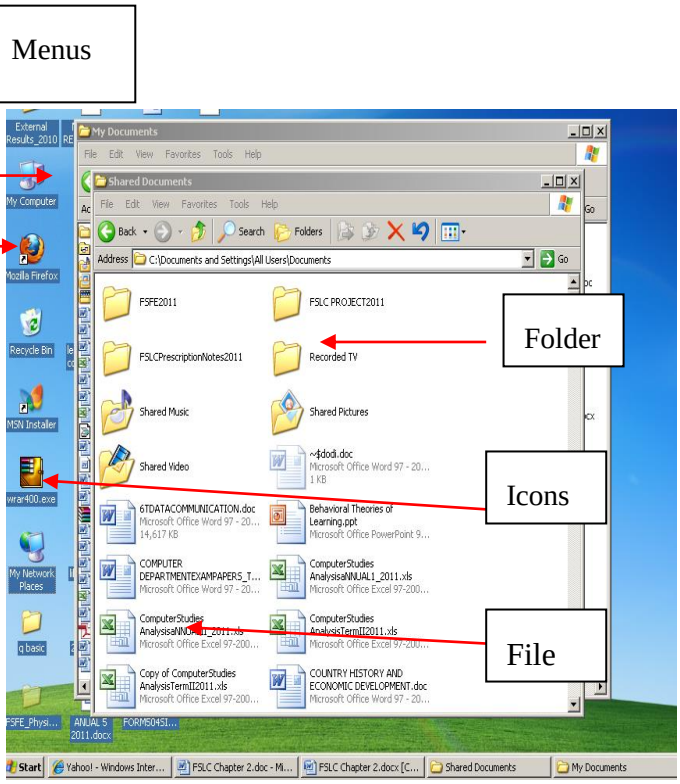


Figure 2.1.1a*Desktop GUI*

Categories of Operating System

The three basic categories of operating system are stand-alone, network and embedded.

Stand-alone operating system works on desktop or notebook computer. Some stand-alone operating systems, called client operating systems, also work in conjunction with a network operating system eg; Windows 2000 Professional, Windows NT, Windows Vista etc.

Network operating system (NOS) are used to control and coordinate computer that are networked or linked together eg; Netware, Windows NT Server, Windows 2000 Server etc.

Embedded operating system are used for handheld computers and small devices like PDAs and mobile phones like Windows CE, Pocket PC 2002, Palm OS, Symbian, Android, Apple iphone and Blackberry.

2.1.2 Utilities

A *utility program* is a type of system software that performs a specific task, usually related to managing a computer, its devices, or its program. In simple terms it performs the house keeping functions of the computer system. There are many types of utilities available and some common ones are shown in Table 2.1.2b below.

Utility Program	Function
Troubleshooting or diagnostic program	A program that recognizes and correct problems, ideally before they become serious.
Antivirus program	Is a program that guard your computer system against viruses or other damaging programs that can invade your computer system.
Uninstall program	A program that allow you to safely and completely remove unneeded programs and related files from your hard disk.
Backup program	A program that make copies of files to be used in case the originals are lost or damage.
File compression programs	A program that reduces the size of files so they require less storage space and can be sent more efficiently over the internet.
Disk defragmenter	A utility program that locates and eliminates unnecessary fragments and rearranges files and unused disk space to optimize operations.

Table 2.1.2b *Utility programs*

Windows utilities

The windows operating systems are accompanied by several utility programs as shown in Table 2.1.2b.

Discovery Learning:

Describe how to keep the anti-virus software up-to-date.

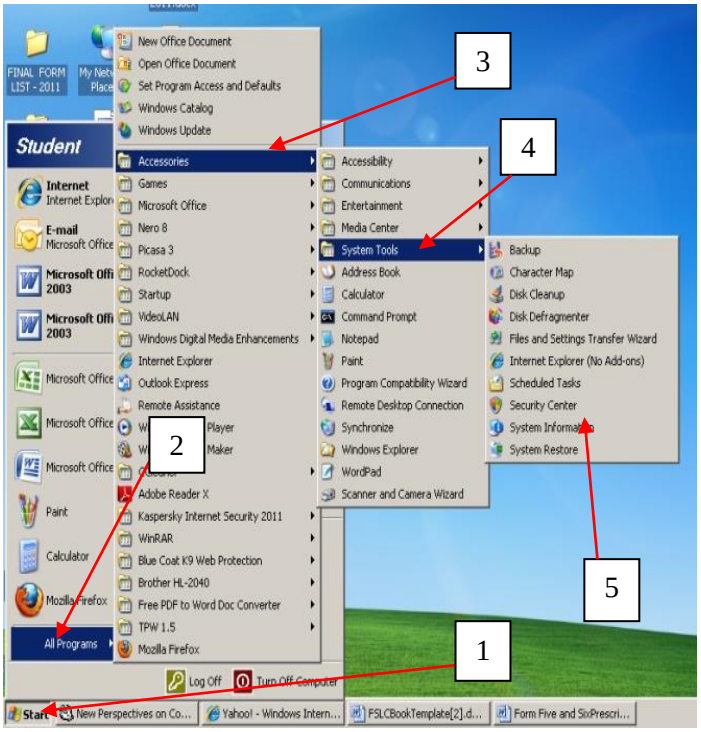


Figure 2.1.2b *Accessing Windows XP utilities*

Utility Suites

Utility suites combine several programs into one package. Buying the packages is less expensive than buying the programs separately. The three best-known utility suites are McAfee Office, Norton System-Works, and V Communications System Suite. These suites provide a variety of utilities, including programs that will protect your system from dangerous programs called computer viruses.

2.1.3 Device Drivers

On installing components like sound cards, modem, mouse or printer, special software called device driver is needed. *Device driver* is a program that provides the interface between the application software, operating system and hardware device. Each time the computer started, the operating system loads all of the device drivers into the computer's memory.

Whenever a new device is added or installed into the computer system, a new device driver must be installed before the device can be used. However, the latest operating systems come with most device

drivers preinstalled so all you have to do is plug in the device and use it. These devices are now called plug n play devices for example mouse, keyboard, digital cameras, flash drives and some printers.

Discovery Learning:

Name some plug n play devices that can be configured automatically with either Window XP, Vista or 7 or any other OS you are using.

2.1.4 Language Translators

Language translators are programs that convert programs written in high level programming language (described in detail in chapter 6) into machine language. Since the CPU can process only 0's and 1's everything task that we perform on the computer must be converted into machine language (0's and 1's). Some examples of language translators are *compilers*, *interpreters* and *assemblers*.

Note: do not confuse yourself with the other language translator programs that are available which simple changes one spoken language into another for example, English to Hindi.

Review Exercise 2.1

True or False

a) One computer can only run one kind of system software.
b) Virtual memory increases the amount of memory available to run application programs.
c) Macintosh computers are designed to use the Pentium microprocessor.
d) The operating system Linux is the most popular with graphic designers and those who work in multimedia.
e) Application software allows computer to interact with the user, applications and hardware.

Short Answer Questions

a) Why is a graphical user interface described as user-friendly?

b) What is a network operating system?

c) Describe at least three utility programs?

d) What is meant by multitasking?

Discovery Learning:

Compare and contrast Windows and Macintosh operating system? Find different versions of Mac OS and Linux OS and show the evolution of Windows.

2.2 Application Software

Applications software is created to perform either *specific* or *general* task which is not related to the computer system itself. Application software can be bought off-the-shelf. There are two broad categories of application software: special-purpose and general-purpose (refer to Figure 2.0).**Special-purpose programs** are designed to perform specific tasks for example inventory, payroll, accounting, point of sales, virtual reality, artificial intelligence and games. This software is in most cases customized to suit a particular business need. **General-purpose programs** are designed to be used by many people to do the most common kinds of tasks such as typing, preparing budgets, presentations and small databases. This is why they are also known as **basic application.** Word processors, spreadsheets, database management system and presentation graphics are general-purpose applications.

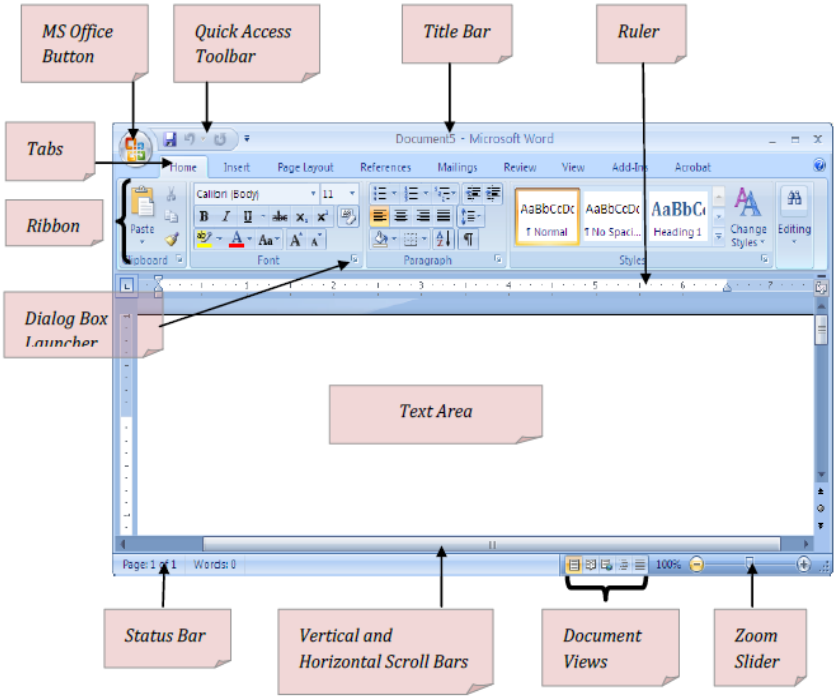


Figure 2.2a*Features of application software*

Common features of application software

Feature	Description
Tabs	Presents tools/buttons available for selection from the ribbon.
Shortcut keys	Special-purpose keys for frequently used commands.
Ribbon	Presents graphic objects/buttons for commands
Help	Presents explanations of various commands.
Dialog Box	Used to specify additional command options.
Insertion Point	Shows where data can be entered.
Scroll Bars	Used to display additional information.
Quick Access	Tools that are frequently used can be set here. Eg Save, undo, print and print preview.
Groups	Provide categorized tools options under specific headings.

Table 2.2a*Features of application software*

WYSIWYG: stands for "*What You See Is What You Get"*. This means that the image on the screen display looks the same as the final printed document. The WYSIWYG feature allows the user to preview the document's appearance before it is printed out.

2.2.1 Word Processing

Word processing software is used to create, edit, save and print documents. Word processing software creates text-based documents such as reports, letters and memos. Word processors are one of the most flexible and widely used software tools. All types of people and organization use word processors to create personalized Web pages. The three most widely used word processing programs are Microsoft Word, Corel WordPerfect and Lotus Word Pro.

Word processors provide a variety of features to make entering, editing and formatting documents easy. One of the most basic features for entering text is **word wrap.** This feature automatically moves the word to the next line once the current line is full.

There are numerous features designed to support **editing** or modifying a document. One of these is a **Thesaurus** that provides synonyms, antonyms and related words for a selected word or phrase. You can quickly locate any character, word or phrase in your document using the **search** or **find** commands. Spelling can be checked by running a **spelling checker**. Incorrectly spelled words are identified and alternative spelling suggested. In a similar manner **grammar checker** can be run that will identify poor wording, excessive long sentences, and incorrect grammar. Other features are designed to improve the **format** or appearance of a document. One of the most basic is the **font** or design of the characters.

2.2.2 Spreadsheet

A spreadsheet is an **electronic worksheet** used to organize and manipulate numbers and display options for "What-if" analysis. It enables one to manipulate figures and texts in **columns** and **rows** and perform calculations using formulas. The columns are identified by letters and rows are identified by numbers. The intersection of row and column creates a **cell**. For example, the cell A10 is formed by the intersection of column A and row 10. Thus spreadsheet programs organize, manipulate and graph numeric information. The three most widely used spreadsheet programs are Microsoft Excel, Corel Quattro Pro and Lotus 1-2-3.

Some common features of spreadsheet programs include the following.

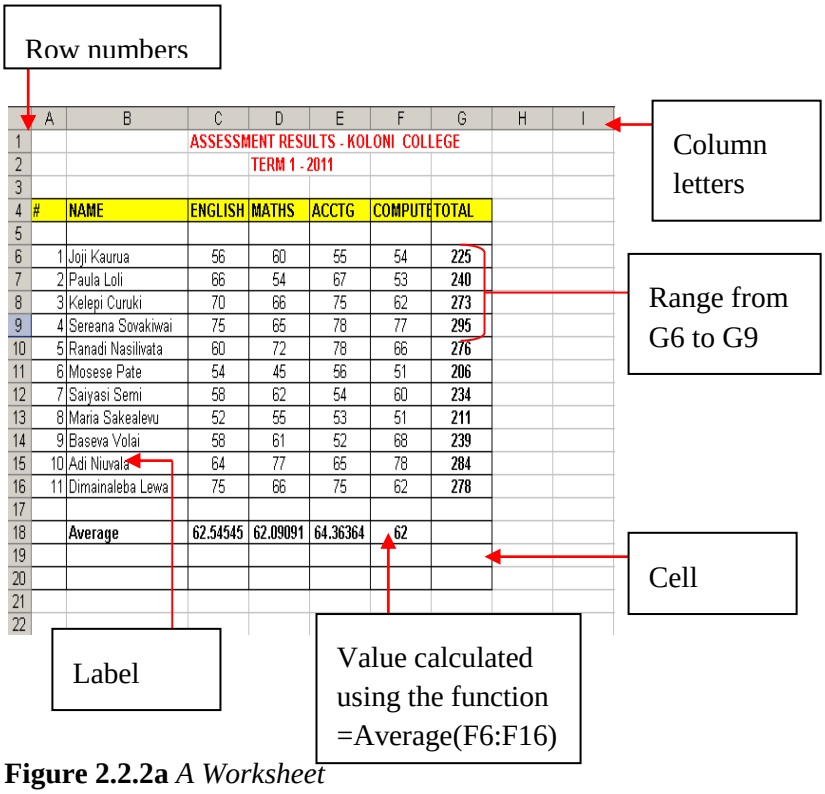
Formatting cells

The same font and paragraph formatting features can be applied to the contents of a cell as in a word processor. *Labels* are often used to identify information in a worksheet. Usually a **label** is a word or symbol, such as hash sign (#). A number in a cell is called a **value**. Labels and values can be displayed or formatted in different ways. For example, a label can be centered in the cell or positioned to the left or right or indented. A value can be displayed to show decimal places, dollars, or percent. The number of decimal positions (if any) can be altered, and the width of columns can be adjusted.

Formulas and Functions (main attribute of a spreadsheet)

Formulas are instruction for calculations. It is defined by the user and usually comprises of arithmetic operations (+,*,-,/) with cell references. For example: to add cells C6, D6, E6 & F6 as shown in Figure 2.2.2a, the user defined formula written in cell G6 would be = C6+D6+E6+F6.

Functions are prewritten formulas that perform calculations automatically. For example to perform the same addition, the function to be used in cell G6 would be = SUM(C6:G6).



	A	B	C	D	E	F	G	H	I
1			ASSESSMENT RESULTS - KOLONI COLLEGE						
2				TERM 1 - 2011					
3									
4	#	NAME	ENGLISH	MATHS	ACCTG	COMPUTE	TOTAL		
5									
6	1	Joji Kaurua	56	60	55	54	225		
7	2	Paula Loli	66	54	67	53	240		
8	3	Kelepi Curuki	70	66	75	62	273		
9	4	Sereana Sovakiwai	75	65	78	77	295		
10	5	Ranadi Nasilivata	60	72	78	66	276		
11	6	Mosese Pate	54	45	56	51	206		
12	7	Saiyasi Semi	58	62	54	60	234		
13	8	Maria Sakealevu	52	55	53	51	211		
14	9	Baseva Volai	58	61	52	68	239		
15	10	Adi Niuvala	64	77	65	78	284		
16	11	Dimainaleba Lewa	75	66	75	62	278		
17									
18		Average	62.54545	62.09091	64.36364	62			
19									
20									
21									
22									

Figure 2.2.2a *A Worksheet*

A **range** is a series of continuous cells. For example the cell G6 contains the function =SUM(C6:F6), which adds the values from cells C6, D6, E6 and F6. The sum of the values in this range is displayed in cell G6.

Analytical graphs or **charts** are visual representations of data in a worksheet. You can easily create graphs in a spreadsheet program by selecting the cells containing the data to be graphed and then selecting the type of chart to display. If you change one or more numbers in your spreadsheet, all related formulas will automatically recalculate and charts will be automatically adjusted. *Recalculation* is one of the most important features of spreadsheet.

What-if analysis lets you change one or more values in your spreadsheet, all related formulas will recalculate automatically. Thus you can substitute one value for another in a cell and observe the effect on other related cells in the spreadsheet.

2.2.3 Database

A database is a program, which is used for computerized record keeping. It provides a place to store information and a way to organize data so that it can be accessed in an organized and timely manner. A **database manager** or **database management system (DBMS)** is a software package used to set up, or structure a database. It also used to retrieve information from a database.

Data is organized into tables. Each table is made up of rows called *records* and columns called *fields*. Each record contains fields of information about some specific item. Some of the database programs include Microsoft Access, Corel Paradox, Lotus Approach, dBase IV.

Some features of database are as follows:

Locate and Display

A basic feature of all database programs is the capability to quickly locate or find records in the database. Easier way to locate information is to apply a **filter** to the database. A filter displays the subset of records that meet certain conditions or criteria. The main method of locating specific kind of data for a data from a database is to create a **query**. A query locates the specified records and displays only selected fields.

Sorting

Database administrators make it easy to change the order of records in a file. Normally, records are displayed in the order they are entered or by key field such as social security number. **Rearranging or sorting of records** is a common feature utilized by database administrators.

2.2.4 Presentation Graphics

A *presentation graphics* program can display numeric data in a visual format for analysis and presentation purposes. These programs are often used by marketing or sales people as well as many others. Most commonly used presentation graphics programs are Microsoft PowerPoint, Corel Presentation and Lotus Freelance Graphics.

Features that are common to most presentation graphics include the following:

Most programs include features that help you organize the content of your presentation such **design layout** and **schemes** that includes *preformatted text* for many different types of presentations from selling a product to reporting on progress.

Professionally designed **templates** or models are provided. They include selected combination of text layouts with features such as title placement and size. Additionally, various bullet styles, background colors, patterns, borders and other enhancements are provided.

Animations include special visual and sound effects. These effects include blinking text and transitions between topics. You can insert audio and video clips that play automatically or when selected. You can even record your own voice to provide a narration to accompany a slide show.

2.2.5 Integrated packages and Software suites

An *integrated package* is a single program, which combines two or more applications programs. An integrated package provides the functionality of a word processor, spreadsheet, database and more. An integrated package usually shares a common user interface and you can switch from one application to another and cut or copy data from one to another.

The primary disadvantage of an integrated package is that the capabilities of each function (such as word processing) are not as extensive as in the specialized programs (such as Microsoft Word). The primary advantage is that the cost of an integrated package is much less than the cost of purchasing a word processor, spreadsheet and database. The most widely used integrated package is Microsoft Works.

A *software suite* is a collection of separate application programs bundle together and sold as a group. The most popular software suite is Microsoft Office, which comes in different version.

Discovery Learning:

Give more examples of integrated packages and software suites.

2.3 Advanced Application

Advanced applications include graphics programs, audio and video, multimedia, Web authoring and artificial intelligence and virtual reality.

Graphics programs

Advanced graphics programs are used by professionals in graphic arts. Three types are desktop publishers, image editors, and illustration programs.

Desktop publishing programs allow one to mix text and graphics to create publications of professional quality. While word processors focus on creating text and have the ability combine text and graphics, desktop publishers focus on page design and layout and provide greater flexibility. Desktop publishing programs are widely used by graphic artists to create brochures, newsletters, newspapers and textbooks. Popular desktop publishing programs include Adobe Frame-Maker, Adobe PageMaker, Corel Ventura, and QuarkXPress.

Image editors, also known as **paint programs,** are used to create and to modify bitmap images files. In a **bitmap file,** the image is made up of thousands of dots or pixels to represent images. Popular professional image editor programs include Adobe Photoshop, Corel Photo-Paint, and Paint Shop Pro.

Illustration programs, also known as **draw programs**, are used to modify **vector images**. In a vector file, the image is composed of a collection of objects such as lines, rectangles and ovals. A vector file contains all the shapes, colors, and starting and ending points necessary to recreate the image.

Graphic suites

Graphics suites are the bundling of the separate graphics programs as a group. The advantage of the graphics suites is that a large variety of graphics programs can be purchased at a lower cost.

Audio and Video

Using audio and video editing software enables user to compile movies. *Video editing software* allows one to reorganize, add effects and more to the digital video footage. *Audio editing software* allows user to create and edit audio clips. Most audio editing software has features that allow you to add audio effects, like filters, to your tracks.

Multimedia

Multimedia also called **hypermedia** is the integration of all sorts of media into one form of presentation. The media may include video, music, voice, graphics, and text. An essential and unique feature of multimedia is user participation or interactively.

Web Authoring

Web authoring programs are typically used to create sophisticated commercial sites. Also known as Web page editors and HTML editors, these programs provide support for web sites design and HTML

coding. Widely used authoring programs include Macromedia, Dreamweaver, Net Objects Fusion and Microsoft FrontPage.

Discovery Learning:

Give an example of each of the graphics programs.

Artificial intelligence (AI)

The field of computer science known as artificial intelligence attempts to develop computer systems that can mimic or simulate human senses, thought processes and actions. These include reasoning, learning from past actions and using senses such as vision and touch.

Three areas which human talents and abilities have been enhanced with computerized intelligence: robotics, knowledge-based systems, and virtual reality.

Robots are computer-controlled machines that mimic the motor activities of humans and some are used for household activities, entertainment purposes, while most are used in factories and hazardous environment to handle dangerous, repetitive tasks with high degree of precision.

Knowledge-based systems, also known as expert systems, are computer programs that provide advice to decision makers who would otherwise rely on human experts. These expert systems use knowledge bases that contain specific facts, rules to relate these facts, and user input to formulate recommendations and decisions. Expert systems have been developed in areas such as medicine, geology, architecture, military science, financial analysis and nature.

Virtual reality incorporates interactive sensory equipment (headgear and gloves) allowing users to experience alternative realities generated in 3-D by a computer, thus imitating the physical world. The headgear has earphones and three-dimensional stereoscopic screens. The gloves have sensors that collect data about your hand movement. Coupled with software, this interactive sensory equipment lets you immerse in a computer-generated world.

2.4 Summary

1. **Software**, also called a **computer program**, is the series of instructions that tells the hardware of a computer what to do.

2. **System software** controls the operations of the computer and its devices and serves as the interface between a user and computer hardware.

3. System software consists of a variety of programs including: ***operating system*** which contains instructions that coordinate the activities of hardware devices, ***utility program***, which performs specific tasks usually related to managing a computer, ***device drivers*** are specialized programs to allow input and output devices to communicate with the rest of the computer system.

4. **Application software** are program which are written for specific and general tasks which are not related to the computer system itself. Contrast must be drawn between application software and operating system software.

5. There are two broad categories of application software: and general-purpose programs and special-purpose programs.

6. **General-purpose applications** are widely used in nearly all career areas. Programs include word processing documents, spreadsheets, databases, or presentation graphics.

7. **Specialized (special purpose) applications** focus on specific disciplines and occupations. These programs include graphics, audio, video, multimedia, web authoring and artificial intelligence programs.

Key Terms

application software
basic application
booting
device driver
dialog box
embedded operating system
general-purpose application
help
icons
language translator
Macintosh operating system
menus
Multiprogramming
multitasking
network operating system
operating system
presentation file
program
service program
software
special-purpose application
standalone operating system
systems
system software
utility program
virtual memory
warm boot
windows

Review Questions – Multiple Choice

1. The Operating system that is widely used in Fiji is
   a. Windows XP
   b. Windows 2000
   c. Windows 7
   d. Windows 98

2. An embedded operating system usually resides on a
   a. hard disk
   b. RAM chip
   c. ROM chip
   d. removable disk

3. A _____ combines several utility programs into a single package.
   a. utility service
   b. zipped file
   c. disk scanner
   d. utility suite

4. A program that enables you to quickly find the right word or an alternative word with a similar meaning is
   a. Thesaurus
   b. grammar checkers
   c. spelling checkers
   d. search and replace

5. One example of an **expert system** is
   a. CAD/CAM
   b. the personal computer
   c. Windows 2000
   d. troubleshooting

6. Security personnel use _____ to locate and disarm explosive devices.
   a. mobile robots
   b. industrial robots
   c. system robots
   d. perception robots

7. These programs guard your computer against malicious programs that may invade your computer system?
   a. file compression program
   b. backup program
   c. antivirus program
   d. troubleshooting program

8. Every time the computer system is started, the operating system loads these into memory
   a. driver updates
   b. device drivers
   c. device managers
   d. windows updates

9. The software that would be most suitable to include special visual, sound effects and audio as well as video clips is
   a. MS-Excel
   b. MS-Power-point
   c. MS-Word
   d. Desktop Publishing

10. The background software that loads the current program (ie,MSWORD) is called
   a. system software
   b. application software
   c. integrated software
   d. communication software

Review Questions – Short Answers

1. What is the difference between application and system software?
2. Discuss the role of device drivers.
3. Explain the difference between special-purpose programs and general-purpose programs?
4. Explain what is meant by an integrated software and give an examples.
5. What are the three areas of artificial intelligence?

Chapter 3

Computers and Information Processing

"So, what you can do in Microsoft Word is what Bill Gates has decided. What you can do in Oracle Database is what Larry Ellison and his crew have decided." ~ Ted Nelson

After completing this chapter, you will be able to:

1. Distinguish between data and information
2. Recognize the role of information in decision making.
3. Learn about the importance of databases in data management
4. Explain the fundamental concepts in a database management system (DBMS).
5. Demonstrate how to create a basic database

3.0 Introduction

There are seemingly endless amounts of information in our society. Each day, as scholars and professionals ponder new ideas and ask questions, or as events unfold, more new information is created. This information are described as processed or meaningful data, data context or any collection of words, numbers and symbols, organized so that it is meaningful to the person using it.

Have you performed any of the following tasks in the past few weeks?

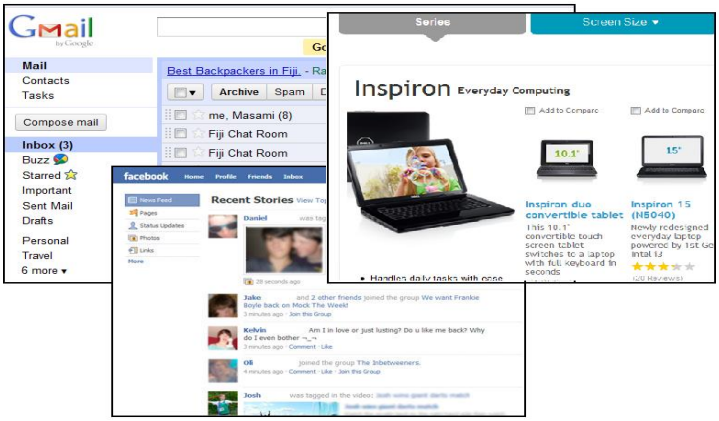


Figure 3.0 *Commonly used Web Applications*

You definitely must have used the internet to do one of the following tasks:

i. *Checked your web email (Gmail, Ymail or Hotmail)?*

ii. *Searched the Library for a book, etc.*

iii. *Used the MOE exams website for information or your results.*

iv. *Searched for products on a website*

v. *Updated your profile details on Facebook or any other social networking site.*

How do you think it is possible to meet the data requirements for each of the listed task?

All these efficient means of data access and data management has been made possible by a database. Databases are designed to offer an organized mechanism for storing, managing and retrieving information.

Discovery Learning:

What are the 2 methods a user interacts with a Database?

Some databases store confidential and important information and hence require passwords and other security features in order to access the information. Databases can operate on a standalone machine or can be accessible in a network environment such as the Fiji Governments intranet and the internet.

3.1 Data and Information

Data is raw measurements and observations in the form of text, numbers, symbols, images, and sounds which on their own have no meaning. Data may be made up of numbers called **numeric** data, text called **alpha** data or a combination of both numeric and alpha data called **alpha-numeric** data. Examples of data include

- *Height of a student, suppose 1.5m, is data;*
- *His name, suppose Josaia, is a data;*
- *His weight, suppose 67kg is a data;*
- *His hair color, suppose brown is a data; and so on.*
- *Number of hours worked, suppose 40hrs.*
- *Number of units of electricity consumed, suppose 75kw.*

Information is data organized and presented with context and meaning which can be evaluated, that is, statements can be made about it, either true or false and coherent or incoherent. Examples of Information include:

- *The average height or weight of Form 5 students, suppose 1.58m, is information;*
- *The average weight of the class, suppose 61kg, is information.*

Another example of Data vs Information:

Suppose Shameeta got 58 in Math, 76 in English, 69 in Physics and 82 in Computing Science in his Short test 1.

Total Mark = 58 + 76 + 69 + 82 = **285**(information).

Here, the individual marks are data but the total mark that calculated is information. Processing helps transform data into information.

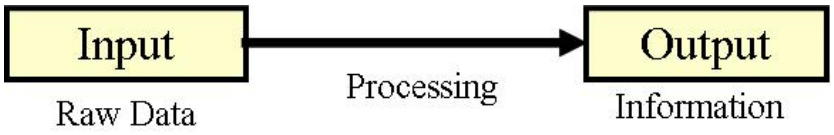


Figure 3.1a *The Input/output Process*

Data Organization

To be processed by the computer data is typically classified into groups or categories as shown in Figure 3.1b. Each group is more complex than the one before.

Figure 3.1b *Database construction*

Character is a single letter, number or special character such as punctuation marks, the $ sign etc. These are the smallest units of data representation.

A *Field* (column) contains a set of logically related characters. For example on a form, a person's first name is a field, the last name is another field, street name is another field etc.

Record (row) is a collection of logically related fields represented together. All the contents of a form concerning one particular itinerary can be called a record.

File (table) is a collection of logically related records. All forms (which are records) are kept in one location that is a file.

Database integrates data. It is defined as the collection of integrated data. By integrated we mean the data consists of logically related files (linked tables).

Characteristics of data and information	
1) Data are the raw materials (input) of information. 2) Data is a distinct piece of information. 3) Data is disorganized or unprocessed.	1) Information is the resultant (output) version of some data. 2) Information always be processed or organized. 3) Information provides context which gives meaning to data.

Table3.1c *Difference between Data and Information*

Review Exercise 3.1

Short Answer Questions

1. If you are applying for an interview, give some examples of data and information you will furnish to your potential employer. (*Differentiate between what data and information you will provide*)
2. Suppose you are using Facebook. Give some examples of data and information displayed on the social networking site.

3.2 Role of information processing in decision making

Data processing produces information which is required to form conclusions and make decisions on plans of action. Good decisions are based on sufficient and timely information. Insufficient information usually does not help in making good decisions. Because the computer can handle large amounts of data efficiently and present summaries of information effecting e.g. in the production of tables and graphs, it is considered to be essential for decision makers.

Data processing is the process of manipulating data in one or more of the following six procedures:

Collecting Data
Data may be collected from a number of sources. The most common form of data collection is data entry from source documents. For example, collecting test marks for Form six students. These marks are written on a sheet of paper and then can be entered into a database or spreadsheet for manipulation

Organizing Data
Data must be arranged into relevant categories so that the relationships between various facts can be seen as shown in Table 3.2a.

Name	Computer Mark
Anshu	78
Retasha	66
Ravneel	88

Table3.2a *Sample Student Dataset*

Combining Data
This involves the combination of similar data to reduce the number of data items to be processed. For example:

Table3.2b *Combined Student Data*

Name	Computer Sc.	Mathematics	Total Marks
Anshu	78	67	145
Retasha	66	77	143
Ravneel	88	89	177

Sorting Data
This involves the arrangement of data in the order that is needed e.g. alphabetical, ascending/descending, chronological (SEQUENCIAL) etc.

Alphabetic order

Name	Computer Sc.
Anshu	78
Ravneel	88
Retasha	66

Table3.2c *Sorted Student Data*

Manipulating Data

This involves performing calculations on the data e.g. finding the average of a set of numbers, calculating the percentage of a quantity etc.

Summarizing

Data is summarized based on the contents of the relevant categories as shown in the tables below.

Name	Computer Sc.
Anshu	78
Retasha	66
Ravneel	88

Table3.2d *Student Data*

Name	Computer Sc.	Position
Anshu	78	2
Ravneel	88	1
Retasha	66	3

Table3.2e *Summarised Student Data*

Traditionally data is processed in 2 ways:

Batch Processing

Data is collected over several hours, days or even weeks (period of time). It is then processed all at once as a batch. Example a bank credit card account which is updated monthly or weekly or a passbook savings account which is updated at the end of the day.

Real Time Processing

Occurs when data is processed at the same time the transaction occurs. For example, ATMs and online bill payment systems. Real time processing is made possible by the availability direct access storage.

Review Exercise 3.2

Short Answer Questions

a) List three applications of databases in
- Business.
- Government.
- Home.

b) Briefly explain the following application areas of databases
- Inventory
- Accounting
- Mailing List Management
- Libraries
- Banking

c) What is the difference between an operational and a transactional database?

3.3 Information Retrieval

This section will focus on databases which is the most widely used data storage, manipulation and retrieval tool.

A *database* is a collection of related files that can be retrieved when needed. It is usually stored in a secondary storage device e.g. hard disk or magnetic tape. The data in a database are accessed using an application program called a database management system (DBMS). Students normally confuse the definition of the two terms; database and Database management systems. A DBMS acts like a custodian for all the information in a database.

A database is a store of organization that can be recalled if and when required. The information in the database can be organized or manipulated to show specific patterns or to make selection of specific pieces of information

A *file* is a collection of data stored in secondary devices. It is composed of a number of related records each containing information about a particular subject e.g. a file of students' grade will contain a record for each student.

A *Record* contains a number of fields which are related. A field is usually an important feature of the subject whose data is stored in a record e.g. in the file of students' grade, a record may contain the following fields:

- Students Name
- ID No.
- Form
- Subject
- Marks Gained
- Grade

A *key field* is a field that can be used to locate one particular record. In the above example, the students' ID No. can be used as a key field because it *uniquely identifies the record*. Sometimes one key field may not be enough identify a record e.g. in airline reservations, a passenger's name is not a useful key field because there can be more than one passenger with the same name traveling on the same flight. In the same way, a flight has so many passengers on it and the same flight number goes up each day making the flight number alone and unsuitable key field. But combination of a passenger's name, flight number and date of the flight will be able to uniquely identify a record.

Discovery Learning:

How does a database increase end-user productivity?

Advantages of a Database

The four advantages of having databases are

1. Sharing
2. Security
3. Fewer Files
4. Data Integrity

Sharing in organisations, information from various departments can be readily shared with other departments and users.

Security enables user's proper and authorised access to only the kind of information they need to know. For example the payroll department may have access to employees pay rate but other departments may not. Access is restricted to authorized users only.

Fewer files mean less storage requirements. With several departments having access to one file, there are fewer files in the information systems. Excess storage (extra copies of information) called data redundancy is also reduced.

Data Integrity enables data to be updated instantaneously. Older filing systems did not have data integrity i.e. a change made in a file in one department might not be made in another copy of the file holding the same information in another department. This can cause serious problems and conflicts when data is used for important decisions affecting both departments. Data integrity is when changes made in one file to a particular data, updates are made in other files which contain the same data as well.

Disadvantages of Databases

The benefits and improvements database systems have brought about in data management is unquestionable. Database systems have enabled more sophisticated use of the data. However, apart from the many advantages of a database system, there exist some significant disadvantages such as the following.

Increased costs for maintaining database systems since it requires sophisticated hardware and software. The cost of hardware maintenance, software licensing, upgrades and skilled DB professional needed incur quite a significant cost.

Management complexity is the systems interfacing cost in terms of company's resources and culture as well as the security issues prevalent must be assessed constantly.

Maintaining currency is keeping the system current, up-to-date and personnel training costs tend to be significant.

Vendor dependence with the heavy investment related to DB systems, companies might be reluctant to change vendors. This leads to limited choice of database system components.

Frequent upgrade/replacement cycles occur when vendors frequently upgrade their products which companies have to keep par with. Some of these upgrades require hardware upgrades as well as personnel training (users and administrators) incurring additional cost.

Review Exercise 3.3

Short Answer Questions

1. Identify three situations in your community or school where people are still keeping data in traditional files systems.
   a. List two reasons why you feel a database is better suited for storing information than a traditional file system.
   b. List two reasons why the organization would still prefer to use traditional files rather than a database to store information.

3.4 Database Management System (DBMS)

A Database Management System (DBMS) is a program that manages the following five functions.

Create records A DBMS provides a structure for the data and identifies the relationships among the data.

Update records - A DBMS allows for the updating of files in the entry of new data and it sees that new data conform to the defined structures already existing.

Maintain records - A DBMS corrects errors of misspelling, omission in content eg. File name or data. It allows for changes in the structure of the database in cases where important information may have been left out or useless information included.

Provide Access to records - Data may be accessed through the use of command languages where the user types in the commands or prompting systems where the user selects commands from menus. Depending on the user's needs, information can be retrieved on various forms. Notes well the difference between the use of commands and the use of menu-driven or table-driven systems, their advantages and disadvantages.

Control the integrity and security of data- Most systems perform the following to control the integrity and security of files

a. *Maintain conformity* to the database definition eg. By comparing new entries to the database definitions to see that no errors are made.
b. *Control updating* particularly when many users use the database simultaneously. Problems may arise when two users are trying to update the same data at the same time.
c. *Assure the existence of data* in the case of technical problems which may cause the loss of data. This may require complicated techniques in restoring the data.
d. *Control access to the data* to ensure that users can only see data which they have legal access to.
e. *Resource locking* refers to maintaining a database so that its data are accurately accessed and problems which can rise from having two or more users working interactively with the data can be prevented. For example, the double booking of a plane seat etc.

Common Errors in a Database

Content Error refers to wrong input or misspelling.

Structural Error refers to error or flaws in the programming or definitions of the database.

Some common DBMS are MS Access, Oracle, MS SQL Server, MySQL and DB2.The key components of DBMS software consists of the following.

Discovery Learning:

Gives specific examples of errors that exist in a school database and justify whether they are Content or Structural errors?

Data Dictionary

A data dictionary contains a description of the structure of data (fields) used in the database. For each particular item of data (field), it defines the properties of that item for example the name of that field, the data type, the length caption etc. It also specifies the character length of a field and whether the field is a key field.

Query Language

The access to most databases is accomplished through the use of query languages. A query is simply a question that you can ask the database to provide relevant and specific information only on demand. This is an easy way to use a language understandable to most users and uses simple natural language structures like English words.

One of the most widely used query language is called the Structured Query Language (SQL). SQL uses commands such as ADD, COMPARE, and DISPLAY, SELECT, JOIN, UPDATE, etc to select relevant and specific information only.

Report Generation

This part of the DBMS software enables a user to design and format reports for presentation and decision making. Reports are normally generated from the results of the queries but organized in a very neat and presentable way so that it is easily understood by everyone reading the report.

Review Exercise 3.4

Short Answer Questions

a) What is the purpose of a DBMS and how is it different from a database?
b) What are the drawbacks of using file systems to store data?

3.5 Database Security

Since databases are a valuable asset for all organizations, security is a vital issue. One concern is that personal information about people stored in databases will be used for the wrong purpose. For example a person's credit history, medical records maybe used for hiring and making promotional decision.

Another concern is with preventing unauthorized users from gaining access to databases either directly or through a network. Another serious concern is the prevention of the intrusion of a virus. They may be introduced by end-users unknowingly or intentionally by unauthorized users. There have been numerous cases where computer viruses have been launched into databases doing un-repairable damages.

Computer viruses are hidden instructions that migrate through networks and operating systems and become embedded in different programs and databases and do harm.

Discovery Learning:

Give 2 reasons for controlling access to a database?

Security can require putting guards in a company's computer room and checking everybody's ID. Some security systems automatically check for fingerprints. Security concerns are particularly important to organizations using wide area networks. Violation of computer systems can occur both physically and without entering secured areas. See chapter 6 for more details regarding types of computer crimes.

3.6 Creating a Database

In this practical you will be introduced to the basic structure of building a database, entering and saving data that will contain records of a Student database.
A database is like a huge electronic filing systems that contains large data collected from employees, students, clients, inventory and others. Microsoft Access allows you to design and create an electronic filing system to keep all the records of individual and any other useful information for later retrieval and editing of important data/information.

Terms to Learn	**Action/Meaning**
Database	Collection of tables with related information.
Table	A Group of related data organized in fields (columns) and record (rows).
Record	A group of related fields.
Field	Contain particular data that is being recognized by a unique field name, such as "Employee Id Number".

Table 3.6a *Key terms to learn*

Before you start or launch Microsoft Access you need to create a new folder inside your My Documents folder and name it ***Lab Chapter 3***. You will save your database files inside this folder.

You are now ready to start or launch the Microsoft Access application.

Following these steps:

1. On your desktop locate and double click the Microsoft Access icon, or
   Click the Start button from the task bar → All Programs → Microsoft Office then click on Microsoft Office Access 2007. See Figure 3.6.1 below.

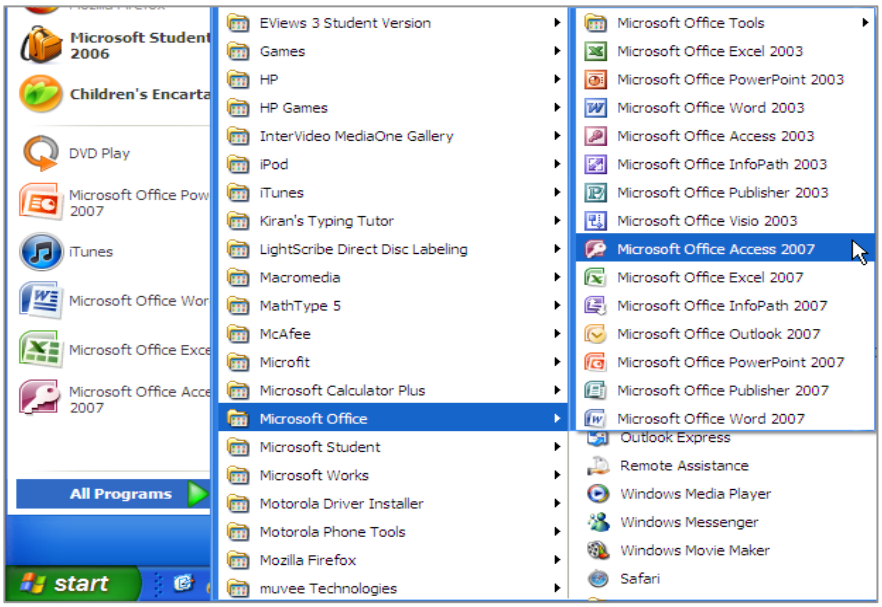


Figure 3.6.1 *Launching MS Access*

2. The first window you will see is the **Getting Started with Microsoft Office Access screen**. Figure 3.6.2 below shows some of the details.

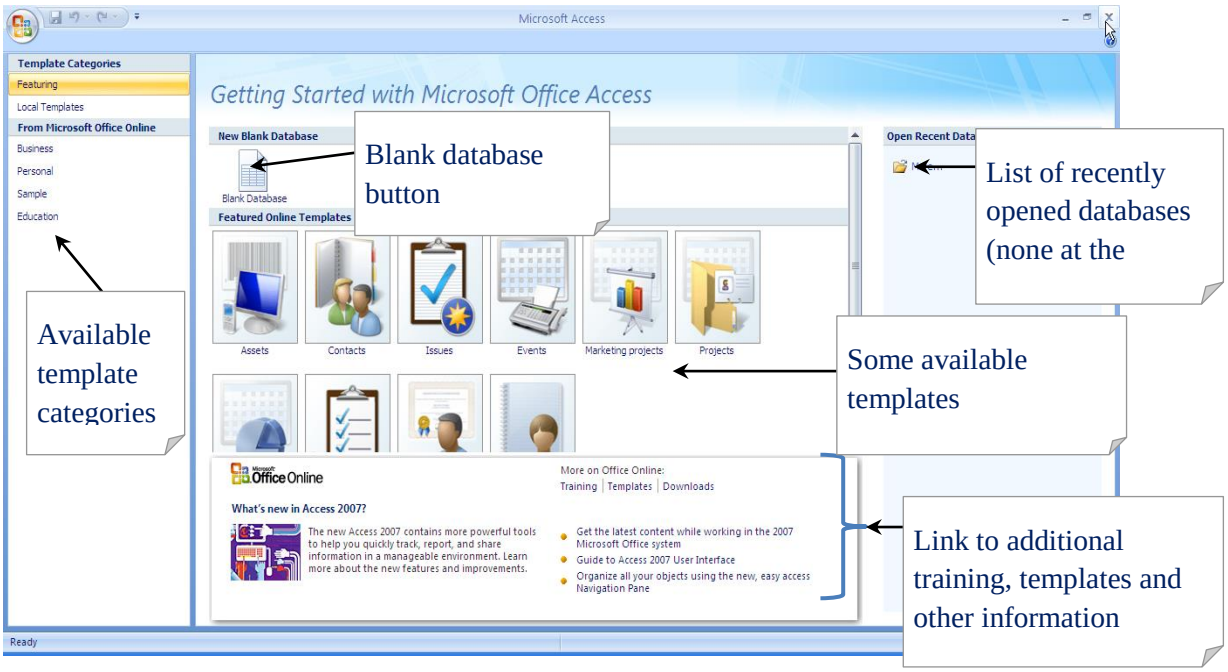


Figure 3.6.2 *Getting Started with Microsoft Office screen*

Creating a Database

In Access, all **tables**, **reports**, **forms**, and **queries** that you create are stored in a single file called a database. So you create a database before creating these objects.

1. To Create a Database using the Blank Database option**,** click on the **Blank Database button**. You must know the tables and fields you want in your database.
2. To Create a Database using a Template, click the template you wish to use. If template is not visible, double-click on an appropriate link in the **Template Categories pane** to display the desired template.
    a. Enter a file name (or accept the suggested file name) and select a location for the database. In this case save to the ***Lab Chapter 3*** folder.
    b. Click the Create button to create the database or the Download button to download the database and create a database, if necessary.

Planning your Database structure

Before deciding to create a database, you must plan the database structure. For example, you must decide how many tables you need. You will create a database for Form 5x students. This database has only one table named Student. Now you must decide what fields that the table Student can have and the type of data it will hold (text, numbers, currency, date) and its size. Please note a real database consists of many tables and are very complicated than our simple student example.

Refer to Table 3.6b on the next page to verify the fields you will need for you Student table. You can add you own fields.

Student Table Design

Field Name	Data Type	Size	Description
Student ID	Text	9	Identification #
Last Name	Text	20	
First Name	Text	20	
Date of Birth	Date/Time	Auto	
Year Enrolled	Date/Time	Auto	Date/year joined the school
Fees Balance	Currency	Auto	Fees to be paid

Table 3.6b *Student Table Structure*

3. Because you know the table and fields you want for the Students database, click the **Blank Database button** to create a new blank database. Then follow the steps in the figures below.

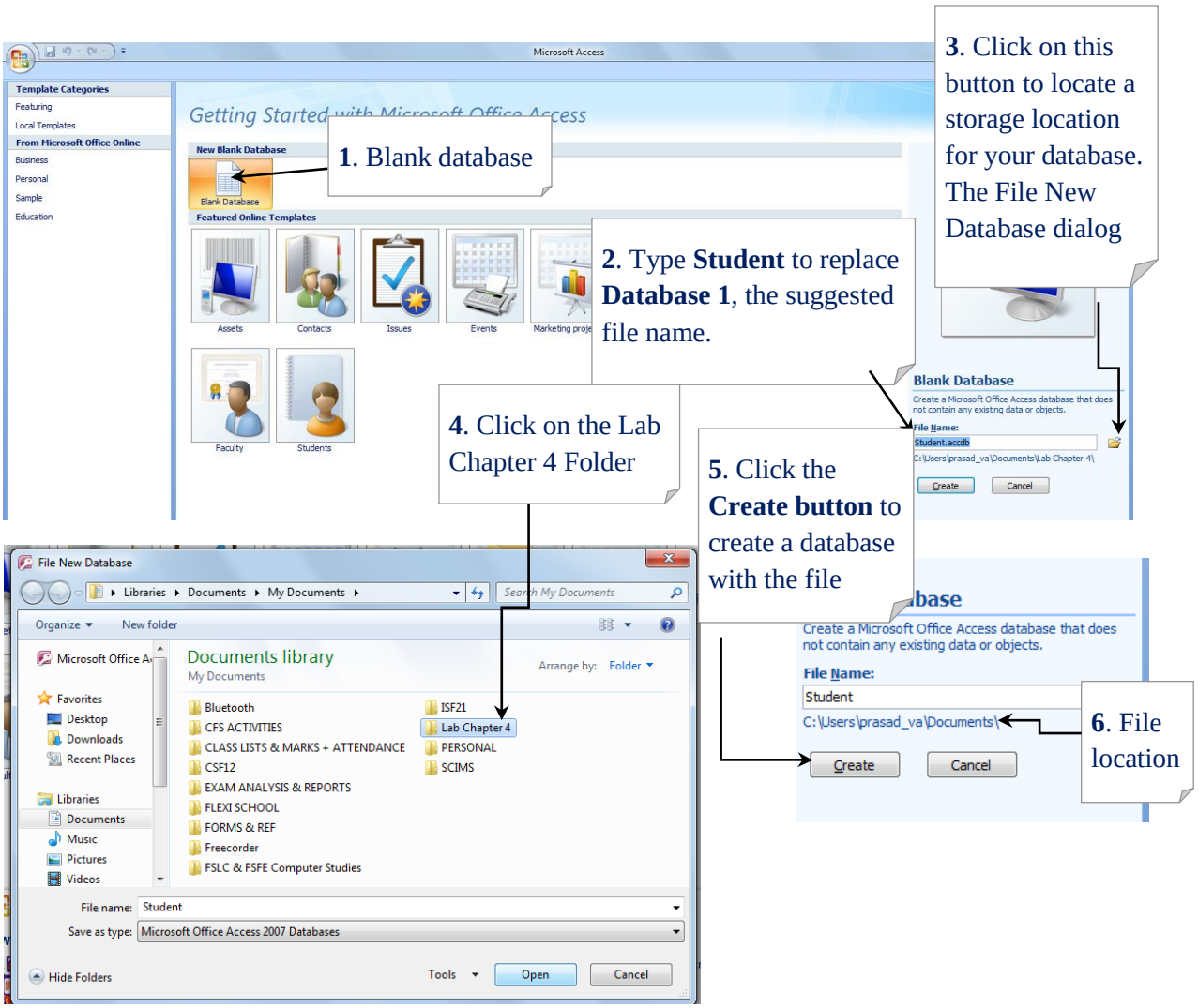


Figure3.6.3 *Creating a database*

Microsoft Office Access Window

Now the main access window appears, similar to Figure 3.6.4 below. You should now familiarize yourself with most of the items that are shown in the Access window.

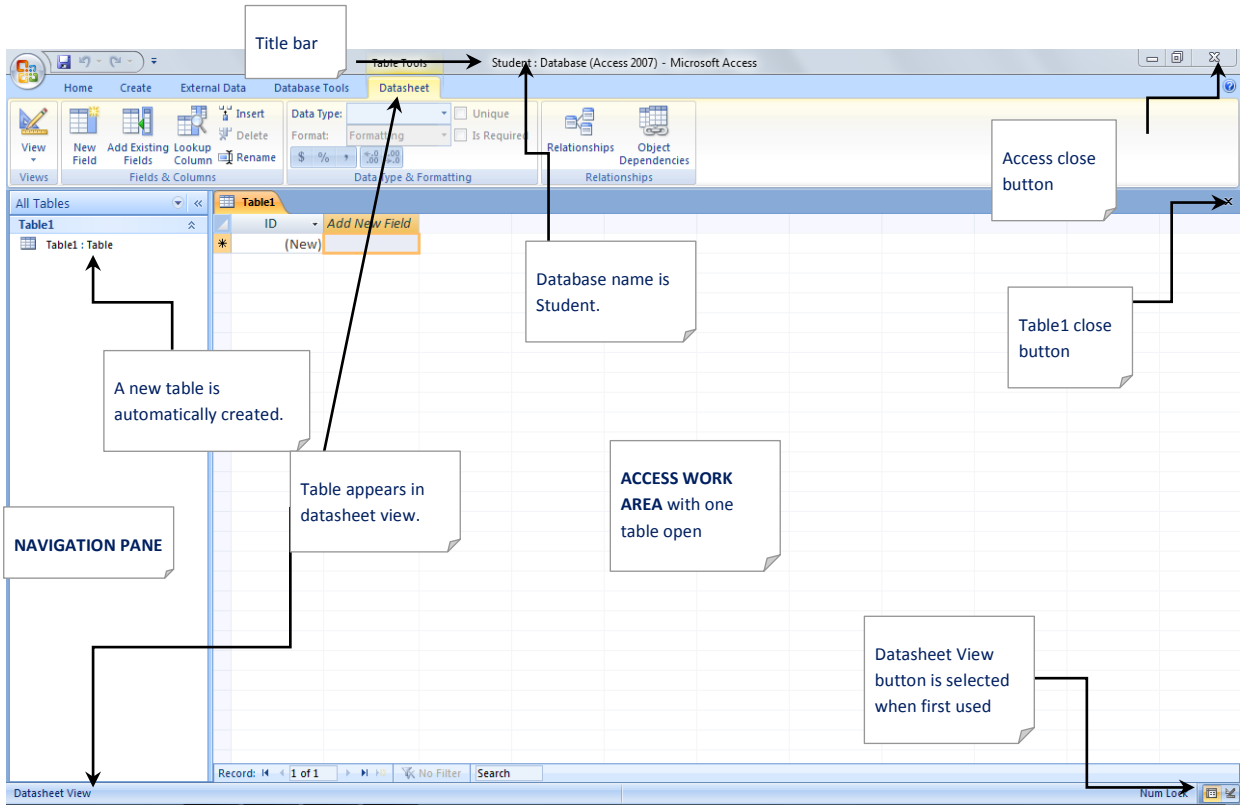


Figure 3.6.4 *Microsoft Access Window*

The Access window has some familiar components common to other Microsoft Office 2007 applications where others are unique to Access it.

To Close Table1

Click on the **Table1 Close button** to close Table1 without saving.

The main area below the **Ribbon** and above the **status bar** is split into two areas as in Figure 3.6.4 above:

1. **The Navigation Pane** – on the left, contains a list of objects (tables …etc.) you can access in the current database.
2. **Access Work Area** – the main work area for Access where you work on objects listed on the navigation pane.

Microsoft Office Access Ribbon

The **Ribbon**, as with the other Microsoft Office 2007 programs, is the **control center** in Access. The ribbon contains **tabs**, **groups**, and **commands**. Each tab surrounds a collection of groups, and each group contains related commands. There are **four top-level** tabs: **Home**, **Create**, **External Data** and **Database Tools**.

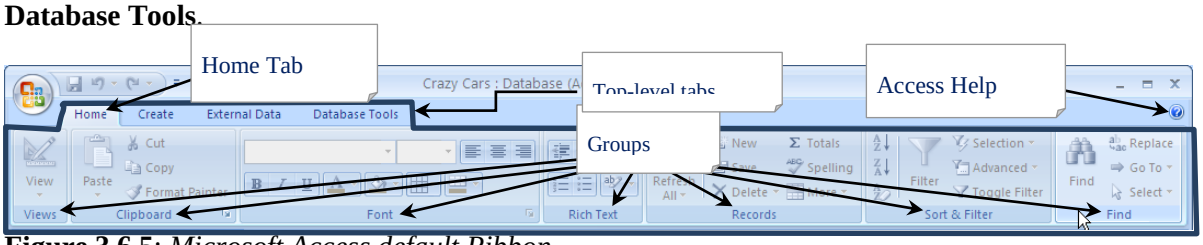


Figure 3.6.5: *Microsoft Access default Ribbon*

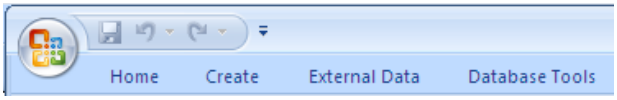


Figure 3.5.6 *Microsoft Access minimized Ribbon*

Getting On-Screen Help

Access provides an easy access to information and help.
Do the following steps:

1. Click on the **Help** button, , just below the Close button. See Figure 3.5.7 previous page.
2. **Access Help** dialog box opens.
3. To search for help, you can type keyword or phrase on topics you need help in and then click the Search button, or you can Browse Access Help major topics.

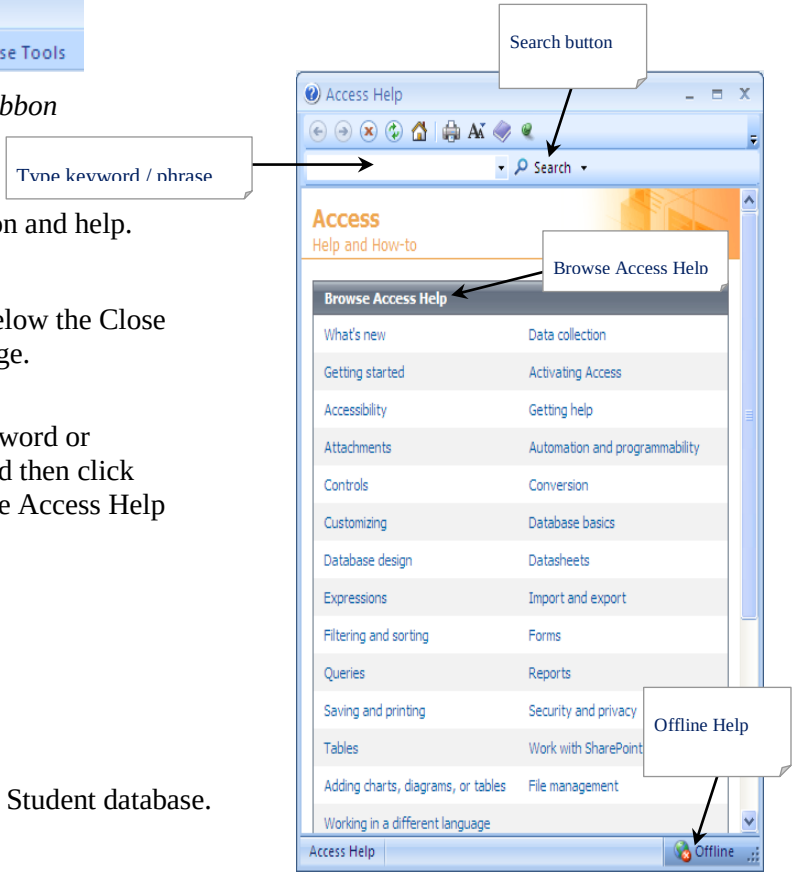


Figure 3.5.7 *Microsoft Access Help*

To Create a New Table

We now want to create the only table for our Student database.
Do the following steps:

1. Click on **Create** tab to open.
2. On the **Tables** group, click **Table Design** button.

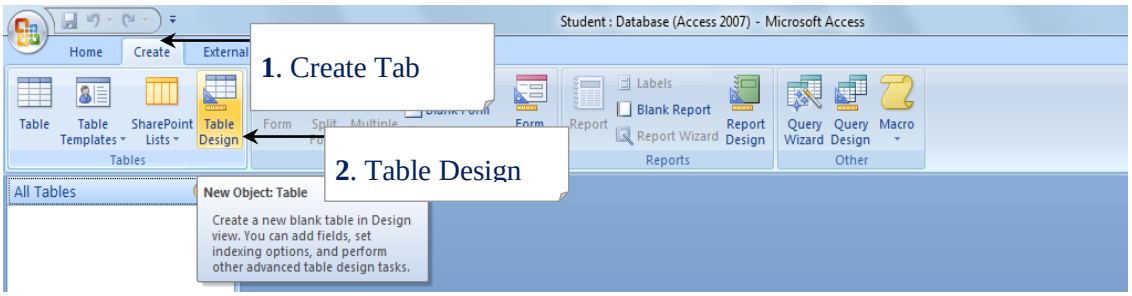


Figure 3.5.8 *Create a Table in Design View*

3. A new Table in Design View will open in Access Work Area.

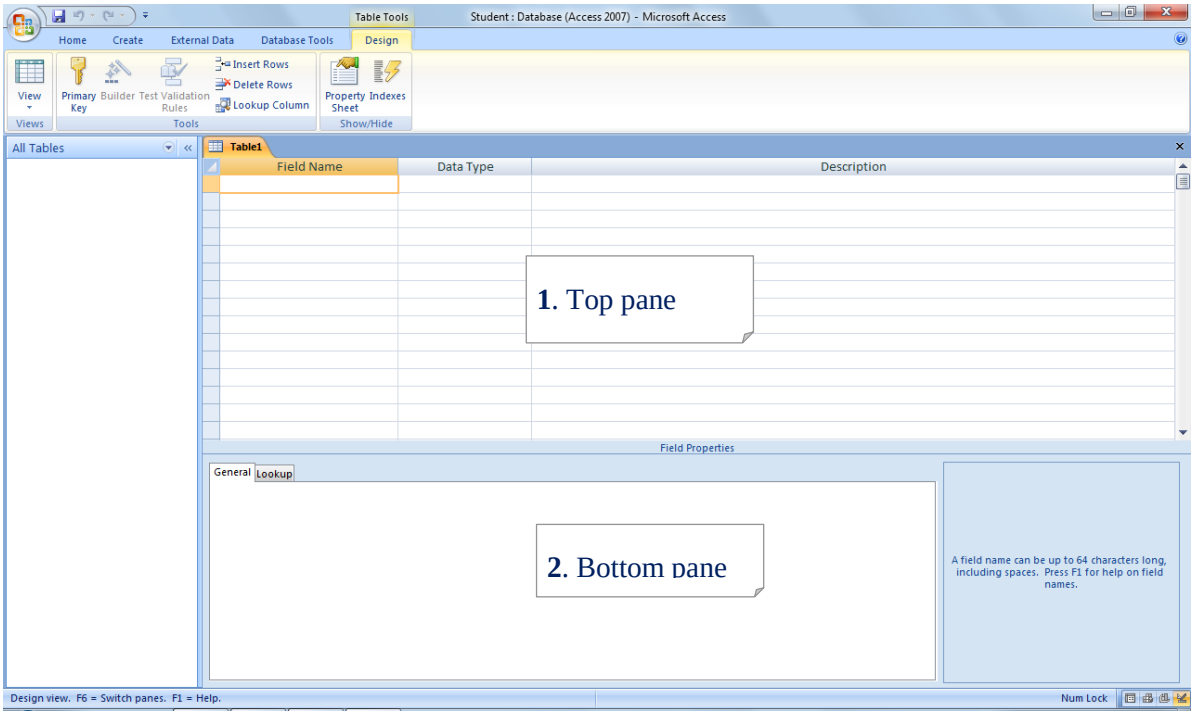


Figure 3.6.9 *New Table in Design View*

Table in Design View

Design View allows you to define the fields in the table before adding any data to the datasheet.

Terms to Learn	Action/Meaning
Top pane	Enter field name, data type and field description.
Bottom pane	Specifying field properties.
F6	Switch between panes.

Table 3.6c *Terms To Learn*

Enter the information in the Student table as shown in Table 3.6b, in the Table Design by following the steps below. Figure 3.6.10 below shows the completed table being entered.

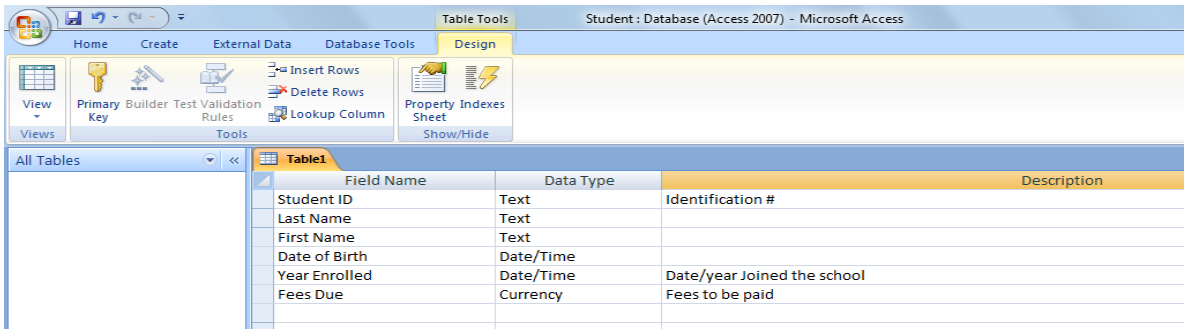


Figure 3.6.10 ***Student Table data entry in Design View***

Do the following steps

1. Type a **Field Name** and then press **ENTER** key.
   The insertion point moves to the **Data Type** field.
2. Click the dropdown **arrow** and select the required data type

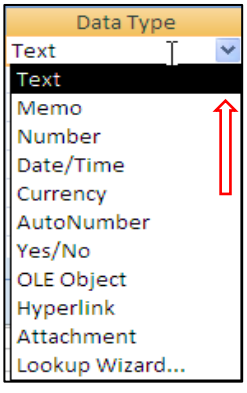


Figure 3.6.11
Access Data Types

from the list then press **ENTER** key.

3. On the **Description** field type an appropriate description. Press **ENTER** key to move to the Field Name.
4. Repeat steps 1 to 3 to enter the information about first 3 fields: **Student ID, Last Name, First Name**.
5. For the last field, **Date of Birth** and **Year Enrolled**, steps 1 and 3 are as before, but for step 2 after selecting **Date/Time** for the Data type, press F6 to move to the bottom pane.
6. Selecting the **General** tab, and on the **Format** property, click on the down arrow.
7. Click on the drop down arrow list in the **Format** row. There are options available to choose from as shown in Figure 3.6.12 below.
8. Click on the **Short Date** option in the list.

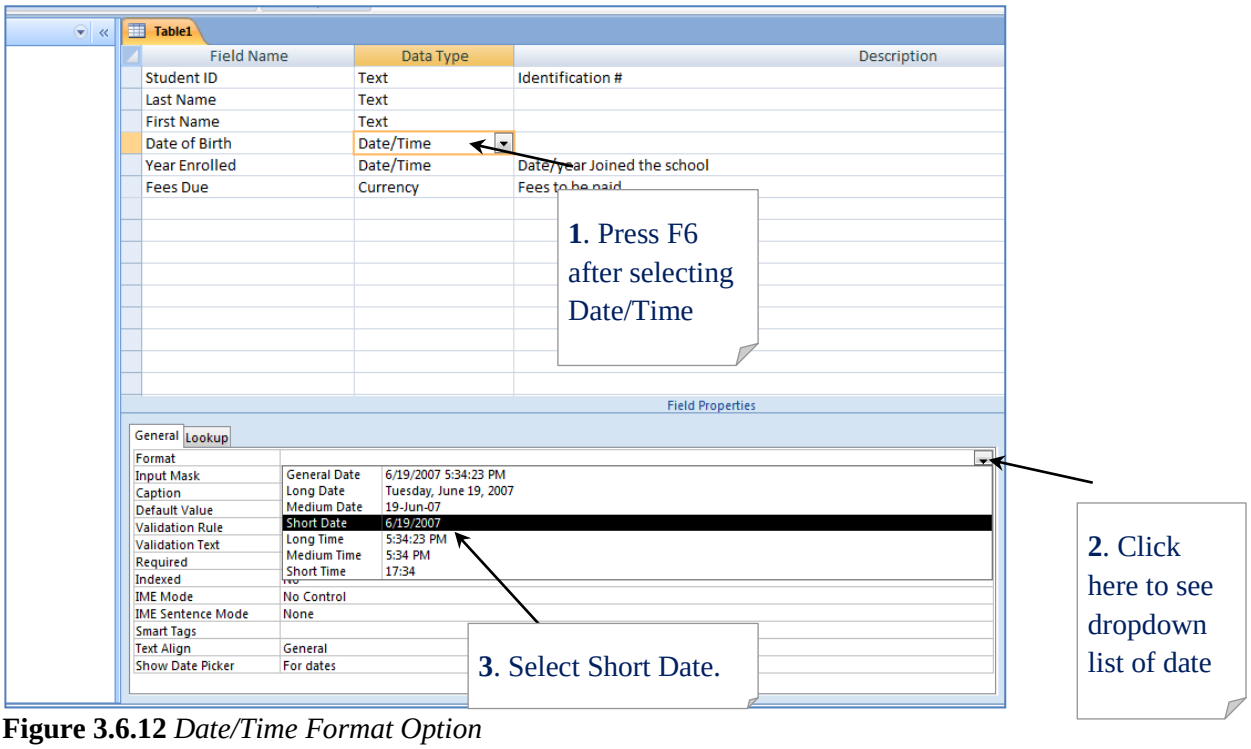


Figure 3.6.12 *Date/Time Format Option*

The table below lists some of the properties that can be set for a particular field.

Terms to Learn	Action/Meaning
Validity Checks	Controlling the appearance and validity of the data.
Input Mask	A format for all data to be entered.
Default Value	A value that is provided by the computer.
Validation Rule	A rule that limits the values being entered.
Required	Data or value that must be entered into this field.
Primary key	Uniquely identifies each record.

Table 3.6d *Terms to Learn*

Make further Settings to some Field

We want to ensure the user will enter a value for the Student ID field and restrict the size to 9.

Do the following steps:

1. Click the **Student ID** field
2. On the bottom pane, under the name.**General** tab, click the **Field Size** property and change the value from 255 to 9.
3. An on the **Required** property, click the drop arrow.
4. Click **Yes** to change Required property value from **No** to **Yes**. Your screen should look similar to Figure 3.6.13 below.
5. Do steps 1 – 4 for the Last Name and First Name fields as well but for step 2, set the field size to **20**.

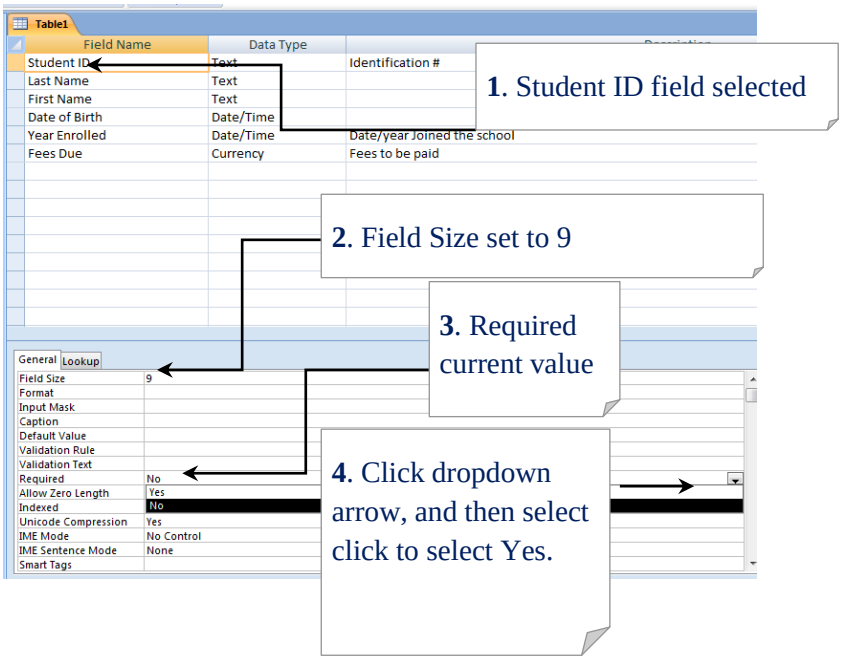


Figure 3.6.13 *Field size property set to 9, Required property Yes*

We also want to set validation rule of the Fees due to $0.00 or more.
Do the following steps:

1. Click on the **Fees Due** field name.
2. Go to the bottom pane, under the General tab, click the **Validation Rule** property field.
3. Type **>=0**
4. Click the **Validation Text** property field.
5. Type **Fees Due cannot be below $0.00**

This validation checks that the Feed Due cannot be less than $0.00. Your screen should be similar to Figure 3.6.14 right.

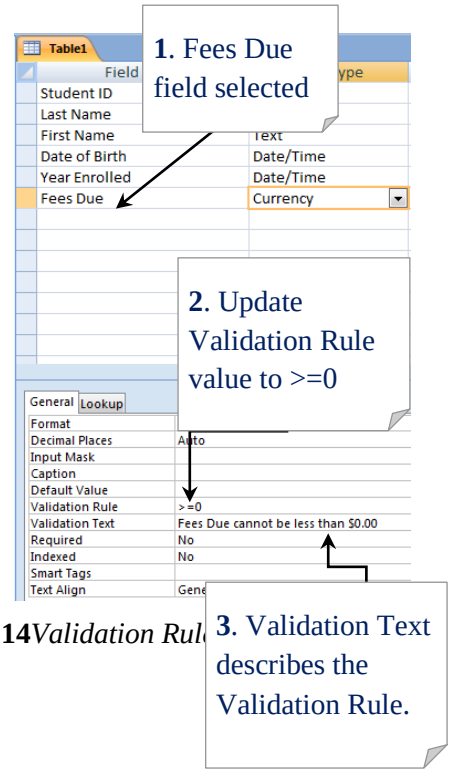


Figure 3.6.14*Validation Rul*

Saving the Student Table

You must save your table for later retrieval of data.

Do the following steps

1. Click the **Save** button on the **Quick Access Toolbar**. A **Save As** dialog box appears as shown in Figure 3.6.15 below.

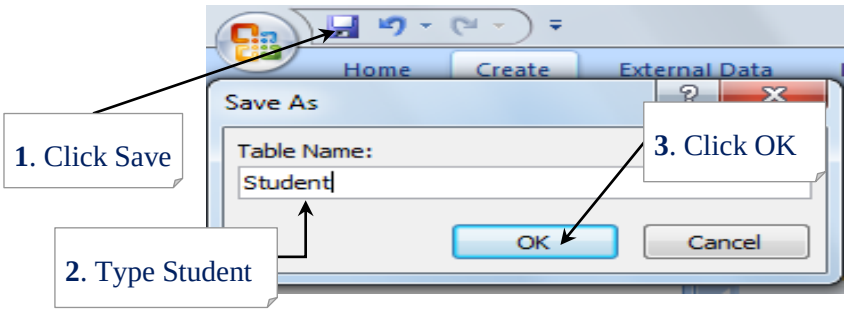


Figure 3.6.15 *Save As dialog box*

2. Type **Student** and the click **OK** button to complete.
3. A **Microsoft Office Access** message box appears, warning that your database has no primary key.

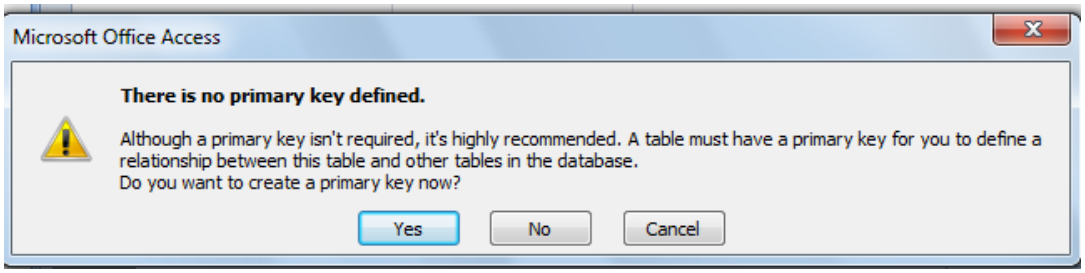


Figure 3.6.16 *Primary key warning*

4. If you click the **Yes** button. Microsoft Access **saves** the Cars table and automatically **creates** a primary key called **ID** and assigned a **Data Type** of **AutoNumber**.

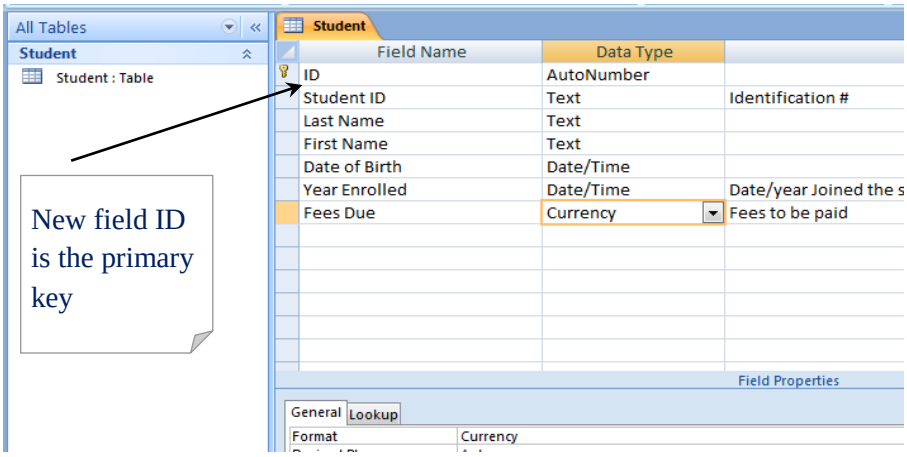


Figure 3.6.17 *Primary key created automatically*

If you click the **No** button in step 3, Cars table will be saved **without** a primary key. So click the **Cancel** button and create your own primary key.

We want the Student ID field to be used to uniquely identify each car so we make **Student ID** the primary key. It is important that you define or create a primary key for every table in your database. The primary key can be made up of one or more fields.

5. Click on **Student ID** to be selected.
6. Click on the **Primary Key** button under the **Design** tab, **Tools** group.
7. The **Primary Key** icon or symbol appears next to the **Student ID** field name. This implies that Student ID is now the primary key.

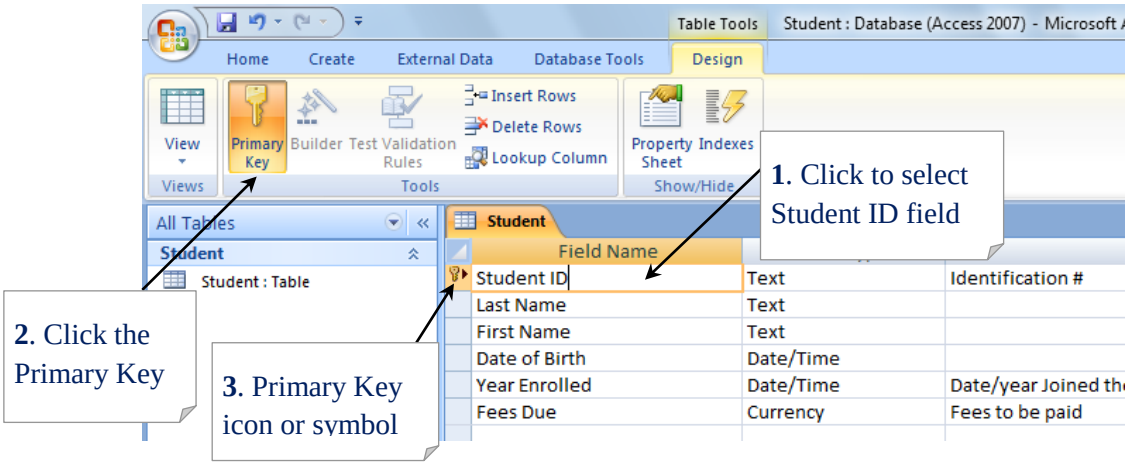


Figure 3.6.18 *Creating the primary key for the Student table*

8. Repeat steps 1 and 2 in the previous page to complete saving the **Student** table. Student table will appear on the Navigation pane.
9. Click on **Close Student** button to close the Student table.
10. Now click the **Office** button to open the Office **menu**, and then click on the **Exit Access** button to exit Access.

Now you are ready to create databases consisting of at least one table.

Ask your teacher to guide you through the following processes

1. You can also enter data in the table using the form. Ask you teacher to show how to create a form using the Wizard to entering data instead of using the datasheet.
2. Next ask your teacher to show you how to create queries.
   These queries form an integral part of any database. You can design queries to extract the relevant and specific data only especially if your database is very big. You must design queries in the design view and make sure not to use the wizard this time.
   Note: Queries are named according to what your query is. For example if you want to extract the names of students from your Student table those who owe more than $100 fees, then your query should be named as "*Students owing more than One Hundred dollars fees*".
3. The final part is for you to be able to present your queries in a presentable way. We use reports to do this. Ask your teacher to show how to create reports using the wizard.
   Note: reports are generated mostly on Queries and named accordingly.

3.7 Summary

1. Databases are designed to offer an organized mechanism for storing, managing and retrieving information.
2. Data is raw measurements and observations in the form of text, numbers, symbols, images, and sounds which on their own have no meaning.
3. Information is data organised and presented with context and meaning which can be evaluated
4. Data processing produces information which is required to form conclusions and make decisions on plans of action.
5. A database is a collection of related files that can be retrieved when needed.
6. Resource locking refers to maintaining a database so that its data are accurately accessed and avoid problems which can arise from having two or more users working simultaneously with the data.
7. Structured Query language (SQL) is used to select information or records from a relational database.
8. Database security concerns the use of a broad range of information security controls to protect databases against compromises of their confidentiality, integrity and availability

Key Terms

data	database
DBMS	SQL
record	resource locking
data integrity	batch processing
real-time processing	information
field	data dictionary

Review Questions – Multiple Choice

1. Numbers, pictures or words without context are known as?
   a. Data
   b. Information
   c. Knowledge
   d. Communication

2. Which of the following is correct?
   a. information leads to data, and data leads to knowledge
   b. data leads to information, and information leads to knowledge.
   c. knowledge leads to information, and information leads to data
   d. data leads to knowledge and knowledge leads to information

3. In a database of a newspaper, journal or magazine articles, each record represents:
   a. one magazine, journal or newspaper
   b. one author
   c. one article from a magazine, journal or newspaper
   d. all of the above

4. You are making your own database so you can organize information about your 'Top 100' movies. You want to include information like Title, Actor(s), Director, Year, Genre, etc. Each record in your database will represent:
   a. an actor
   b. a director
   c. a year
   d. a movie

5. A database program replaces what piece of office equipment
   a. typewriter
   b. photocopier
   c. FAX machine
   d. filing cabinet

6. Database Management System(DBMS) is/are

   a. Computer Programming Language
   b. Collection of interrelated data
   c. Query Language to access a database.
   d. DBMS provides an environment that is both convenient and efficient to use.

7. John is working in the customer table and needs to know what customers are located in Florida. To find the information he would ____.
   a. create a new table
   b. create a new query
   c. create a new form
   d. utilize the Database Wizard

Review Questions – Short Answers

1. Differentiate between batch processing and real-time processing. Give examples to support your answer.
2. What are the different types of file organization?
3. List six (6) procedures that are usually involved in information processing?
4. What is a key-field used for in a data table?
5. Outline the role of a Database Administrator.
6. Database and data management are at a turning point. Among the drivers are changes in architecture like cloud computing and the needs to deal with large amounts of data. What is cloud computing and how has it changed data storage and data management?

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