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DEPARTMENT OF INFORMATION TECHNOLOGY

COURSE CODE: BIT 1105

**COURSE TITLE: COMPUTER
ARCHITECTURE**

*Instructional Manual for BBIT – Distance
Learning*

TABLE OF CONTENTS

COURSE OUTLINE	5
CHAPTER ONE: COMPUTER ARCHITECTURE.....	7
INTRODUCTION TO COMPUTERS	8
1.1. HISTORY OF COMPUTERS	8
1.2. GENERATION OF COMPUTERS	8
1.2.1 Computer generations	8
1.3. CHARACTERISTICS OF COMPUTERS	10
1.4. BASIC COMPUTER CONCEPTS.....	10
1.5. TYPES OF COMPUTERS	10
1.6. SOFTWARE AND HARDWARE.....	12
1.7. CHAPTER REVIEW QUESTIONS	13
CHAPTER 2: BASIC HARDWARE UNITS OF A COMPUTER.....	14
2.1. INPUT DEVICES	14
2.2. OUTPUT DEVICE	15
2.3. CENTRAL PROCESSING UNIT (CPU)/PROCESSOR:.....	16
2.4. MAIN MEMORY:.....	17
2.5. SECONDARY STORAGE	19
2.6. COMPUTER UNITS INTERACTION DIAGRAM	20
2.7. HOW INFORMATION IS STORED IN COMPUTERS	21
2.8. SIZE.....	21
2.9. CHAPTER REVIEW QUESTIONS	21
CHAPTER THREE: INSIDE THE COMPUTER.....	23
3.1. THE PROCESSOR.....	23
3.2. CLOCK SPEED	24
3.3. REGISTERS	24
3.4. MOTHERBOARD	26
3.4.1 Form Factor	26
3.5. BUSES.....	28
3.6. WORD SIZE	30
3.7. I/O CONTROLLERS.....	30
3.8. COMMON BUS INTERFACES	30
3.9. CHAPTER REVIEW QUESTIONS	31
3.10. SUGGESTED READINGS	31
CHAPTER FOUR: FAULT DIAGNOSIS	32
4.1. POWER SUPPLY TROUBLESHOOTING.....	32
4.2. VIDEO FAILURE TROUBLESHOOTING	32
4.3. MOTHERBOARD AND CPU TROUBLESHOOTING	32
4.4. HARD DRIVE FAILURE TROUBLESHOOTING.....	33
4.5. CHAPTER REVIEW QUESTIONS	38
4.6. SUGGESTED READINGS	38
CHAPTER FIVE: INPUT AND OUTPUT DEVICES AND INTERRUPTS	39
5.1. INPUT DEVICES	39
5.2. OUTPUT DEVICE	39
5.3. INTERRUPTS.....	39
5.3.1 Types of interrupt.....	39

5.3.2	<i>Interrupt priorities</i>	40
5.3.3	<i>The Interrupt Handler</i>	40
5.4	CHAPTER REVIEW QUESTIONS	41
5.5	SUGGESTED READINGS	41
CHAPTER SIX: COMPUTER LANGUAGES.....		42
6.1	FIRST GENERATION - MACHINE LANGUAGE	42
6.2	SECOND GENERATION - ASSEMBLY LANGUAGE	42
6.3	THIRD GENERATION - HIGH LEVEL LANGUAGES.....	43
6.4	FOURTH GENERATION.....	43
6.5	FIFTH GENERATION	44
6.6	TYPES OF PROGRAM TRANSLATOR.....	44
6.7	CHAPTER REVIEW QUESTIONS	46
6.8	SUGGESTED READINGS	46
CHAPTER SEVEN: COMPUTER SOFTWARE.....		47
7.1	CLASSIFICATION OF SOFTWARE	47
7.2	SYSTEM SOFTWARE.....	48
7.3	APPLICATION SOFTWARE.....	49
7.4	OPERATING SYSTEMS CONCEPTS	51
7.5	COMPUTER USER INTERFACE.....	52
7.6	CHAPTER REVIEW QUESTIONS	54
7.7	SUGGESTED READINGS	54
CHAPTER EIGHT: DISKS AND SECONDARY STORAGE		55
8.1	THE BENEFITS OF SECONDARY STORAGE.....	55
8.2	MAGNETIC DISK STORAGE	56
8.3	DISKETTES	57
8.4	HARD DISKS.....	58
8.5	REMOVABLE STORAGE: ZIP DISKS.....	59
8.6	HARD DISKS IN GROUPS.....	59
8.8	OPTICAL DISK STORAGE.....	61
8.10	MAGNETIC TAPE STORAGE	63
8.11	BACKUP SYSTEMS.....	64
8.12	FLASH MEMORY	64
8.13	FILE ACCESS AND STORAGE METHODS	65
8.14	CHAPTER REVIEW QUESTIONS	66
8.15	SUGGESTED READINGS	66
CHAPTER NINE: HOW TO UPGRADE A SLOW COMPUTER.....		67
9.1	CHANGING THE PARTS	67
9.2	UPGRADING MEMORY	68
9.3	CHANGING A CPU	68
9.4	CHAPTER REVIEW QUESTIONS	69
9.5	SUGGESTED READINGS	69
CHAPTER TEN: INTRODUCTION TO BINARY NUMBERS		70
10.1	HOW COMPUTERS STORE NUMBERS	70
10.2	BASIC CONCEPTS BEHIND THE BINARY SYSTEM.....	71
10.3	BINARY ADDITION.....	72
10.4	BINARY MULTIPLICATION	74
10.5	BINARY DIVISION.....	74

10.6	DECIMAL TO BINARY	75
10.7	ANOTHER ALGORITHM FOR CONVERTING DECIMAL TO BINARY	77
10.8	HEXADECIMAL.....	79
10.9	CHAPTER REVIEW QUESTIONS	80
10.10	SUGGESTED READINGS	81
REVIEW QUESTIONS ANSWERS.....		82
SAMPLE QUESTION PAPERS		83

COURSE OUTLINE

BBIT 1105: COMPUTER ARCHITECTURE

Purpose of the course

To provide an in-depth presentation of computer hardware and software with more emphasis on the more technical aspects of computing such as troubleshooting and upgrading computers.

COMPUTER ARCHITECTURE - TOPICS - DETAILS

I. Introduction to Computer and its components

- A. History of computers
- B. Generations of computers
- C. Characteristics of computers
- D. Types of computers
- E. Software and Hardware

II. Hardware and software

- A. Hardware: input and output devices, backup storage, central processing unit, memory (ROM, RAM).
- B. Software: Categories of software, System software, applications software, general purpose software, integrated packages and software suites.

III. Inside the computer

- A. The processor; Arithmetic and Logic Unit, Control Unit, system clock, registers
- B. The fetch execute cycle
- C. The motherboard; form factor, sockets and slots
- D. Buses; control bus, data bus, Address Bus, SCSI, EISA, MCA

IV. Fault Diagnosis

- A. Power Supply Troubleshooting
- B. Video Failure Troubleshooting
- C. Motherboard and CPU Troubleshooting
- D. Hard Drive Failure Troubleshooting

V. Input and output devices and interrupts.

- A. Output devices
- B. Input Devices
- C. Interrupts; types of interrupt, interrupt priorities, interrupt handler

VI. Computer Languages

- A. First Generation - Machine language
- B. Second generation - Assembly Language
- C. Third Generation - High Level Languages
- D. Fourth Generation
- E. Fifth Generation

VII. Software

- A. System Software
- B. Application Software; general purpose, special purpose
- C. Operating systems(OS) concepts; functions of OS, types of OS

VIII. External Storage

- A. Storage Devices
- B. Access time, block size and access speed
- C. Files – types and organization

IX. Upgrading computers

- A. Upgrading a slow computer; changing the parts
- B. Upgrading memory
- C. Upgrading the Processor

X. Knowledge of data representation

- A. number system
- B. Binary numbers; binary conversion to Denary, Binary addition, multiplication, division and subtraction
- C. Hexadecimal numbers

Main course text

Fuller F., Larson B., Computers: Understanding Technology(Second Edition)

Reference Books

- i. White R., How Computers Work (Millennium edition).
- ii. Capron H.L., Computers: Tools for information age (5th Edition).
- iii. C.S. French, Computer science (Fifth Edition)

Assessment: Examination - 70%: Coursework - 30%

CHAPTER ONE: COMPUTER ARCHITECTURE

Computer architecture or **digital computer organization** is the conceptual design and fundamental operational structure of a computer system. It is a blueprint and functional description of requirements and design implementations for the various parts of a computer, focusing largely on the way by which the central processing unit (CPU) performs internally and accesses addresses in memory.

It may also be defined as the science and art of selecting and interconnecting hardware components to create computers that meet functional, performance and cost goals.

Computer architecture comprises at least three main subcategories:

- Instruction set architecture, or ISA, is the abstract image of a computing system that is seen by a machine language (or assembly language) programmer, including the instruction set, word size, memory address modes, processor registers, and address and data formats.
- Microarchitecture, also known as Computer organization is a lower level, more concrete and detailed, description of the system that involves how the constituent parts of the system are interconnected and how they interoperate in order to implement the ISA. The size of a computer's cache for instance, is an organizational issue that generally has nothing to do with the ISA.
- *System Design* which includes all of the other hardware components within a computing system such as:
 1. System interconnects such as computer buses and switches
 2. Memory controllers and hierarchies
 3. CPU off-load mechanisms such as direct memory access (DMA)
 4. Issues like multiprocessing.

INTRODUCTION TO COMPUTERS

Objectives

At the end of the chapter the learner shall be able to;

- i. Explain the evolution of computing technology and the technological advancement in computer architecture to current technologies
- ii. Explain the characteristics of computers and how they are different from humans.
- iii. Explain the different types of computers categorized based on size, price and capabilities
- iv. Explain the fundamental difference between computer hardware and software

1.1. History of Computers

When the human race started doing some trade, it felt a need for a calculating device. The first calculating device, which was used 2000 years ago was called **abacus** and the improvements in the calculating device in that age were slow. The next change came after about 1600 years. Following this, the changes were frequent and the mechanical desk calculator was developed around 1800 A.D.

In 1833, Prof. Charles Babbage, the father of the computer, developed a machine called **analytical engine** which was the base for the modern digital computer.

1.2 Generation of Computers

1.2.1 Computer generations

First generation computers (1946-1956)

They made use of vacuum tubes to store and process information. The tubes consumed a lot of power and generated a lot of heat (overheating). They were huge in size and occupy a room. They used magnetic tape. Storage capacity was very low i.e. 2kb and speed of processing was also very low. First machine in this category was ENIAC (electronic discrete variable automatic computer) and later came UNIVAC (universal automatic computers). These computers were mostly computational machines. Their input/output capabilities were usually limited to the keyboard and or punched card input and printer and or punched card output. The speed of these machines was described in milliseconds (1/1000 of a second)

Second generation computers (1957-1967)

These computers used transistors after invention of transistors. The transistor is smaller cheaper and produced less heat than vacuum tubes and consumed less power. The cost of computers decreased and the speed increased. The second generation saw the introduction of more complex ALU and CPU, the use of high level languages and provision of system software with the computer. Data access time was measured in micro-seconds. Removable disk storage units were

developed for use on these machines. The speed of these machines was described in microseconds (1/1000, 000 of a second). These computers had programming languages whose vocabularies are close to the human natural language, English language.

Third generation computers (1965-1980)

Introduced the use of very small electronic circuit called integrated circuits (IC) by combining several transistors together between 3 transistors to make 1 IC. With IC you can house thousands of transistors in one IC. This change further decreased the size, heat output and the maintenance complexity of the computers while increasing its speed. The small circuitry that resulted improved the processing speed i.e. 10 times the past. The speed of these machines was described in nanoseconds (1/1,000,000,000 of a second). They have higher main memory capacity, reliable and increased processing power (have the capability of holding more than one set of instructions and operate on them) than the second generation computers. Invention of IC revolutionised electronics and started the error of micro-electronics. The IBM 360 is an example of third generation computers.

Fourth generation computers (1980s)

Use large scale integration circuits which housed hundreds of transistors and very large IC which are between 200,000 to 400, 000 in one IC. Memory used includes magnetic disc and optical disc. Memory size expanded up to several MB and speed was 10 times faster. This generation marked the origin of mini computers in use today.

Fifth generation computers (1990-current)

The design of these computers was based on VLSI (very large scale integration) technology, the micro chip technology that gave rise to the smaller computers known as the micro computers in use today. These computers are used in networking .examples of micro computers are IBM PCs BBC micro etc. the micro computers are usually described as PCs or stand alone or desktop computers because they were designed primarily to serve single person at a time. The fifth generation is still a state of the art technology that relies on predictions and further technological refinements.

Summary

Research shows that the trend in computer technology revolution is that there is;

- o Continual decrease in computer size
- o Improved speed and power processing
- o Decrease in computers and the related facilities cost

- o Number of components in computer per circuit (IC) greatly increased over 500,000 physical elements e.g. transistors, capacities, diodes etc per chip(IC).

1.3 Characteristics of Computers

1. **Speed** – a computer is a very fast machine. It can perform in a very few seconds the amount of work that a human being can do in a year if he/she worked day and night doing nothing else.
2. **Accuracy** – the computer accuracy is consistently high.
3. **Diligence** – computers are free from monotony, tiredness and lack of concentration etc. It can therefore work for hours without creating an error. For example if 10 million calculations are to be done, a computer will do the tenth million calculations with exactly the same speed and accuracy as the first one.
4. **Versatility** – a computer performs various tasks with ease. I.e. it can search for a letter, the next moment prepare an electricity bill, and write a report next then do an arithmetic calculation all with ease.
5. **Power of remembering** – a computer can store and recall any information due to its secondary storage capability.
6. **No intelligence Quotient (IQ)** – a computer cannot make its own decisions and has to be instructed on what to do.
7. **No feelings** – computers are devoid of emotions. They have no feelings or instincts and none possesses the equivalent of a human heart and soul.

1.4 Basic Computer Concepts

Definition of a computer

A computer is an electronic device capable of executing instructions, developed based on algorithms stored in its memory, to process data fed to it and produce the required results faster than human beings.

The definition from the [Merriam-Webster Dictionary](#) :

"one that computes; *specifically* : a programmable electronic device that can store, retrieve, and process data"

1.5 Types of Computers

What different types of computers are there ?

This categories are based on **size, price and capabilities**

Super computers

They are very large in size and use multiple processors and superior technology. Super computers are biggest in size, the most expensive in price than any other is classified and known as super computer. It can process trillions of instructions in seconds. This computer is not used as a PC in a home neither by a student in a college. Governments specially use this type of computer for their different calculations and heavy jobs. Different industries also use this huge computer for designing their products.

In most of the Hollywood's movies it is used for animation purposes. This kind of computer is also helpful for forecasting weather reports worldwide. They are known for von Newman's design i.e. multiple processor system with parallel processing. In such a system a task is broken down and shared among processes for faster execution. They are used for complex tasks requiring a lot of computational power.

Mainframe computers

A mainframe is another giant computer after the super computer and can also process millions of instruction per second and capable of accessing billions of data .They are physically very large in size with very high capacity of main memory. This computer is commonly used in big hospitals, air line reservations companies, and many other huge companies prefer mainframe because of its capability of retrieving data on a huge basis. They can be linked to smaller computers and handle hundreds of users they are also used in space exploitation. The term mainframe was mainly used for earliest computers as they were big in size though today the term is used to refer to large computers. A large number of peripherals can be attached to them. They are expensive to install.

Minicomputers

They are smaller than the main frame but bigger than minicomputers. They support concurrent users. They can be used as servers in companies. They are slower and less costly compared to mainframe computers but more powerful, reliable and expensive than micro computers.

Micro computers

They are of advanced technology i.e. the micro era based on large scale integration that confines several physical components per small elements thumb size IC, hence the size reduced. It is the smallest of the three computers. They are usually called personal computers since they are designed to be used by individuals. The micro chip technology has enabled reduction of size of

computers. Microcomputers can be a desktop, laptop, notebooks, or even palmtop

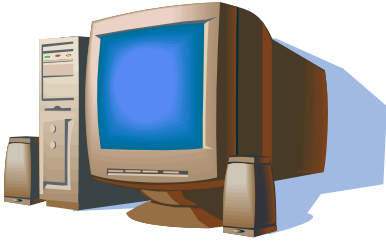
- o **Notebook computer** An extremely lightweight personal computer. Notebook computers typically weigh less than 6 pounds and are small enough to fit easily in a briefcase. Aside from size and portability,. Notebook computers use a variety of techniques, known as *flat-panel technologies*, to produce a lightweight and non-bulky display screen.
- o **Desktop Computer** is an independent personal computer that is made especially for use on a desk in an office or home. The term is used mainly to distinguish this type of personal computer from portable computers and laptops, but also to distinguish other types of computers like the server or mainframe.
- o **Laptop** A small portable computer light enough to carry comfortably, with a flat screen and keyboard that fold together. Laptops are battery-operated, often have a thin, backlit or sidelit LCD display screen, and some models can even mate with a docking station to perform as a full-sized desktop system back at the office. Advances in battery technology allow laptop computers to run for many hours between charges, and some models have a set of business applications built into ROM. Today's high-end (Advanced) laptops provide all the capabilities of most desktop computers.
- o **Palmtop** A small computer that literally fits in your palm. Compared to full-size computers, palmtops are severely limited, but they are practical for certain functions such as phone books and calendars. Palmtops that use a pen rather than a keyboard for input are often called *hand-held computers* or *PDAs*. Because of their small size, most palmtop computers do not include disk drives. However, many contain PCMCIA slots in which you can insert disk drives, modems, memory, and other devices. Nowadays palmtops are being integrated into the mobile phones as multipurpose devices.

1.6 Software and Hardware

A computer has to main components;

- I. Hardware
- II. Software

Computer hardware refers to the physical components of a computer such as the monitor, Keyboard, Mouse, system unit etc shown in the diagram below.



Computer software

A set of programs associated with the operation of a computer

The two components (hardware, software) will be discussed later in other chapters.

1.7 Chapter Review Questions

1. The second generation of computers used
(a) Vacuum tubes (b) Capacitors (c) Transistors (d) Integrated circuits
2. The third generation of computers used
(a) Vacuum tubes (b) Capacitors (c) Transistors (d) Integrated circuits
3. The **analytical engine** was the vase for the modern digital computer in which year was is developed?
(a) 1833 (b) 1933 (c) 1923 (d) 1893
4. Which one of the following types of computers is commonly used in offices
(a) Supercomputers (b) Mainframe (c) Mini computer (d) Micro computer
5. Computers have continued to decrease in size but the processing power has increased. **True or false?**

Suggested Readings

1. Fuller F., Larson B., Computers: Understanding Technology(Second Edition)
Pages 4-16

CHAPTER 2: BASIC HARDWARE UNITS OF A COMPUTER

At the end of the chapter the learner shall be able to;

- Explain the different hardware units of a computer system such as input, output, Central processing unit (CPU), main memory and secondary storage
- Explain how the different units of a computer interact with each other to give the user output
- Explain how information is stored in a computer
- Explain the different storage units of a computer such as byte, Kilobyte, megabyte, Gigabyte and Terabyte

Hardware units (Devices) of a computer can be categorized into five units;

- I. Input unit
- II. Output
- III. Central processing unit (CPU) or processor
- IV. Main Memory
- V. Secondary storage/Backing Storage

2.1 Input Devices

An input device lets you communicate with a computer. They are used to enter information and issue commands to the computer. Commands tell the computer to do something, like save the file. A keyboard, mouse, scanner, digital camera, touch pads and joystick are examples of input devices.

- o **Keyboard** Used to type data into the computer. It has special keys for giving the computer commands called command or function keys
- o **Pointing Devices** Pointing devices move some object on the screen and can do some action Mouse is a common pointing device
- o **Scanner** allows you to scan documents, pictures, or graphics and view them on the computer. You can also use software to edit the items you scan. Used to put printed pictures and text into a computer. It Converts an image into dots that the computer can understand .To scan text, optical character recognition (OCR) software is needed
- o **Digital Camera** Used to take electronic pictures of an object. The pictures taken by a digital camera can be used directly by a computer
- o **Microphone** Used to put sound into a computer. Need sound recording software
- o **Video Capture Card** Usually place inside the computer's case. Use to put video into a computer. Need a video source, either a video camera or video recorder
- o **Voice input device**-A computer I/O device in which vocal commands may be entered into a computer system.

- o **Optical character recognition (OCR)** is computer software designed to translate images of handwritten or typewritten text (usually captured by a scanner) into machine-editable text, or to translate pictures of characters into a standard encoding scheme representing them (e.g. ASCII or Unicode).
- o **Optical Mark Reader (OMR)** A special scanning device that can read carefully placed pencil marks on specially designed documents. OMR is frequently used in forms, questionnaires, and answer-sheets

2.2 Output device

An output device displays information on a screen, creates printed copies or generates sound. A monitor, printer, and speakers are examples of output devices.

- o **Monitors and Displays** Shows the processed information on a screen. A monitor uses a Picture Tube like a television with the image displayed on the front of the tube, which is called the screen.
- o **Printers** produce a hard copy. The information is printed on paper and can be used when the device is off. It is also called a printout. There different types of printers;

- **Dot-matrix printers (impact printer)**

- Uses metal pins to strike an inked ribbon to make dots on a piece of paper.
- Lowest print quality of all of the printers.
- Very low in cost per page to use.

- **Ink jet printers (non-impact printer)**

- Use drops of magnetic ink to produce dots on a page to produce text or images.
- The print quality is almost the same as a laser printer's.
- The ink is very expensive
- The ink is water soluble and will run if the paper gets wet
- Highest cost per page of all the printers
- For producing color documents, it has the highest quality at a reasonable price.

- **Laser printers (non-impact printer)**

- A laser or LEDs make dots on a light sensitive drum
- Toner (very tiny particles of plastic) stick to the drum where the dots were made
- For black and white printouts, very low cost per page
- Printout is permanent
- Color laser printers are still fairly expensive

- o **Speakers** Used to output sound
- o **LCD Projectors** Similar to monitors but projects an image on to a screen. They are mainly used for presentations.

2.3 Central Processing Unit (CPU)/Processor:

It is the main part of a computer system like the brain of a human being. It interprets the instructions in the program and executes one by one. The CPU of a microcomputer is called a microprocessor. Central Processing Unit is implemented in a single piece of silicon device known as a computer chip.

The processor and main memory of a PC are commonly held on a single board called a mother board. The processor has the following functions:

- It controls the transmission of data from input devices to memory;
- It processes the data held in main memory;
- It controls the transmission of information from main memory to output devices.

The processor contains the **control unit** and the **arithmetic/logic unit(ALU)**.

The **control unit** coordinates and controls all the operations carried out by the computer. The **control unit** operates by repeating three operations which are:

- **Fetch** – cause the next instruction to be fetched from memory;
- **Decode** – translate the program instruction into commands that the computer can process
- **Execute** – cause the instruction to be executed

The **arithmetic/logic unit(ALU)** plays two roles.

- **Arithmetic** operations – these operations are addition, subtraction, multiplication and division..
- **Logical** operations – it compares two data items to determine whether the first one is smaller than, equal to or greater than the second item.

2.4 Main Memory:

The cycle (input - processing - output) would not be possible without a holding place for the instructions and data that the processors (CPU) can easily reach. This holding place is known as memory also called main storage and is internal to the computer consisting of RAM and possibly ROM.

Random Access Memory (RAM)

- Is the basic kind of internal memory that holds data and instructions while the computer is in use.
- It can be read from and written to.
- It is called random access because the processor or computer can access any location in memory in any order as contrasted with sequential access devices which must be accessed in order.
- RAM is volatile; losing the stored information in an event of power loss, and quite expensive.

There are two basic types of RAM.

Static RAM does not need to be refreshed, which makes it faster; but it is also more expensive than dynamic RAM. **Dynamic RAM** needs to be refreshed thousands of times per second. Both types of RAM are *volatile*, meaning that they lose their contents when the power is turned off.

Over the years, newer computers have been introduced that contain faster microprocessors. To accommodate the increased speed, chip manufacturers have designed and built faster RAM chips. SDRAM (Synchronous DRAM) divides RAM into two separate memory banks to increase the processing of the memory requests. To overcome the performance limitations of SDRAM, two competing technologies have been developed. RDRAM (Rambus DRAM) involves a new memory design that achieves a higher data transfer speeds but it is expensive to manufacture. DDR SDRAM (Double Data Rate SDRAM) can transfer data twice as fast as SDRAM because it reads data twice during each clock cycle. Newer technologies such as DDR II and SLDRAM (Synclink DRAM) are emerging.

ROM (Read only memory)

- Is also random access but only for reads, once data has been written onto a ROM chip, it cannot be removed and can only be read.
- It refers to special memory used to store programs that boot the computer and perform diagnostics. Most personal computers have a small amount of ROM (a few thousand bytes).
- Retains its contents even when the computer is turned off and is therefore referred to as being *nonvolatile*.

Types of ROM

ROM: A mask programmed read only memory that can be only be produced by the manufacturer. It is designed to perform a specific function and cannot be changed. This is inflexible and so regular ROMs are only used generally for programs that are static (not changing often) and mass-produced. This product is analogous to a commercial software CD-ROM that you purchase in a store.

Programmable ROM (PROM): This is a type of ROM that can be programmed using special equipment (a PROM programmer.); it can be written to, but only once. This is useful for companies that make their own ROMs from software they write, because when they change their code they can create new PROMs without requiring expensive equipment. This is similar to the way a CD-ROM recorder works by letting you "burn" programs onto blanks once and then letting you read from them many times. In fact, programming a PROM is also called *burning*, just like burning a CD-R, and it is comparable in terms of its flexibility.

Erasable Programmable ROM (EPROM): An *EPROM* is a ROM that can be erased and reprogrammed. A little glass window is installed in the top of the ROM package, through which you can actually see the chip that holds the memory. Ultraviolet light of a specific frequency can be shined through this window for a specified period of time, which will erase the EPROM and allow it to be reprogrammed again. Obviously this is much more useful than a regular PROM, but it does require the erasing light. Continuing the "CD" analogy, this technology is analogous to a reusable CD-RW.

Electrically Alterable Read-Only Memory (EAROMs) can be modified a bit at a time, but writing is a slow process and uses non-standard voltages (usually higher voltages around 12 volts). Rewriting an EAROM is intended to be an infrequent operation - most of the time the memory is used as a ROM. EAROM may be used to store critical system setup information in a non-volatile way. For many applications, EAROM has been supplanted by CMOS RAM backed-up by a lithium battery.

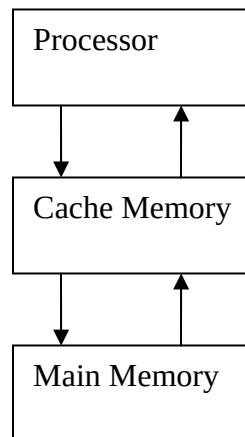
Electrically Erasable Programmable ROM (EEPROM): The next level of erasability is the *EEPROM*, which can be erased under software control. This is the most flexible type of ROM, and is now commonly used for holding BIOS programs. When you hear reference to a "flash BIOS" or doing a BIOS upgrade by "flashing", this refers to reprogramming the BIOS EEPROM with a special software program. Here we are blurring the line a bit between what "read-only" really means, but remember that this rewriting is done maybe once a year or so,

compared to real read-write memory (RAM) where rewriting is done often many times per second!

Cache memory

After **Random Access Memory (RAM)**

Cache memory is a type of very fast memory that is used to improve the speed of a computer doubling it in some cases. It acts as an intermediate store between the CPU and the main memory, and works by storing the most frequently or recently used instructions and data so that it will be very fast to retrieve them again.

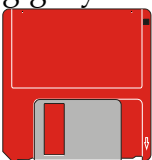


2.5 Secondary storage

These are devices which are used to store huge information for future use. This is mostly hard drives and removable media such as floppy disks, optical media (CD ROM) etc.

Hard Drive:

Floppy Disk: Floppy disks allow information to be transported easily from one computer to another they have limited storage capacity, generally 1.44 MB. Saving and retrieving information from a floppy disk is slower than on a hard drive. They are more susceptible to physical damage and viruses than the hard drive. The size of a hard drive is usually expressed in terms of megabytes and gigabytes.



Compact Disk Read Only Memory (CD ROM): CD ROMs are read only storage medium. Typically, a CD ROM holds up to 650 MB of information. While information retrieval is faster than from a floppy disk, it is still not as fast as from the hard drive.

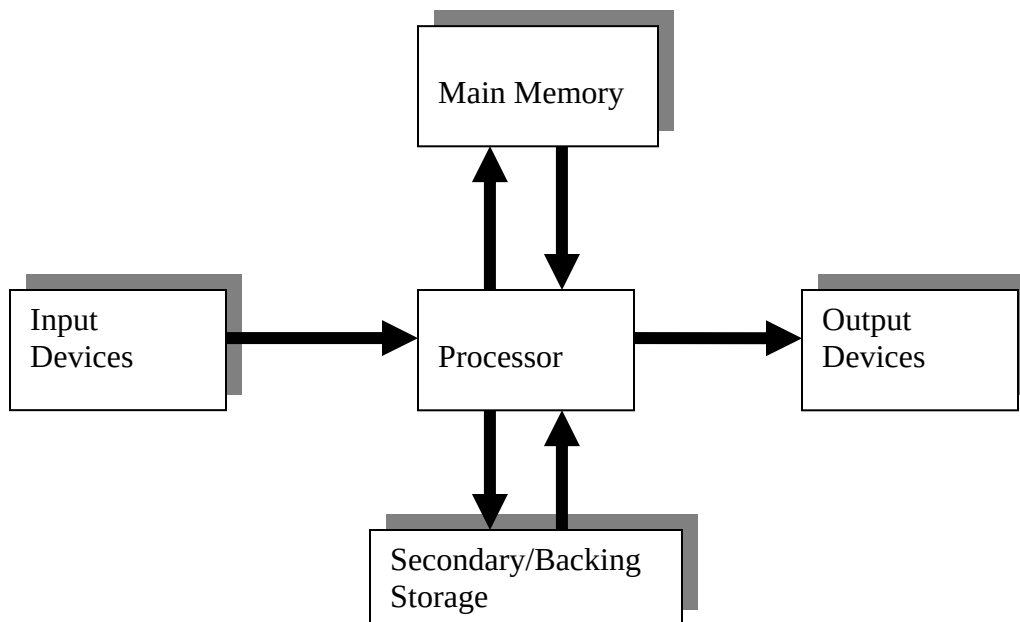


Compact Disk-Writable (CD-R): A CD-R is highly effective for storing a large amount of data. Can hold up to 700MB of information. A CD-R is a one time recordable compact disc.

Compact Disk-Re-Writable (CD-RW):

A CD-RW allows you to read, write, erase and write again. Writing takes place in a single pass of the focused laser beam. This is sometimes referred to as direct overwriting and can be repeated several thousand times per disc.

2.6 Computer units interaction diagram



The diagram above shows how the units interact with each other in the processing of data. Input devices enter information to be processed by the processor. The processor can read and write into the secondary storage devices.

The processor also stores the instructions being currently executed into the main memory. So can be able to read and write into the main memory (RAM). Once the data has been processed by the processor, the data can be displayed by the output devices. Please note the direction of the arrows as it depicts the flow of the data and instructions.

2.7 How information is stored in computers

Information is stored in computers in the form of **bits**. A bit is used to represent information in the computer. They are referred to as binary digits i.e. the 0's and 1's with 0 representing an OFF state and 1 representing an ON state.

The stored bits are usually retrieved from computers memory for manipulation by the processor

A single bit alone cannot represent a number, letters or special characters, to represent information; bits are combined into groups of eight. A group of eight bits is called a **byte**. Each byte can be used to represent a number, letter or special character.

2.8 Size

Byte – a string of 8 bits

Kilobyte – 1,024 bytes

Megabyte – 1,024 Kilobytes

Gigabyte – 1,024 Megabytes

Terabyte – 1,024 Gigabytes

2.9 Chapter Review Questions

1. Which are the five basic units of a computer?
 - (a) Central processing unit, Arithmetic and Logic Unit, Input Unit, Output Unit, Visual Display unit
 - (b) Central processing unit, Random Access Memory, Input Unit, Output Unit, Visual Display unit
 - (c) Central processing unit, Random Access Memory, Input Unit, Output Unit, Visual Display unit
 - (d) Central processing unit, Main Memory, Input Unit, Output Unit, Backing Storage
2. Which of the following is **not** an input device
 - (a) Mouse
 - (b) speaker
 - (c) Scanner
 - (d) Digital Camera
3. Which of the following is **not** an output device
 - (a) Printer
 - (b) Scanner
 - (c) speaker
 - (d) Monitor
4. Which of the following is **not** a task of the Central Processing Unit?
 - (a) It controls the transmission of information from application programs to output devices

- (b) It controls the transmission of data from input devices to memory;
- (c) It processes the data held in main memory;
- (d) It controls the transmission of information from main memory to output devices

5. Which of the following is used to store programs and data that are currently being used
- (a) Read only Memory (b) Hard Disk
 - (c) Random Access Memory (d) Magnetic Disk

Suggested Readings

1. Fuller F., Larson B., Computers: Understanding Technology(Second Edition)
Pages 17-20

CHAPTER THREE: INSIDE THE COMPUTER

Chapter Objectives

At the end of the chapter the learner shall be able to;

- Explain the functions of the different components of the processor such as the **control** unit, arithmetic/logic unit(ALU) and the system clock
- Explain the term form factor in relation to mother boards
- Explain the different types of buses and their functions in a computer system

Internal components are contained in the System Unit. The system unit is the unit that houses the processing unit (processor), memory, the input output controllers and the buses. The system unit is often called the Central Processing Unit.

The external components of a computer are called peripheral devices which include input and output.

3.1 The Processor

The processor contains the **control unit** and the **arithmetic/logic unit(ALU)** and **the system clock**.

The control unit coordinates and controls all the operations carried out by the computer. The **control unit** operates by repeating three operations which are:

- **Fetch** – cause the next instruction to be fetched from memory;
- **Decode** – translate the program instruction into commands that the computer can process
- **Execute** – cause the instruction to be executed

The **arithmetic/logic unit(ALU)** plays two roles.

- **Arithmetic** operations – these operations are addition, subtraction, multiplication and division..
- **Logical** operations – it compares two data items to determine whether the first one is smaller than, equal to or greater than the second item.

The system clock – generates a continuous sequence of clock pulses to step the control unit through its operation.

3.2 Clock speed

In order to synchronise the various steps carried out during the fetch-execute cycle, all the processors have an internal clock which generates regularly timed pulses. All the processor activities, such as fetching an instruction, reading data into the memory register etc. must begin on a clock pulse, although some activities take more than one clock pulse to complete. Typically the clock pulse rate in 2000 is around 500 megahertz (million cycles per second). The clock speed, therefore, is one of the factors which will influence the speed at which instructions are executed; a 600MHZ processor will in general operate faster than a 500MHz processor.

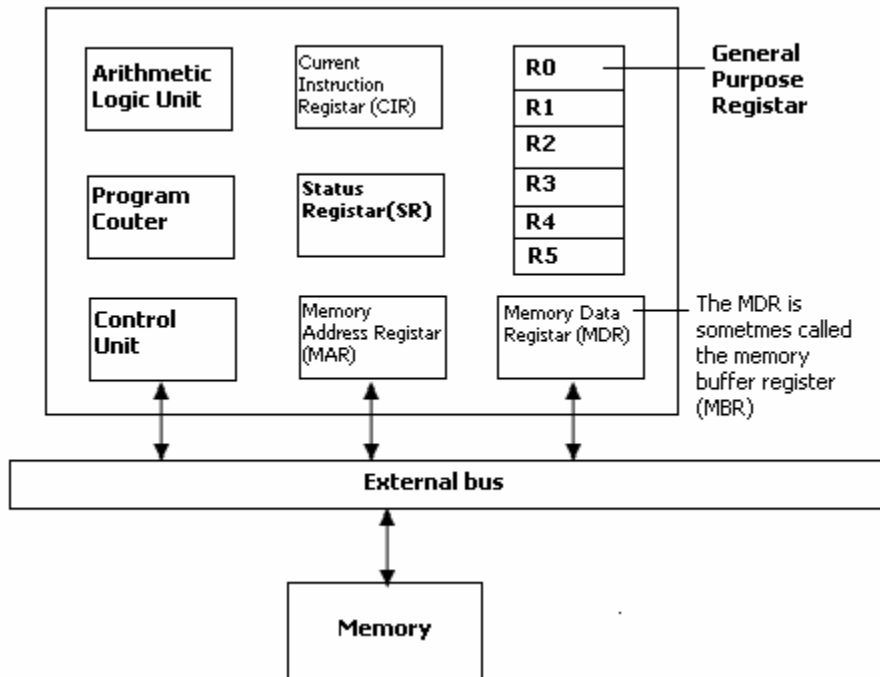
The main features which distinguish one processor from another and which determine the performance of each are;

- Clock speed
- Word size
- Bus size
- Architecture

3.3 Registers

In addition the CPU contains circuitry controlling the interpretation and execution of instructions. Special storage locations called **registers** are included

in this circuitry to hold information temporarily while it is being decoded or manipulated. They are shown in the block diagram below.



The registers shown in the block diagram above, which represents a 'typical' computer, each have a specific purpose, which is described below.

- **Program counter (PC)** holds the address of the next instruction to be executed. It is also known as the **sequence control register (SCR)** or the **sequence register**.
- **General purpose registers** are used for performing arithmetic functions. In some computers, there is only one general purpose register, usually called an accumulator, which acts as the working area.
- **Current instruction register (CIR)** contains both the operator and the operand of the current instruction.
- **Memory address register (MDR)** holds the address of the memory location from which data will be read or to which data will be written.

- **Memory data register (MDR)** is used to temporarily store data read from or written to memory.
- **Status register (SR)** contains bits that are set or cleared based on the result of an instruction.

3.4 Motherboard

A motherboard allows all the parts of your computer to receive power and communicate with one another. Motherboards have come a long way in the last twenty years. The first motherboards held very few actual components. The first IBM PC motherboard had only a processor and card slots. Users plugged components like floppy drive controllers and memory into the slots. Today, motherboards typically boast a wide variety of built-in features, and they directly affect a computer's capabilities and potential for upgrades.

3.4.1 Form Factor

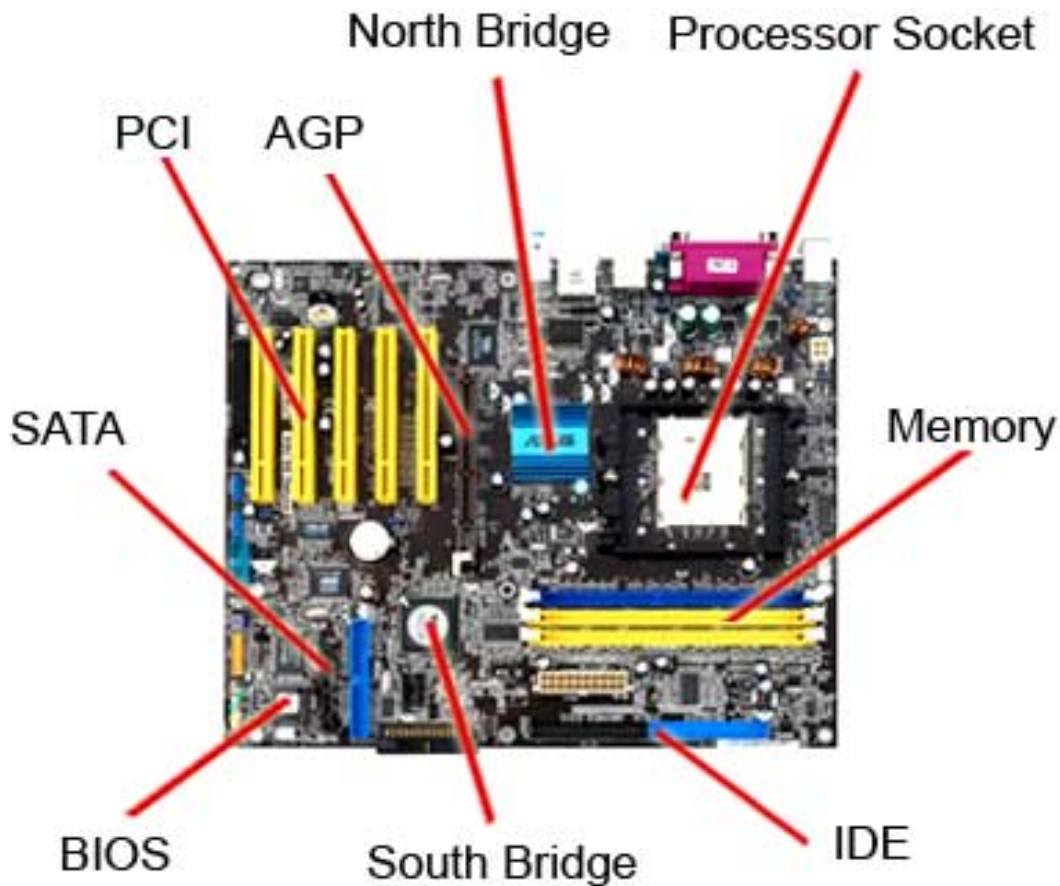
A motherboard by itself is useless, but a computer has to have one to operate. The motherboard's main job is to hold the computer's microprocessor chip and let everything else connect to it. Everything that runs the computer or enhances its performance is either part of the motherboard or plugs into it via a slot or port. The shape and layout of a motherboard is called the **form factor**. The form factor affects where individual components go and the shape of the computer's case. There are several specific form factors that most PC motherboards use so that they can all fit in standard cases. The form factor is just one of the many standards that apply to motherboards. Some of the other standards include:

The **socket for the microprocessor** determines what kind of Central Processing Unit (CPU) the motherboard uses.

The **chipset** is part of the motherboard's logic system and is usually made of two parts -- the northbridge and the southbridge. These two "bridges" connect the CPU to other parts of the computer.

The Basic Input/Output System (BIOS) chip controls the most basic functions of the computer and performs a self-test every time you turn it on. Some systems feature dual BIOS, which provides a backup in case one fails or in case of error during updating.

The **real time clock chip** is a battery-operated chip that maintains basic settings and the system time.



Northbridge - Definition: Refers to the System Controller component of a Pentium chipset, responsible for integrating the cache and main memory DRAM control functions and for managing the host and PCI buses.

South bridge - Refers to the Peripheral Bus Controller component of a Pentium chipset, responsible for implementing a PCI-to-ISA bridge function and for managing the ISA bus and all the ports.

The slots and ports found on a motherboard include:

Peripheral Component Interconnect (PCI)- connections for video, sound and video capture cards, as well as network cards

Accelerated Graphics Port (AGP) - dedicated port for video cards.

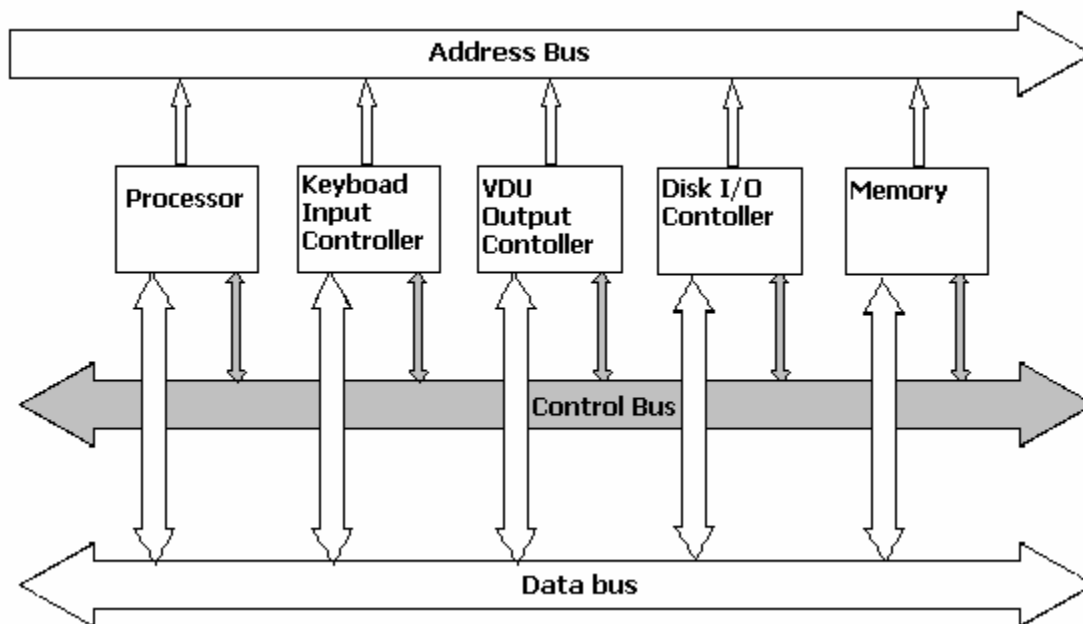
Integrated Drive Electronics (IDE) - interfaces for the hard drives

Universal Serial Bus or FireWire - external peripherals

Memory slots

3.5 Buses

A Bus is a set of parallel wires connecting two or more components in a computer. The CPU is connected to the main memory by three separate buses. When the CPU wishes to access a particular memory location, it sends this address to memory on the **address bus**. The data in that memory location is then returned to the CPU on via the data bus. Control signals are sent along the control bus.



Control Bus

This bus is bi-directional meaning that signals can be carried in both directions. All the components in the computer share the data and address buses. Control lines are used to ensure that access to and use of the data and address buses by the different components of the system does not lead to conflict. The purpose of the control bus is to transmit command , timing and specific status information between system components such as the memory, processor, keyboard input controller VDU output controller and the Disk I/O controller.

Data bus

A data bus provides a bi-directional path for moving data and instructions between system components. A typical data bus consists of 8, 16, or separate lines. The width of the data bus is a key factor in determining overall system performance. For example, if the data bus is 8 bits wide, and each instruction is 16 bits long, then the processor must access the main memory twice during each instruction cycle.

Address bus

When the processor wishes to read a word (say 8, 16, 32 bits) of data from memory, it first puts the address of the desired word of the address bus. The **address bus** is used for communicating the physical addresses of computer memory elements/locations that the requesting unit wants to access (read/write).

The width of an address bus, along with the size of addressable memory elements, determines how much memory can be accessed.

3.6 Word size

Word size means the number of Bits that the processor can process simultaneously. Typical processors can have 8-, 16-, 32-, 64- or even larger word sizes. Word size also determines the speed of the computer. Bus size means the number of bits that can be transmitted together. Most mainframe computers have 32-bit words.

3.7 I/O Controllers

Each peripheral device operates in a different way and hence these devices cannot be connected directly to the processor. The processor communicates and controls a peripheral device through an I/O or device controller. I/O controllers are available which can operate both input and output transfers of bits, e.g. floppy disk controller. Other controllers operate in one direction only, either as an input controller, e.g. keyboard controller or as output controller, e.g. vdu controller.

3.8 Common Bus Interfaces

Small Computer System Interface(SCSI)

EISA is the second most commonly used interface for disk drives. Unlike competing standards, SCSI is capable of supporting eight devices, or sixteen devices with Wide SCSI.

Extended Industry Standard Architecture (EISA) also known as **Extended ISA**, EISA is a standard first announced in September of 1988 for IBM and IBM compatible computers to compete with the IBM MCA bus. The EISA bus is found on Intel 80386, 80486 and early Pentium computers. The EISA bus provided 32-bit slots at an 8.33 MHz cycle rate for the use with 386DX or higher processors. In addition, the EISA can accommodate a 16-bit ISA card in the first row.

Although the EISA bus is backwards compatible and not a proprietary bus it never became widely used and is no longer found in computers today.

Micro Channel Architecture (MCA) was introduced by IBM in 1987. MCA, or the **Micro Channel bus**, was a competition for ISA bus. The MCA bus offered several additional features over the ISA such as a 32-bit bus (although there was also a 16-bit bus), ran at 10MHz, automatically configure cards (similar to what Plug and Play is today), and bus mastering for greater efficiency.

3.9 Chapter review questions

1. Briefly describe the roles of the data bus and the address bus within the central processing unit
2. State one benefit of increasing the width of the data bus
3. State one benefit of increasing the width of the address bus
4. Explain the importance of the system clock

3.10 Suggested Readings

1. Fuller F., Larson B., Computers: Understanding Technology(Second Edition) Pages 65-70

CHAPTER FOUR: FAULT DIAGNOSIS

Chapter Objectives

At the end of the chapter the learner shall be able to;

- Troubleshoot a computer that is having a problem and identify the cause of the problem and how it can be solved
- Explain how to trouble shoot a Hard Drive Failure, Motherboard and CPU, Video Failure and Power Supply Troubleshooting
- Explain how the divide and conquer method of troubleshooting can be applied during troubleshooting

4.1 Power Supply Troubleshooting

The first place to start is always confirming that the power supply is operating properly. When you start troubleshooting a dead computer, never ignore the possibility that the AC power to the PC's power supply is at fault. Power supplies often fail gradually, giving rise to symptoms that appear to be caused by individual component failure. Many cheaper PC's ship with power supplies I would basically describe as "disposable." If I had to choose one part to blame the majority of intermittent failures in cheap PC's on, it would be the power supply

4.2 Video Failure Troubleshooting

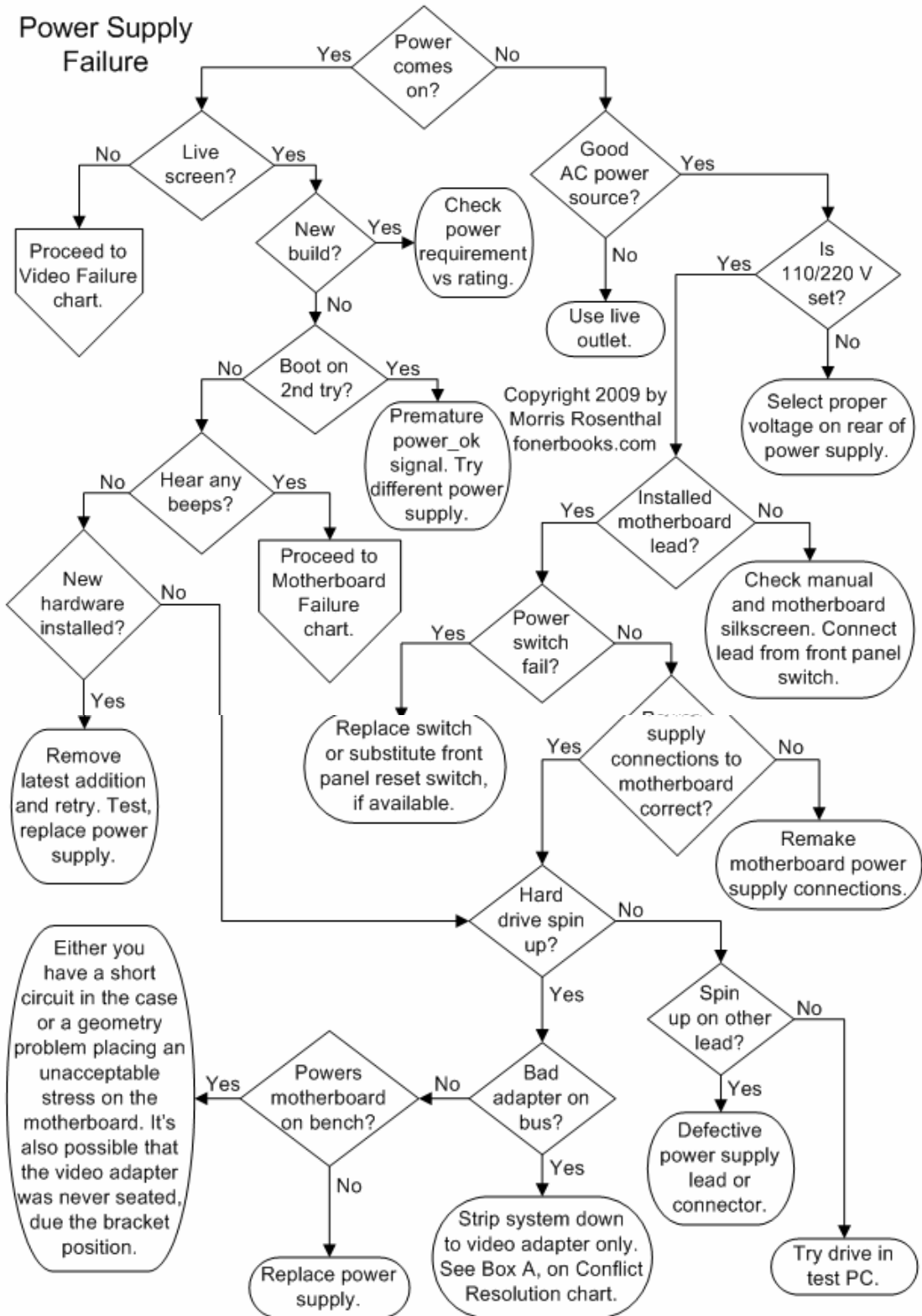
When we talk about troubleshooting video failures, we're usually talking about no image at all on the screen. The easy cases to diagnose are those where the monitor or LCD isn't powering up properly, or the PC not powering up. Video card failure isn't uncommon, and video cards can lose their contact with the motherboard, especially early AGP adapters which frequently popped out of their slot. Video failure can also be due to motherboard failure or to external interference, when it comes to poor image quality.

4.3 Motherboard and CPU Troubleshooting

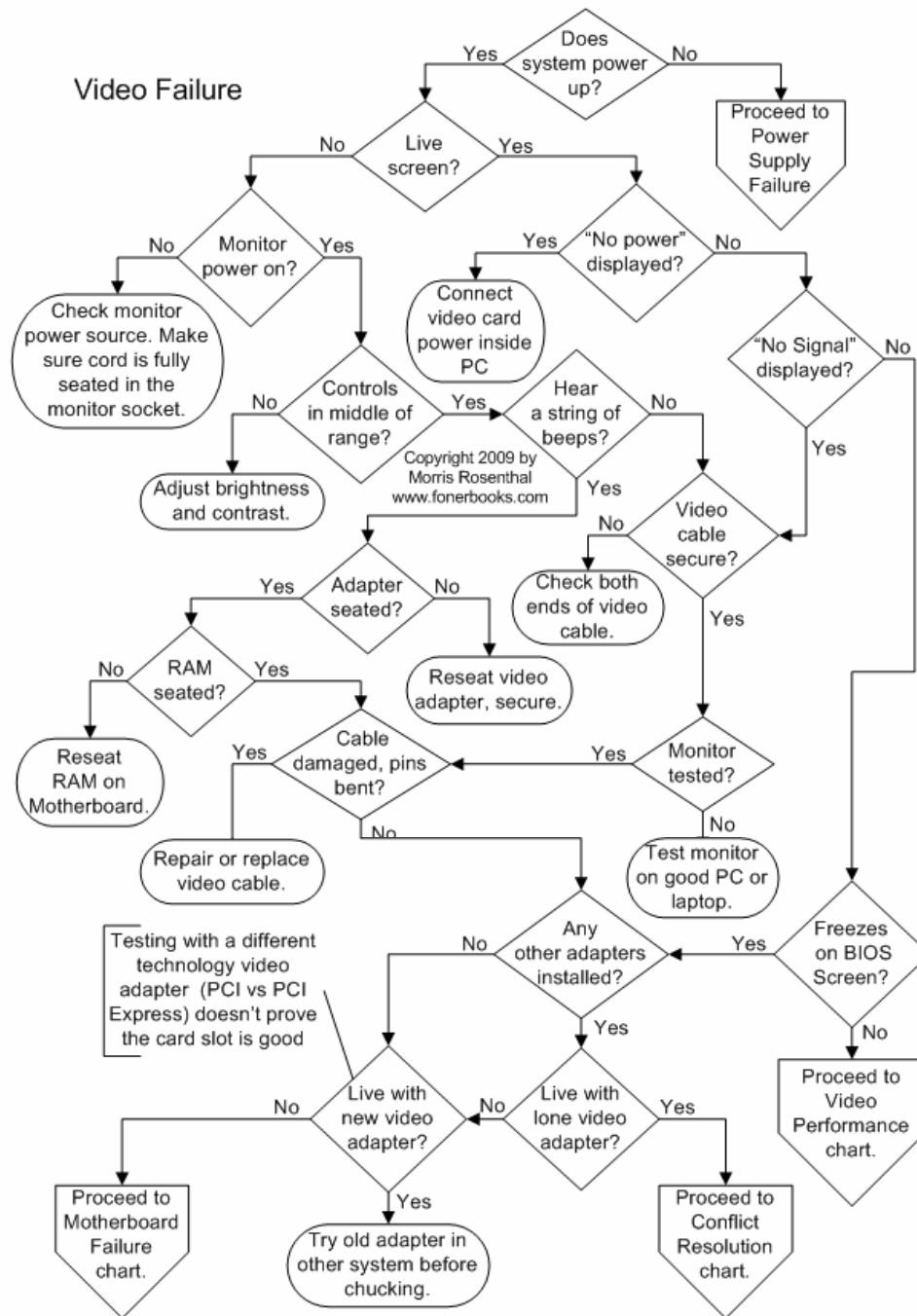
There are very few instances when you'd turn on a PC, have it either power up or not, and be able to say, "Oh, that's a motherboard problem." Motherboard failures usually show up as second level problems, like "I've replaced the video card and the screen is still dead." If you want to learn how to repair PC's without swapping every part, it's critical to know what to look for on a powered up system, like a CPU fan that isn't running, or RAM that stays cold. Sometimes you can spot a blown capacitor on a motherboard, but it's not a common problem.

4.4 Hard Drive Failure Troubleshooting

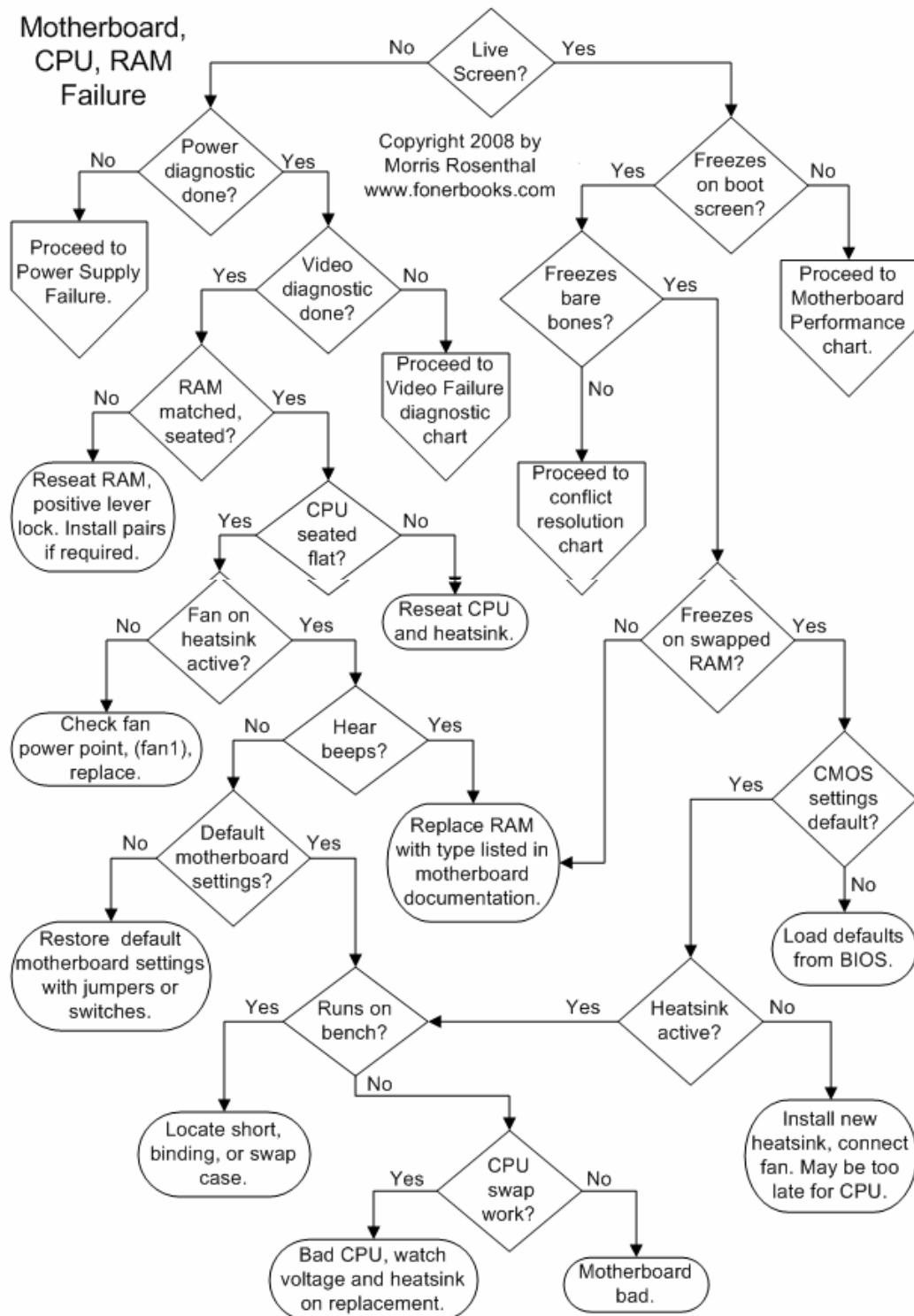
Students who are still learning the basics of computer repair, like what components are involved in what operation, will frequently assume that all boot issues are due to a hard drive failure. The truth is, of all the four subsystems represented in this table, hard drives are probably the most reliable. I don't mean that hard drives last longer than memory modules or video cards in the pure MTBF (Mean Time Between Failure) sense, I mean they are rarely at fault when you're called in to repair a PC. Hard drive failures are generally pretty easy to troubleshoot, in part because the operating system will include tools to report on the hard drive's reliability when it's accessible..

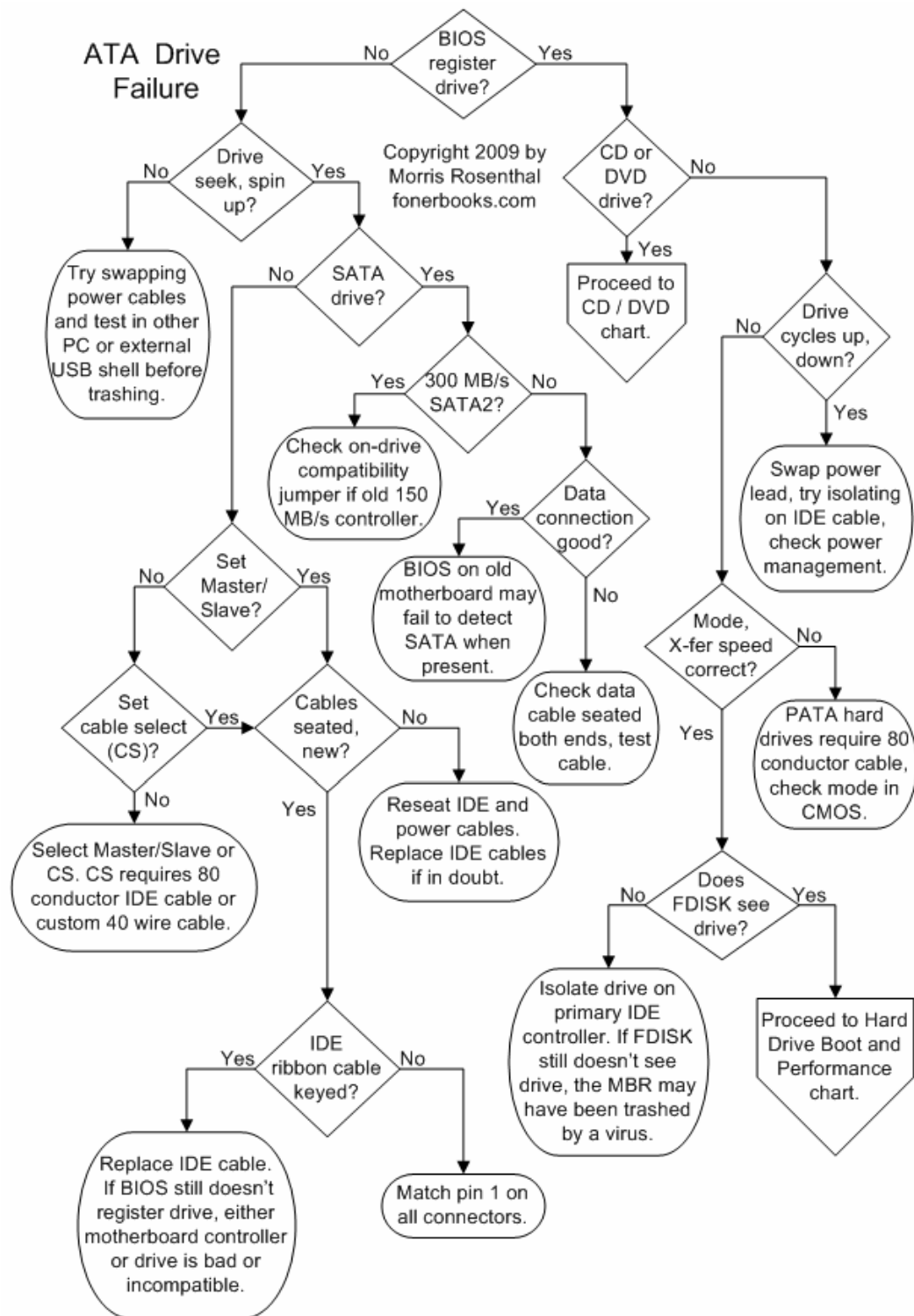


Video Failure Troubleshooting



Motherboard, CPU, RAM Failure





4.5 Chapter review questions

1. The computer is not starting and when switched on it is not turning on. What could be the problem
2. The computer is showing an error during startup “no operating system” What could be the problem

4.6 Suggested Readings

Howstuffworks.com

CHAPTER FIVE: INPUT AND OUTPUT DEVICES AND INTERRUPTS

Chapter Objectives

At the end of the chapter the learner shall be able to;

- Explain input and output devices and the role they play in a computer
- Define the term interrupt and explain the different types of interrupts
- Explain how an interrupt handler operates

5.1 Input Devices

An input device lets you communicate with a computer. They are used to enter information and issue commands to the computer. Commands tell the computer to do something, like save the file. A keyboard, mouse, scanner, digital camera, touch pads and joystick are examples of input devices.

5.2 Output device

An output device displays information on a screen, creates printed copies or generates sound. A monitor, printer, and speakers are examples of output devices.

The input and output devices are discussed in details in chapter 2 of the module.

5.3 Interrupts

An interrupt is a signal from some device or source seeking the attention of the processor. The interrupt signal is sent along a control line to the processor, and the currently executing program is suspended while control is passed to an interrupt service routine.

5.3.1 Types of interrupt

The following are the different types of interrupt that could occur;

- **Interrupts generated by the running process;** the process might need to perform I/O, obtain more storage or communicate with the operator
- **I/O interrupts;** these are initiated by the I/O hardware and signal to the CPU that the status of a channel or device has changed. An I/O interrupt will occur when an I/O operation is complete, when an error occurs, or when device is made ready.
- **Timer interrupts;** these are generated by a timer within the processor, and allow the operating system to perform certain functions at regular intervals. For example, each user in a multi-user system may be allocated

- **Program check interrupts;** these are caused by various types of error such as division by zero.
- **Machine check interrupts;** these are caused by malfunctioning hardware

5.3.2 Interrupt priorities

There is a special register in the CPU called the interrupt register. At the beginning of each fetch-execute cycle, the interrupt register is checked. Each bit of the register represents a different type of interrupt, and if a bit is set, the state of the current process is saved and the operating system routes control to the appropriate interrupt handler.

Some interrupts, such as those generated by hardware failure, may need to be dealt with immediately, whereas such as an I/O device signaling that it is ready for I/O, can be temporarily ignored. Interrupts are therefore assigned priorities so that when two interrupts are received simultaneously, the one with the highest priority is dealt with first. Only an interrupt with a higher priority is allowed to interrupt the servicing of another.

Class of Interrupt	Source of Interrupt	Priority
Hardware failure	Power failure-initiated when a decline in the internal voltages is detected, giving the OS a few milliseconds to close down as gracefully as possible.	1
	Memory parity error	1
Program	Arithmetic overflow	2
	Division by zero	2
	Attempt to execute an illegal machine instruction	2
	Reference outside a user's allowed memory space	2
Timer	Generated by internal clock within the processor	3
I/O	I/O device signals normal completion or the occurrence of an error condition	4

5.3.3 The Interrupt Handler

What happens when, for example, a key on the keyboard is pressed, thus generating an interrupt? A small program called an interrupt service routine (ISR) or interrupt handler is executed to transfer the character value of the key pressed into main memory. A different ISR is provided for each different source of interrupt. A typical sequence of actions when an interrupt occurs would be:

1. The current fetch-execute cycle is completed
2. The contents of the program counter, which points to the next instruction of the program to be executed, must be stored away safely so it can be restored after servicing the interrupt.
3. The contents of other registers used by the user program are stored away safely for later restoration
4. The source of the interrupt is identified
5. Interrupts of a lower priority are disabled
6. The program counter is loaded with the start address of the relevant interrupt service routine.
7. The interrupt service routine is executed
8. The saved values belonging to the user program for registers other than the program counter are restored to the processor's registers
9. Interrupts are re-enabled
10. The program counter is restored to point to the next instruction to be fetched and executed in user program

5.4 Chapter review questions

1. Give four different types of event that may cause an interrupt
2. When data is being sent to a printer an interrupt may occur. State two reasons why an interrupt may occur in this case
3. Describe the role of priorities in the handling of interrupts

5.5 Suggested Readings

1. Fuller F., Larson B., Computers: Understanding Technology(Second Edition) Pages 102-120

CHAPTER SIX: COMPUTER LANGUAGES

Chapter Objectives

At the end of the chapter the learner shall be able to;

- Explain the different generations of programming languages
- Explain the different program translators such as the Assembler, Compiler and Interpreter
- Explain the advantages and disadvantages of the different program translators

6.1 First Generation - Machine language

The computers can execute a program written using binary digits only. This type of programs is called machine language programs and the programming language is called machine code. Since these programs use only '0's and '1's it will be very difficult for developing programs for complex problem solving. Also it will be very difficult for a person to understand a machine language program written by another person. At present, computer users do not write programs using machine language. Also these programs written for execution in one computer cannot be used on another type of computer. i.e., the programs were machine dependent.

6.2 Second generation - Assembly Language

In assembly language **mnemonic** codes are used to develop program for problem solving. The program given below shows assembly language program to add two numbers A & B.

Program code

READ A
ADD B
STORE C
PRINT C
HALT

Description

It reads the value of A.
The value of B is added with A.
The result is store in C.
The result in 'C' is printed.
Stop execution.

Assembly language is designed mainly to replace each machine code with an understandable mnemonic code. To execute an assembly language program it should first be translated into an equivalent machine language program. Writing and understanding programs in assembly language is easier than that of machine language. The programs written in assembly language are also machine dependent. Assembly language is translated into machine code using an **assembler** before they can be executed.

6.3 Third Generation - High Level Languages

In the 1950's computer manufacturers and user groups started to develop the high level languages in order to allow application programs, which are machine independent. High level language permits the user to use understandable codes using the language structure. In order to execute a high-level language program, it should be translated into a machine language either using a compiler or interpreter. The high level languages commonly used are **FORTRAN (FORmula TRANslation)**, **BASIC (Beginner's All-purpose Symbolic Instruction Code)**, **COBOL (COmmon Business Oriented Language)**. The following program written in BASIC language is to add two given numbers.

<u>Program Code</u>	<u>Description</u>
10 INPUT A,B	To read the value of A&B
20 LET C=A+B	A&B are added and result is stored in C
30 PRINT C	Print the value of C
40 END	Stop execution

6.4 Fourth Generation

A 4GL is an aid which the end user or programmer can use to build an application without using a third generation programming language. Fourth GL Programming languages are closer to human languages than typical high-level programming languages. All 4GLs are designed to reduce programming effort, the time it takes to develop software, and the cost of software development. Applications of 4GL's are concentrating on the daily performed tasks such as

screen forms, requests for data, change data, and making hard copies. In most of these cases one deals with Data Base Management Systems (DBMS).

Most 4GLs are used to access databases. For example, a typical 4GL command is:

FIND ALL RECORDS WHERE NAME IS "SMITH"

A popular 4GL is SQL , which is a database language used to create queries and build database objects.

6.5 Fifth Generation

5GL or fifth-generation language is programming that uses a visual or graphical development interface to create source language that is usually compiled with a 3GL or 4GL language compiler. Microsoft, Borland, IBM, and other companies make 5GL visual programming products for developing applications in Java, for example. Visual programming allows you to easily envision object-oriented programming class hierarchies and drag icons to assemble program components.

6.6 Types of Program Translator

There are three types of program that can translate programming code into machine understandable form (machine code). These are:

1. Assembler

An assembler is a program that translates assembly code into machine code. Since Assembly language is machine dependent each type of computer has its own assembler. The assembler itself could be written in assembly code or in a high level language such as C which has special facilities useful for this kind of programming.

2. Compiler

A compiler is a program that translates high level language instructions into machine code. In short a COMPILER is: the translator of the source code into computer language.

- First the source code is read into the computer's memory
- Then it will be translated into a kind of in between code: OBJECT CODE
- A program will have many different objects and libraries that need to be linked together into one (large) executable

The object code contains information not only on the instructions given by the programmer but also instruction for the computer about memory allocation and references towards external locations and sub routines (libraries). The code written by the programmer is called the **source code** and the compiled code is called the **object code**.

3. Interpreter

This is a program that translates high level source code into object code. The interpreter translates one line at a time and then executes it. During interpretation no object code is produced, and so the program has to be interpreted each time it is to be run.

Relative advantages of Compilers and interpreters

These are the advantages of a compiler over an interpreter:

- Object code can be saved on disk and run whenever required without the need to recompile. In case an error is discovered the source code has to be recompiled after correcting an error.
- Object code executes faster than interpreted code

- Object code generated by a compiler can be executed with the absence of a compiler
- Object code is more secure, as it cannot be read without a great deal of 'reverse engineering'.

Advantages of an interpreter over a compiler

- There is no need to for recompilation each time an error is discovered
- It is easier to partially test and debug programs.

6.7 Chapter review questions

1. Explain two differences between second and third generation languages
2. What is meant by a high-level programming language
3. Distinguish the between a compiler and an interpreter

6.8 Suggested Readings

1. Fuller F., Larson B., Computers: Understanding Technology(Second Edition) Pages 509-510

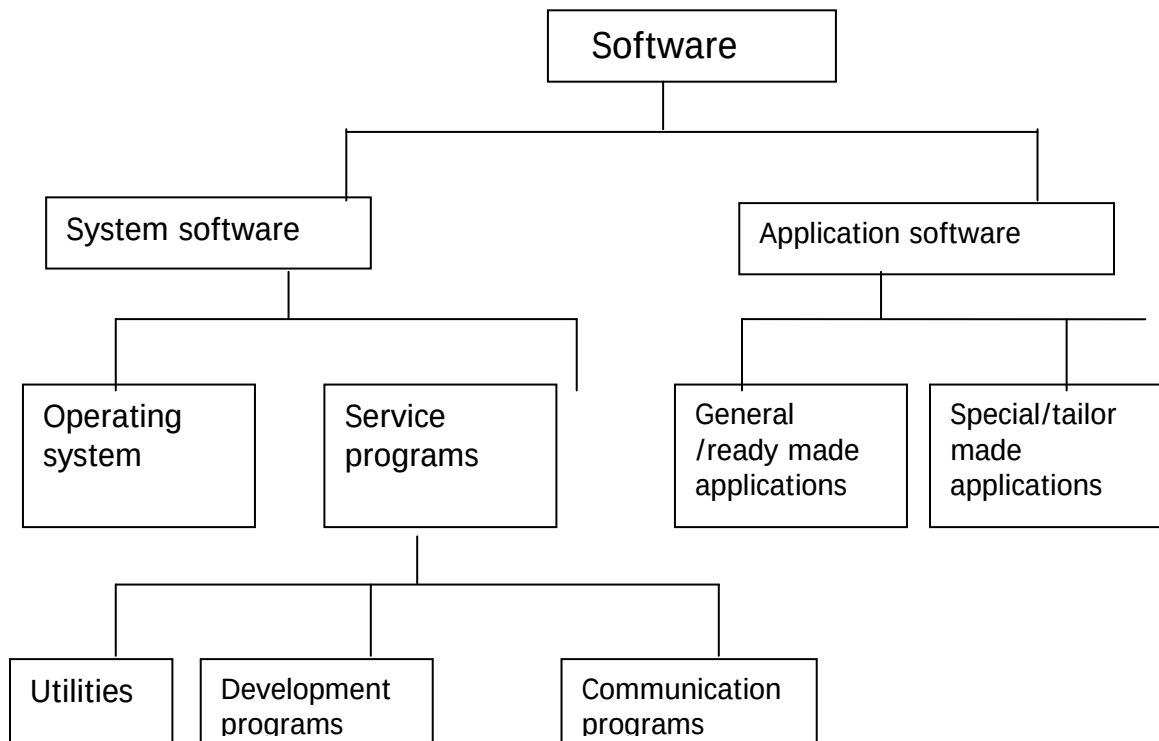
CHAPTER SEVEN: COMPUTER SOFTWARE

At the end of the chapter the learner shall be able to;

- Explain computer software and the classification of computer software
- Explain system software and the different software in that category and their application and importance in computing
- Explain application software and the different software in that category such general purpose and special purpose software
- Explain Ready made software vs tailor made software
- Explain the functions of an operating system
- Explain the difference between command and graphical user interface based operating systems

Software is a Program commercially prepared and tested in software by one or a group of programmers and system analyst to perform a specified task. Software is simply set of instructions that cause a computer to perform one or more tasks. The set of instructions is often called a program or, if the set is particularly large and complex, a system. Computers cannot do any useful work without instructions from software; thus a combination of software and hardware (the computer) is necessary to do any computerized work. A program must tell the computer each of a set of tasks to perform, in a framework of logic, such that the computer knows exactly what to do and when to do it. Data are raw facts and ideas that have not been processed while Information is data that has been processed so as to be useful to the user

7.1 Classification of software



Classification of software

Software can be broadly classified into **system software** and **application software**

7.2 System software

Consists of programs that control operations of the computer and enable user to make efficient use of computers. They coordinate computer activities and optimize use of computers. They are used to control the computer and develop and run application programs examples of jobs done by the system software are management of computer resources, defragmentation etc. They can be divided into;

(i) Operating system - is a complex program and most important program that runs on a computer and which controls the operation of a computer. It perform basic tasks, such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers. In general the operating system supervises and directs all the software components and the hardware components. Sophisticated operating system could handle multi-processors, many users and tasks simultaneously. Examples of computers operating systems are UNIX, Microsoft windows 95/98, Windows NT, Windows 2000, Windows XP, Windows Vista and Linux.

(ii) Service programs are programs designed for general support of the processes of a computer; "a computer system provides utility programs to perform the tasks needed by most users". The service programs can further be divided into;

- o **Utilities** Performs a variety of tasks that maintain or enhance the computer's operating system Utility programs are generally fairly small. Each type has a specific job to do. Below are some descriptions of utilities.
 - **Anti-virus applications** protect your computer from the damage that can be caused by viruses and similar programs
 - **Compression utilities** make files smaller for storage (or sending over the Internet) and then return them to normal size.
 - **Data recovery utilities** attempt to restore data and files that have been damaged or accidentally deleted.
 - **Disk defragmenters** reorganize the data stored on disks so that it is more efficiently arranged.
 - **Firewalls** prevent outsiders from accessing your computer over a network such as the Internet.
- o **Development programs** are used in the creation of new software. They comprise of sets of software tools to allow programs to be written and tested. Knowledge of appropriate programming language is assumed. Tools used here are

- **Text editors** that allows one to enter and modify programs statements
- **Assembler-** allows one to code in machine programs language .i.e. processor specific
- **Compilers-** makes it possible for programmer to convert source code to object code which can be stored and saved on different computers.
- **Interpreters-** used to convert source programs statement by statement as it executes the program without being compiled first.
- **Libraries-** commonly used parts or portions of a program which can be called or included in the programmer's code without having to recode that portion.
- **Diagnostic utilities-** used to detect bugs in the logic of program during program development
- o **Communication programs-** refer to programs that make it possible to transmit data.

7.3 Application software

Are programs for user to do their jobs e.g. typing, recording keeping, production of financial statements, drawing, and statistics.

- o **General/ready made software** is developed to perform a variety of tasks, usually determined by use. Such software can be customized by user to achieve specific goals e.g. ms office which is a suit of programs performing a variety of tasks e.g. word processing for producing documents, database for storing, retrieving and manipulating data and various calculations on spreadsheets. General purpose programs are discussed below;
 - **Word processing applications.** Writing tasks previously done on typewriters with considerable effort can now be easily completed with word-processing software. Documents can be easily edited and formatted. Revisions can be made by deleting (cutting), inserting, moving (cutting and pasting), and copying data. Documents can be stored (saved) and opened again for revisions and/or printing. Many styles and sizes of fonts are available to make the document attractive. Example: MS Word, Word Pad etc.
 - **Spreadsheet applications.** spreadsheet software permits performance of an almost endless variety of quantitative tasks such as budgeting, keeping track of inventory, preparing financial reports, or manipulating numbers in any fashion, such as averaging each of ten departmental monthly sales over a six-month period. A spreadsheet contains cells, the intersection of rows and columns. Each cell contains a value keyed in by the user. Cells also contain

- **Database software:** A database contains a list of information items that are similar in format and/or nature. An example is a phone book that lists a name, address, and phone number for each entry. Once stored in a database, information can be retrieved in several ways, using reports and queries. For example, all the names listed for a given area code could be printed out and used for a commercial mailing to that area. Examples of database software is Ms Access, Dbase, Oracle etc.
- **Presentation software:** for making slide shows. Allows users to create visual presentation A speaker may use presentation software to organize a slide show for an audience. Text, graphics, sound, and movies can easily be included in the presentation. An added feature is that the slide show may be enhanced by inclusion of handouts with two to six slides printed on a page. The page may be organized to provide space for notes to be written in by the audience as the presentation ensues. An example of this is Power Point. Preparation of the software is simplified by the use of 'wizards' that walk the user through the creation of the presentation.
- **Desktop publishing software:** This software permits the user to prepare documents by using both word-processing devices and graphics. Desktop publishing software uses word-processing software, with all its ease of entering and revising data, and supplements it with sophisticated visual features that stem from graphics software. For example, one can enhance a printed message with virtually any kind of illustration, such as drawings, paintings, and photographs. . Examples of Desktop publishing software is PageMaker, Corel Draw, and Ms Publisher
- **Multimedia applications** for creating video and music. Allows users to create image, audio, video etc. Example: Real Player, Media Player etc.
- **Activity management programs** like calendars and address books

NB: Nowadays most of the general purpose software is being sold as a complete **software suites** such as Microsoft office or Lotus SmartSuite. These suites offer

four or more software products packaged together at a much lower price than buying the packages separately.

- o **Tailor made/special purpose software** Tailor-made computer system refers to computer application developed by in-house IT personnel or outside software house according to specific user requirements in a firm. They are developed for given purpose e.g. Payroll system, stock control system etc.

7.4 Operating systems concepts

Operating Systems

Operating systems(OS) acts as an interface between the computer hardware and the computer user and manages the whole computer system. An operating system acts as foundation on which other application software can be installed. It controls and monitors the running of application programs.

Functions of an operating system

The basic functions of an operating system are;

- Memory management – the operating system allocates memory to each application running in the computer.
- Resource allocation and scheduling – In computer systems which are capable of running several programs at once, the OS allocates processing time, memory and input-output resources to each.
- Secondary store management – the OS controls the transfer of data from secondary storage (e.g. disk) to memory and back again. It also has to maintain a directory of the disk so that files and free space can quickly be located.
- Interrupt handling – the OS detects many different kinds of interrupt such as for example a user pressing the enter key on the keyboard, a printer sending a message that it is out of paper, the real-time clock interrupting to indicate that

- Allowing a user to communicate with the computer – a user gives instructions to the computer via the OS to do various things such as copying a file.

Types of Operating System

Stand Alone Operating System

A stand alone operating system controls a single computer that is not connected to others on a network. Examples of this are Ms. Dos, and Windows.

Network Operating System

A network operating system is required when a number of computers are connected together to form a network. The OS controls who logs on to the network by means of user names and passwords, in order to protect the data and programs stored on the network. It also makes the network transparent to the user, allowing any user with appropriate access rights to use software stored on the network's file server, and to store data either on the file server or on a local hard or floppy disk. Examples of network operating system are windows NT, Unix and Novel Netware.

7.5 Computer User interface

There are two types of interface that can be provided by the operating system.

Command based Interface

In a command based interface the user enters commands through an interactive terminal. The commands are entered on a prompt for example the Ms Dos prompt looks like this

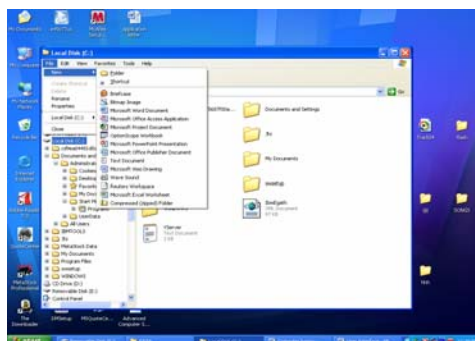
```
C:\ Command Prompt
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Administrator>cd\
C:\>
```

Once the commands are entered on the prompt a command line interpreter(CLI) identifies and executes the commands. A command based interface is quick to operate and very flexible, but the user needs to learn all the commands and type them in correctly. Examples operating systems that use command based interface are Ms Dos and Unix.

Graphical user interface

A graphical user interface (GUI) allows the user to interact with the system using Windows, Icons, Menus, and Pointers to control the operating system. Icons represent programs, groups of programs, folders, devices and files. Instead of typing a command or file name, selection is achieved by moving a pointer with a mouse and clicking a mouse button. Windows is a Graphical user interface based operating system. The first in the Windows series was Windows 3.11 and the latest being Windows Vista.



The GUI has many advantages such as;

- GUIs are easier for the novice user because they are more intuitive
- The graphical symbols represent familiar objects such as a garbage bin
- Only valid options are available to avoid confusing the user
- No need to memorise commands
- Help is available online showing the only relevant options

Graphical user interface has some disadvantages such as

- GUI require more memory
- They require faster processors and better graphics display
- For experienced users they appear slow to operate because they require more operations for simple tasks.

7.6 Chapter Review Questions

1. Which of the following is **not** General Purpose software?
(a) Stock Control (b) Word Processing (c) Internet software (d) Presentation
2. Which of the following is **not** part of the Ms. Office suite?
(a) Ms Word (b) Ms Access (c) Outlook (d) Ms QuickBooks
3. Which of the following is **not** an operating system
(a) Windows XP (b) Windows Explorer (c) Ms Dos (d) Linux
4. Which of the software below would assist a secretary in preparing a report for an annual general meeting?
(a) Ms Word (b) Ms Access (c) Outlook (d) Ms QuickBooks
5. Which of the software below would assist a salesman in recording daily sales for different items for which he needs totals among other analysis?
(a) Ms Word (b) Ms Access (c) Outlook (d) Ms Excel
6. Which is the most important software in a computer system?
7. Which software would be used to create documents such as wills, trusts, or rental contracts?
8. Why would a user decide to use a command based interface as opposed to Graphical user interface?

7.7 Suggested Readings

1. Fuller F., Larson B., Computers: Understanding Technology(Second Edition) Pages 208-239

CHAPTER EIGHT: DISKS AND SECONDARY STORAGE

Chapter Objectives

At the end of the chapter the learner shall be able to;

- Explain the importance of secondary storage devices
- Explain the different secondary storage devices
- Explain how data is organized in a disk

8.1 The Benefits of Secondary Storage

Picture, if you can, how many filing-cabinet drawers would be required to hold the millions of files of, say, tax records kept by the Internal Revenue Service or historical employee records kept by General Motors. The record storage rooms would have to be enormous. Computers, in contrast, permit storage on tape or disk in extremely compressed form. Storage capacity is unquestionably one of the most valuable assets of the computer.

Secondary storage, sometimes called auxiliary storage, is storage separate from the computer itself, where you can store software and data on a semi permanent basis. Secondary storage is necessary because memory, or primary storage, can be used only temporarily. If you are sharing your computer, you must yield memory to someone else after your program runs; if you are not sharing your computer, your programs and data will disappear from memory when you turn off the computer. However, you probably want to store the data you have used or the information you have derived from processing; that is why secondary storage is needed. Furthermore, memory is limited in size, whereas secondary storage media can store as much data as necessary.

Storage	Speed	Capacity	Relative Cost (\$)	Permanent?
Registers	Fastest	Lowest	Highest	No
RAM	Very Fast	Low/Moderate	High	No
Floppy Disk	Very Slow	Low	Low	Yes
Hard Disk	Moderate	Very High	Very Low	Yes

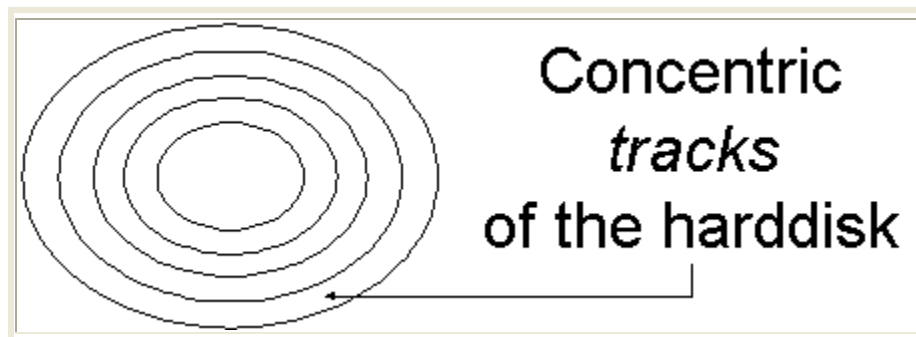
The benefits of secondary storage can be summarized as follows:

- o **Capacity.** Organizations may store the equivalent of a roomful of data on sets of disks that take up less space than a breadbox. A simple diskette for a personal computer holds the equivalent of 500 printed pages, or one book. An optical disk can hold the equivalent of approximately 400 books.
- o **Reliability.** Data in secondary storage is basically safe, since secondary storage is physically reliable. Also, it is more difficult for unscrupulous people to tamper with data on disk than data stored on paper in a file cabinet.
- o **Convenience.** With the help of a computer, authorized people can locate and access data quickly.
- o **Cost.** Together the three previous benefits indicate significant savings in storage costs. It is less expensive to store data on tape or disk (the principal means of secondary storage) than to buy and house filing cabinets. Data that is reliable and safe is less expensive to maintain than data subject to errors. But the greatest savings can be found in the speed and convenience of filing and retrieving data.

These benefits apply to all the various secondary storage devices but, as you will see, some devices are better than others. We begin with a look at the various storage media, including those used for personal computers, and then consider what it takes to get data organized and processed.

8.2 Magnetic Disk Storage

Diskettes and hard disks are magnetic media; that is, they are based on a technology of representing data as magnetized spots on the disk with a magnetized spot representing a 1 bit and the absence of such a spot representing a 0 bit.



- Reading data from the disk means converting the magnetized data to electrical impulses that can be sent to the processor. Writing data to disk is the opposite: sending electrical impulses from the processor to be converted

to magnetized spots on the disk. The surface of each disk has concentric tracks on it. The number of tracks per surface varies with the particular type of disk.

8.3 Diskettes

Made of flexible Mylar, a diskette can record data as magnetized spots on tracks on its surface. Diskettes became popular along with the personal computer.

Flash memory

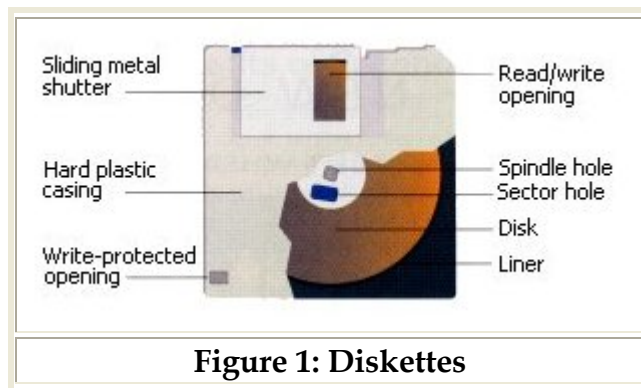


Figure 1: Diskettes

- The older diskette, 5-1/4 inches in diameter, is still in use, but newer computers use the 3-1/2 inch diskette (Figure 1). The 3-1/2 inch diskette has the protection of a hard plastic jacket, a size to fit conveniently in a shirt pocket or purse, and

the capacity to hold significantly more data than a 5-1/4 inch diskette.

Diskettes offer particular advantages which, as you will see, are not readily available with hard disk:

- o **Portability.** Diskettes easily transport data from one computer to another. Workers, for example, carry their files from office computer to home computer and back on a diskette instead of in a briefcase. Students use the campus computers but keep their files on their own diskettes.
- o **Backup.** It is convenient to place an extra copy of a hard disk file on a diskette.
- o **New software.** Although, for convenience, software packages are kept on hard disk, new software out of the box may come on diskettes (new software also may come on CD-ROM disks, which we will discuss shortly).

The end of the diskettes useful life-time may be upon us. In 1998 Macintosh introduced its new computer, the IMAC, without a floppy disk drive. Alternatives such as Zip disks (discussed later), or transferring data via networks are making the low-capacity diskette become obsolete.

8.4 Hard Disks

A hard disk is a metal platter coated with magnetic oxide that can be magnetized to represent data. Hard disks come in a variety of sizes.



Figure 2: Hard Disk and Drive

Hard disk for mainframes and minicomputers may be as large as 14 inches in diameter. Several disks can be assembled into a disk pack. There are different types of disk packs, with the number of platters varying by model. Each disk in the pack has top and bottom surfaces on which to record data. Many disk devices, however, do not record data on the top of the top platter or on the bottom of the bottom platter.

A disk drive is a machine that allows data to be read from a disk or written on a disk. A disk pack is mounted on a disk drive that is a separate unit connected to the computer. Large computers have dozens or even hundreds of disk drives. In a disk pack all disks rotate at the same time although only one disk is being read or written on at any one time. The mechanism for reading or writing data on a disk is an access arm; it moves a read/write head into position over a particular track. The read/write head on the end of the access arm hovers just above the track but does not actually touch the surface. When a read/write head does accidentally touch the disk surface, this is called a head crash and all data is destroyed. Data can also be destroyed if a read/write head encounters even minuscule foreign matter on the disk surface. A disk pack has a series of access arms that slip in between the disks in the pack. Two read/write heads are on each arm, one facing up for the surface above it and one facing down for the surface below it. However, only one read/write head can operate at any one time.

In some disk drives the access arms can be retracted; then the disk pack can be removed from the drive. Most disk packs, however, combine the disks, access arms, and read/write heads in a sealed module called a Winchester disk. Winchester disk assemblies are put together in clean rooms so even microscopic dust particles do not get on the disk surface.

Hard disks for personal computers are 5-1/4 inch or 3-1/2 inch disks in sealed modules and even gigabytes are not unusual. Hard disk capacity for personal computers has soared in recent years; capacities of hundreds of megabytes are

common and gigabytes are not unusual. Although an individual probably cannot imagine generating enough output-letters, budgets, reports, and so forth-to fill a hard disk, software packages take up a lot of space and can make a dent rather quickly. Furthermore, graphics images and audio and video files require large file capacities. Perhaps more important than capacity, however, is the convenience of speed. Personal computer users find accessing files on a hard disk is significantly faster and thus more convenient than accessing files on a diskette.

8.5 Removable Storage: Zip Disks

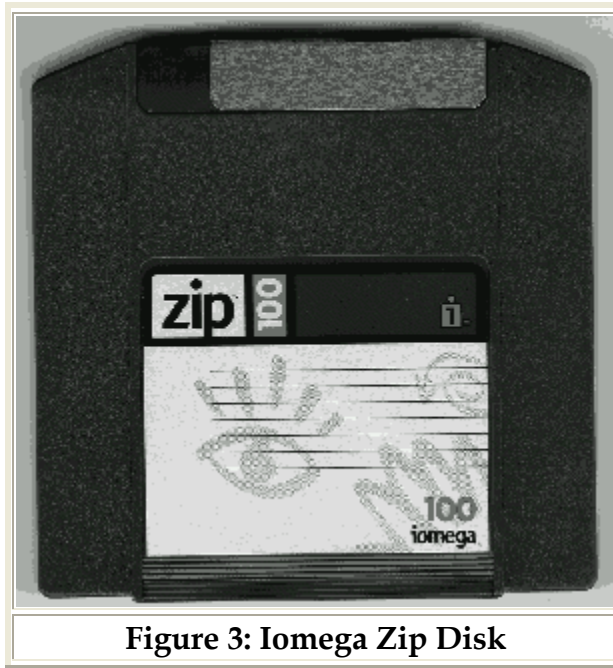


Figure 3: Iomega Zip Disk

Personal computer users, who never seem to have enough hard disk storage space, may turn to a removable hard disk cartridge. Once full, a removable hard disk cartridge can be replaced with a fresh one. In effect, a removable cartridge is as portable as a diskette, but the disk cartridge holds much more data. Removable units also are important to businesses concerned with security, because the units can be used during business hours but hidden away during off hours.

A disadvantage of a removable hard disk is that it takes longer to access data than a built-in hard drive.

The most popular removable disk media is the Zip drive from [Iomega](#) (Figure 3). Over 100's of millions have been sold, making it the de facto standard. The disk cartridges look like a floppy disk, but are slightly bigger in all dimensions. Older Zip disks hold 100MB, newer ones hold 250MB and cost \$8-\$10 a piece (Floppies hold 1.4MB and cost around \$2). The drive sells for around \$80- \$125. Many new PCs come with Zip drives built in addition to floppy drives. Zip disks are a great way to store large files and software programs.

8.6 Hard Disks in Groups

A concept of using several small disks that work together as a unit is called a redundant array of inexpensive disks, or simply RAID. The group of connected disks operates as if it were just one large disk, but it speeds up reading and

writing by having multiple access paths. The data file for, say, aircraft factory tools, may be spread across several disks; thus, if the computer is used to look up tools for several workers, the computer need not read the data in turn but instead read them at the same time in parallel. Furthermore, data security is improved because if a disk fails, the disk system can reconstruct data on an extra disk; thus, computer operations can continue uninterrupted. This is significant data insurance.

8.7 How Data Is Organized on a Disk

There is more than one way of physically organizing data on a disk. The methods we will consider here are the sector method and the cylinder method.

The Sector Method

In the sector method each track is divided into sectors that hold a specific number of characters. Data on the track is accessed by referring to the surface number, track number, and sector number where the data is stored. The sector method is used for diskettes as well as disk packs.

Zone Recording

The fact that a disk is circular presents a problem: The distances around the tracks on the outside of the disk are greater than that of the tracks on the inside. A given amount of data that takes up 1 inch of a track on the inside of a disk might be spread over several inches on a track near the outside of a disk. This means that the tracks on the outside are not storing data as efficiently.

Zone recording involves dividing a disk into zones to take advantage of the storage available on all tracks, by assigning more sectors to tracks in outer zones than to those in inner zones. Since each sector on the disk holds the same amount of data, more sectors mean more data storage than if all tracks had the same number of sectors.

The Cylinder Method

A way to organize data on a disk pack is the cylinder method. The organization in this case is vertical. The purpose is to reduce the time it takes to move the access arms of a disk pack into position. Once the access arms are in position, they are in the same vertical position on all disk surfaces.

To appreciate this, suppose you had an empty disk pack on which you wished to record data. You might be tempted to record the data horizontally-to start with the first surface, fill track 000, then fill track 001, track 002, and so on, and then move to the second surface and again fill tracks 000, 001, 002, and so forth. Each new track and new surface, however, would require movement of the access arms, a relatively slow mechanical process.

Recording the data vertically, on the other hand, substantially reduces access arm movement. The data is recorded on the tracks that can be accessed by one positioning of the access arms—that is, on one cylinder. To visualize cylinder organization, pretend a cylindrically shaped item, such as a tin can, were figuratively dropped straight down through all the disks in the disk pack. All the tracks thus encountered, in the same position on each disk surface, comprise a cylinder. The cylinder method, then, means all tracks of a certain cylinder on a disk pack are lined up one beneath the other, and all the vertical tracks of one cylinder are accessible by the read/write heads with one positioning of the access arms mechanism. Tracks within a cylinder are numbered according to this vertical perspective: A 20-surface disk pack contains cylinder tracks numbered 0 through 19, top to bottom.

8.8 Optical Disk Storage

The explosive growth in storage needs has driven the computer industry to provide cheaper, more compact, and more versatile storage devices with greater capacity. This demanding shopping list is a description of the optical disk, like a CD. The technology works like this: A laser hits a layer of metallic material spread over the surface of a disk. When data is being entered, heat from the laser produces tiny spots on the disk surface. To read the data, the laser scans the disk, and a lens picks up different light reflections from the various spots.

Optical storage technology is categorized according to its read/write capability. Read-only media are recorded on by the manufacturer and can be read from but not written to by the user. Such a disk cannot, obviously, be used for your files, but manufacturers can use it to supply software. Applications software packages sometimes include a dozen diskettes or more; all these could fit on one optical disk with plenty of room to spare. The most prominent optical technology is the CD-ROM, for compact disk read-only memory. The disk in its drive is shown in Figure 3.



Figure 3: Compact Disk (CD) and Drive)

- CD-ROM has a major advantage over other optical disk designs: The disk format is identical to that of audio compact disks, so the same dust-free manufacturing plants that are now stamping out digital versions of Mozart or Mary Chapin Carpenter can easily convert to producing anything from

software to an encyclopedia. Furthermore, CD-ROM storage is large -up to 660 megabytes per disk, the equivalent of over 400 3-1/2 inch diskettes.

When buying a computer the speed of the CD-ROM drive is advertised using an "X" factor, like 12X, or 24X. This indicates the speed at which the CD can transfer data to the CPU - the higher the X factor, the faster the CD.

- Modern computers now offer a write CD drive or, CD-RW as an option. CD-RW is a write-once, read-many media. With a CD-RW drive, you can create your own CDs. This offers an inexpensive, convenient, safe way to store large volumes of data such as favorite songs, photographs, etc.

8.9 Digital Versatile Disk (DVD) drives are now widely available in computers as well as home entertainment centers. DVD-ROM drives can read data, such as stored commercial videos for playing. DVD-RW allow DVDs to be created on a computer.



Figure 4: DVD Disk and Drive

- 9 The DVD is a flat disk, the size of a CD - 4.7 inches diameter and .05 inches thick. Data are stored in a small indentation in a spiral track, just like in the CD. DVD disks are read by a laser beam of shorter wave-length than used by the CD ROM drives. This allows for smaller indentations and increased storage capacity. The data layer is only half as thick as in

the CD-ROM. This opens the possibility to write data in two layers. The outer gold layer is semi transparent, to allow reading of the underlying silver layer. The laser beam is set to two different intensities, strongest for reading the underlying silver layer.

A 4.7 GB side of a DVD can hold 135 minutes top quality video with 6 track stereo. This requires a transmission rate of 4692 bits per second. The 17 GB disk holds 200 hours top quality music recording.

DVD movies are made in two "codes." Region one is USA and Canada, while Europe and Asia is region two. When you play movies, your hardware (MPEG decoder. MPEG is the data coding for movies similar to JPEG for pictures.) must match the DVD region. The movies are made in two formats, each with their own coding.

The DVD drives come in 2X, 4X, etc. versions, like the CD-ROM's.

The DVD drives will not replace the magnetic hard disks. The hard disks are being improved as rapidly as DVD, and they definitely offer the fastest seek time and transmission rate (currently 5-10 MB/second). No optic media can keep up with this. But the DVD will undoubtedly gain a place as the successor to the CD ROM and is playing an important role in the blending of computers and entertainment centers.

8.10 Magnetic Tape Storage

We saved magnetic tape storage for last because it has taken a subordinate role in storage technology. Magnetic tape looks like the tape used in music cassettes plastic tape with a magnetic coating. As in other magnetic media, data is stored as extremely small magnetic spots. Tapes come in a number of forms, including 1/2-inch-wide tape wound on a reel, 1/4-inch-wide tape in data cartridges and cassettes, and tapes that look like ordinary music cassettes but are designed to store data instead of music. The amount of data on a tape is expressed in terms of density, which is the number of characters per inch (cpi) or bytes per inch (bpi) that can be stored on the tape.

The highest-capacity tape is the digital audio tape, or DAT, which uses a different method of recording data. Using a method called helical scan recording, DAT wraps around a rotating read/write head that spins vertically as it moves. This places the data in diagonal bands that run across the tape rather than down its length. This method produces high density and faster access to data.

Two reels are used, a supply reel and a take-up reel. The supply reel, which has the tape with data on it or on which data will be recorded, is the reel that is changed. The take-up reel always stays with the magnetic tape unit. Many cartridges and cassettes have the supply and take-up reels built into the same case.

Tape now has a limited role because disk has proved the superior storage

medium. Disk data is quite reliable, especially within a sealed module. Furthermore, as we will see, disk data can be accessed directly, as opposed to data on tape, which can be accessed only by passing by all the data ahead of it on the tape. Consequently, the primary role of tape today is as an inexpensive backup medium.

8.11 Backup Systems

Although a hard disk is an extremely reliable device, a hard disk drive is subject to electromechanical failures that cause loss of data. Furthermore, data files, particularly those accessed by several users, are subject to errors introduced by users. There is also the possibility of errors introduced by software. With any method of data storage, a backup system a way of storing data in more than one place to protect it from damage and errors is vital. As we have already noted, magnetic tape is used primarily for backup purposes. For personal computer users, an easy and inexpensive way to back up a hard disk file is to simply copy it to a diskette whenever it is updated. But this is not practical for a system with many files or many users.

Personal computer users have the option of purchasing their own tape backup system, to be used on a regular basis for copying all data from hard disk to a high-capacity tape. Data thus saved can be restored to the hard disk later if needed. A key advantage of a tape backup system is that it can copy the entire hard disk in minutes, saving you the trouble of swapping diskettes in and out of the machine.

A rule of thumb among computer professionals is to estimate disk needs generously and then double that amount. But estimating future needs is rarely easy. Many users, therefore, make later adjustments like adding a removable hard disk cartridge to accommodate expanding storage needs. To quote many a computer user, "I just couldn't envision how I could use all that disk space. Now I can imagine even the extra disk filling up."

8.12 Flash memory

Electronic memory comes in a variety of forms to serve a variety of purposes. Flash memory is used for easy and fast information storage in computers, digital cameras and home video game consoles. It is used more like a hard drive than as RAM. In fact, flash memory is known as a **solid state** storage device, meaning there are no moving parts -- everything is electronic instead of mechanical.

Here are a few examples of flash memory:

- Your computer's BIOS chip
- CompactFlash (most often found in digital cameras)
- SmartMedia (most often found in digital cameras)
- Memory Stick (most often found in digital cameras)
- PCMCIA Type I and Type II memory cards (used as solid-state disks in laptops)
- Memory cards for video game consoles

Flash memory is a type of **EEPROM** chip, which stands for **Electronically Erasable Programmable Read Only Memory**. It has a grid of columns and rows with a cell that has two transistors at each intersection.

8.13 File access and storage methods

How data files are stored in secondary storage varies with the types of media and devices you are using. Data files may be stored on or in sequential-access storage, direct-access storage, or random-access storage.

SEQUENTIAL-ACCESS STORAGE

This is a technology whereby stored data can be retrieved in only the order in which it is physically stored. Punched cards, paper tape, and magnetic tape are examples of sequential-access storage media. When operating in a sequential environment, a particular record can be read only by first reading all the records that come before it in the file. When you store a file on tape, the 125th record cannot be read until the 124 records in front of it are read. The records are read in sequence. You cannot read just any record at random. This is also true when reading punched cards or paper tape.

DIRECT-ACCESS STORAGE

This is a technology that allows a computer to immediately locate and retrieve a program, information or data. Direct-access storage allows you to access the 125th record without first having to read the 124 records in front of it. Magnetic disks and drums are examples of direct-access storage media. Data can be obtained quickly from anywhere on the media. However, the amount of time it takes to access a record is dependent to some extent on the mechanical process involved. It is usually necessary to scan some (but not all) of the preceding data.

RANDOM-ACCESS STORAGE

Random-access storage media refers to magnetic core, semiconductor, thin film, and bubble storage. Here, a given item of data can be selected from anywhere in storage without having to scan any preceding items. And, the access time is independent of the storage location.

8.14 Chapter review questions

1. On a floppy disk, a numbered concentric circle is called a
(a) Sector (b) Cluster (c) Track (d) Ring
2. On a compact disc, a laser records data by burning tiny indentations onto the disc surface called
(a) Lands (b) Pits (c) Tracks (d) Sectors
3. Which one of the following is not an optical disk format?
(a) Hard disk (b) CD-ROM (c) CD-RW (d) DVD
4. On a floppy disk, data is stored along the _____ and in the _____

8.15 Suggested Readings

- 1) Fuller F., Larson B., Computers: Understanding Technology(Second Edition)
Pages 120-134

CHAPTER NINE: HOW TO UPGRADE A SLOW COMPUTER

Chapter objectives

At the end of the chapter the learner shall be able to;

- Upgrade a slow computer
- Identify the components that need to be changed in order to increase the speed of a computer
- Explain how to Change the CPU and the RAM of a computer while upgrading

There are many reasons for a slow computer, but upgrading the computer's hardware can help speed it up. The CPU and the RAM are two main components that can be upgraded to increase a computer's speed, though doing this may require replacing the motherboard as well.

9.1 Changing the parts

1. If the motherboard is compatible with the new CPU and RAM, it is not necessary to change it out. But if it's not, a compatible one must be used. Determine the compatibility by reading the motherboard specifications from the manual or by searching for the correct specifications on the manufacturer's website. Make sure all components are compatible before moving on.
2. Turn off the computer and unplug it. Take off the side panel to access the inside of the computer.
3. Unhook the various wires that are connected to the motherboard. This may include hard-drive wires, case wires, disc drive wires and power cables.
4. Remove all PCI cards from the motherboard. It may be necessary to unscrew the cards from the chassis of the computer.
5. Unscrew the motherboard. Use a nonmagnetic screwdriver to avoid damage.
6. Remove the motherboard with the CPU (including the cooling device) and RAM still attached.
7. If the motherboard is compatible with the new CPU and RAM, remove the old CPU and RAM. Unclip the RAM, then remove it. For the CPU, it may be necessary to unscrew the cooling device to access the CPU socket. Unclip the socket and remove the CPU.
8. Whether the motherboard is compatible or if a new motherboard is being used, a backplate may need to be installed. Do this before installing anything else.
9. Insert the new RAM onto the motherboard, making sure it clips into place.
10. Insert the new CPU into the socket and clip it in place.

11. Put a small amount of thermal paste on the CPU, then connect the cooling device.
12. Put the motherboard back into the case by screwing it in first, then connecting all the wires back into place. It may be necessary to refer to the manual to ensure the various wires are connected correctly.
13. Close the case, then turn the computer on.

9.2 Upgrading Memory

RAM Installation

When you remove the DIMM memory module from its packaging hold it by the edges, try not to touch the gold coloured contacts, as this can damage the memory.



Take a look at the images below on the right, as you can see, we have pointed out certain parts of the DIMM memory module and the DIMM slot.

In **Fig 1.2**, the notches we have marked as **A**, are used for the ejector clip on the DIMM slot (see later).

The notches we have marked as **B**, are used to align the memory module with the DIMM slot keys **C**, as shown in **Fig 1.3**



In **Fig 1.3** you can see the ejector clips (**D**), using your finger, push these into the down position as shown in **Fig 1.3**, this allows the memory to be inserted.

9.3 Changing a CPU

Instructions

1. First unplug the power cord from the computer and then all external peripherals connected to the computer, i.e. monitor, printer, network cable.
2. The next thing would be to remove the chassis cover off the desktop. Some covers have screws while others have snap-in place latches. Remove the cover and set it to the side.

3. The next step is a very important step. Once the cover is off it is important to ground the static electricity from you. This accomplished by touching the computer chassis for several moments. This will drain the static electricity from you which can fry the microprocessors that you will be handling.



4. Next you would have to locate the microprocessor on the motherboard which is commonly situated near the memory slots on the motherboard.
5. After locating the microprocessor, you must lift the lever which will remove the microprocessor from the motherboard. Be careful lifting the microprocessor from its slot as the pins are easily bent. Once the microprocessor is removed set it on a static free surface.
6. You now must take out your new microprocessor, handling it by the sides only. You can place it in the slot that the old microprocessor was taken from. Notice that the microprocessor has a corner that cut off or the tip is painted. This is a marking to show how the microprocessor fits into the slot. When pressing the microprocessor in the slot be gentle but firmly. Again be careful the pins bend easily enough.
7. Lower and secure the lever back in place so the microprocessor is seated correctly on the motherboard.
8. Replace the chassis cover, reconnect the cable to the computer and turn on the computer to ensure that the computer is working properly. If the microprocessor is seated right all things should be fine.

9.4 Chapter review questions

1. What are the different hardware devices that could be upgraded in a slow computer?
2. Why would a computer technician need to change the hard disk of a computer while upgrading a computer?

9.5 Suggested Readings

- 1) Fuller F., Larson B., Computers: Understanding Technology(Second Edition) Pages 70-78

CHAPTER TEN: INTRODUCTION TO BINARY NUMBERS

Chapter objectives

At the end of the chapter the learner shall be able to;

- Explain how computers store data
- Convert binary numbers to denary and vice versa
- Perform binary calculations such as Addition, subtraction, multiplication and division
- Convert Denary numbers to hexadecimal

10.1 How Computers Store Numbers

Computer systems are constructed of digital electronics. That means that their electronic circuits can exist in only one of two states: on or off. Most computer electronics use voltage levels to indicate their present state. For example, a transistor with five volts would be considered "on", while a transistor with no voltage would be considered "off." Not all computer hardware uses voltage, however. CD-ROM's, for example, use microscopic dark spots on the surface of the disk to indicate "off," while the ordinary shiny surface is considered "on." Hard disks use magnetism, while computer memory uses electric charges stored in tiny capacitors to indicate "on" or "off."

These patterns of "on" and "off" stored inside the computer are used to encode numbers using the *binary number system*. The binary number system is a method of storing ordinary numbers such as 42 or 365 as patterns of 1's and 0's. Because of their digital nature, a computer's electronics can easily manipulate numbers stored in binary by treating 1 as "on" and 0 as "off." Computers have circuits that can add, subtract, multiply, divide, and do many other things to numbers stored in binary.

A binary digit (1 or 0) is known as a Binary digit which in short is a bit. A byte can hold 256 different combinations of 0s and 1s, which means that for example, 256 different characters can be represented. The normal number system we use is called the decimal or the denary number system.

10.2 Basic Concepts Behind the Binary System

To understand binary numbers, begin by recalling elementary school math. When we first learned about numbers, we were taught that, in the decimal system, things are organized into columns:

H	T	O
1	9	3

such that "H" is the hundreds column, "T" is the tens column, and "O" is the ones column. So the number "193" is 1-hundreds plus 9-tens plus 3-ones.

Years later, we learned that the ones column meant 10^0 , the tens column meant 10^1 , the hundreds column 10^2 and so on, such that

10^2	10^1	10^0
1	9	3

the number 193 is really $\{(1 \cdot 10^2) + (9 \cdot 10^1) + (3 \cdot 10^0)\}$.

As you know, the decimal system uses the digits 0-9 to represent numbers. If we wanted to put a larger number in column 10^n (e.g., 10), we would have to multiply $10 \cdot 10^n$, which would give $10^{(n+1)}$, and be carried a column to the left. For example, putting ten in the 10^0 column is impossible, so we put a 1 in the 10^1 column, and a 0 in the 10^0 column, thus using two columns. Twelve would be $12 \cdot 10^0$, or $10^0(10+2)$, or $10^1 + 2 \cdot 10^0$, which also uses an additional column to the left (12).

The binary system works under the exact same principles as the decimal system, only it operates in base 2 rather than base 10. In other words, instead of columns being

10^2	10^1	10^0
they are		
2^2	2^1	2^0

Instead of using the digits 0-9, we only use 0-1 (again, if we used anything larger it would be like multiplying $2 \cdot 2^n$ and getting 2^{n+1} , which would not fit in the

2^n column. Therefore, it would shift you one column to the left. For example, "3" in binary cannot be put into one column. The first column we fill is the right-most column, which is 2^0 , or 1. Since $3 > 1$, we need to use an extra column to the left, and indicate it as "11" in binary ($1 \cdot 2^1 + 1 \cdot 2^0$).

Examples: What would the binary number 1011 be in decimal notation?

Try converting these numbers from binary to decimal:

- 10
- 111
- 10101
- 11110

Remember:

2^4		2^3		2^2		2^1		2^0
						1		0
			1			1		1
1		0		1		0		1
1		1		1		1		0

10.3 Binary Addition

Consider the addition of decimal numbers:

```

23
+48
—
```

We begin by adding $3+8=11$. Since 11 is greater than 10, a one is put into the 10's column (carried), and a 1 is recorded in the one's column of the sum. Next, add $\{(2+4) + 1\}$ (the one is from the carry)=7, which is put in the 10's column of the sum. Thus, the answer is 71.

Binary addition works on the same principle, but the numerals are different. Begin with one-bit binary addition:

```

0 0 1
+0 +1 +0
— — —
0 1 1
```

1+1 carries us into the next column. In decimal form, $1+1=2$. In binary, any digit higher than 1 puts us a column to the left (as would 10 in decimal notation). The decimal number "2" is written in binary notation as "10" ($1 \cdot 2^1 + 0 \cdot 2^0$). Record the 0 in the ones column, and carry the 1 to the twos column to get an answer of "10." In our vertical notation,

$$\begin{array}{r} 1 \\ +1 \\ \hline 10 \end{array}$$

The process is the same for multiple-bit binary numbers:

$$\begin{array}{r} 1010 \\ +1111 \\ \hline \end{array}$$

- Step one:
Column 2^0 : $0+1=1$.
Record the 1.
Temporary Result: 1; Carry: 0
- Step two:
Column 2^1 : $1+1=10$.
Record the 0, carry the 1.
Temporary Result: 01; Carry: 1
- Step three:
Column 2^2 : $1+0=1$ Add 1 from carry: $1+1=10$.
Record the 0, carry the 1.
Temporary Result: 001; Carry: 1
- Step four:
Column 2^3 : $1+1=10$. Add 1 from carry: $10+1=11$.
Record the 11.
Final result: 11001

Alternately:

$$\begin{array}{r} 11 \text{ (carry)} \\ 1010 \\ +1111 \\ \hline 11001 \end{array}$$

Always remember

- $0+0=0$
- $1+0=1$
- $1+1=10$

Try a few examples of binary addition:

$$\begin{array}{r} 111 \\ +110 \\ \hline \end{array} \quad \begin{array}{r} 101 \\ +111 \\ \hline \end{array} \quad \begin{array}{r} 111 \\ +111 \\ \hline \end{array}$$

10.4 Binary Multiplication

Multiplication in the binary system works the same way as in the decimal system:

- $1*1=1$
- $1*0=0$
- $0*1=0$

$$\begin{array}{r} 101 \\ * 11 \\ \hline 101 \\ 1010 \\ \hline 1111 \end{array}$$

Note that multiplying by two is extremely easy. To multiply by two, just add a 0 on the end.

10.5 Binary Division

Follow the same rules as in decimal division. For the sake of simplicity, throw away the remainder.

For Example: $111011/11$

$$\begin{array}{r} 10011 \text{ r } 10 \\ \hline 11)111011 \\ -11 \end{array}$$

$$\begin{array}{r}
 \hline
 101 \\
 -11 \\
 \hline
 101 \\
 11 \\
 \hline
 10
 \end{array}$$

10.6 Decimal to Binary

Converting from decimal to binary notation is slightly more difficult conceptually, but can easily be done once you know how through the use of algorithms. Begin by thinking of a few examples. We can easily see that the number $3 = 2 + 1$, and that this is equivalent to $(1 \cdot 2^1) + (1 \cdot 2^0)$. This translates into putting a "1" in the 2^1 column and a "1" in the 2^0 column, to get "11". Almost as intuitive is the number 5: it is obviously $4 + 1$, which is the same as saying $[(2 \cdot 2) + 1]$, or $2^2 + 1$. This can also be written as $[(1 \cdot 2^2) + (1 \cdot 2^0)]$. Looking at this in columns,

$$\begin{array}{r}
 2^2 \mid 2^1 \mid 2^0 \\
 1 \quad 0 \quad 1
 \end{array}$$

or 101.

What we're doing here is finding the largest power of two within the number ($2^2=4$ is the largest power of 2 in 5), subtracting that from the number ($5-4=1$), and finding the largest power of 2 in the remainder ($2^0=1$ is the largest power of 2 in 1). Then we just put this into columns. This process continues until we have a remainder of 0. Let's take a look at how it works. We know that:

$$\begin{array}{l}
 2^0=1 \\
 2^1=2 \\
 2^2=4 \\
 2^3=8 \\
 2^4=16 \\
 2^5=32 \\
 2^6=64 \\
 2^7=128
 \end{array}$$

and so on. To convert the decimal number 75 to binary, we would find the largest power of 2 less than 75, which is 64. Thus, we would put a 1 in the 2^6 column, and subtract 64 from 75, giving us 11. The largest power of 2 in 11 is 8, or 2^3 . Put 1 in the 2^3 column, and 0 in 2^4 and 2^5 . Subtract 8 from 11 to get 3.

Put 1 in the 2^1 column, 0 in 2^2 , and subtract 2 from 3. We're left with 1, which goes in 2^0 , and we subtract one to get zero. Thus, our number is 1001011.

Making this algorithm a bit more formal gives us:

1. Let D = number we wish to convert from decimal to binary
2. Repeat until $D=0$
 - o a. Find the largest power of two in D . Let this equal P .
 - o b. Put a 1 in binary column P .
 - o c. Subtract P from D .
3. Put zeros in all columns which don't have ones.

This algorithm is a bit awkward. Particularly step 3, "filling in the zeros." Therefore, we should rewrite it such that we ascertain the value of each column individually, putting in 0's and 1's as we go:

1. Let D = the number we wish to convert from decimal to binary
2. Find P , such that 2^P is the largest power of two smaller than D .
3. Repeat until $P < 0$
 - o If $2^P \leq D$ then
 - put 1 into column P
 - subtract 2^P from D
 - o Else
 - put 0 into column P
 - o End if
 - o Subtract 1 from P

Now that we have an algorithm, we can use it to convert numbers from decimal to binary relatively painlessly. Let's try the number $D=55$.

- Our first step is to find P . We know that $2^4=16$, $2^5=32$, and $2^6=64$. Therefore, $P=5$.
- $2^5 \leq 55$, so we put a 1 in the 2^5 column: 1-----.
- Subtracting $55-32$ leaves us with 23. Subtracting 1 from P gives us 4.
- Following step 3 again, $2^4 \leq 23$, so we put a 1 in the 2^4 column: 11----.
- Next, subtract 16 from 23, to get 7. Subtract 1 from P gives us 3.
- $2^3 > 7$, so we put a 0 in the 2^3 column: 110---
- Next, subtract 1 from P , which gives us 2.
- $2^2 \leq 7$, so we put a 1 in the 2^2 column: 1101--
- Subtract 4 from 7 to get 3. Subtract 1 from P to get 1.
- $2^1 \leq 3$, so we put a 1 in the 2^1 column: 11011-
- Subtract 2 from 3 to get 1. Subtract 1 from P to get 0.
- $2^0 \leq 1$, so we put a 1 in the 2^0 column: 110111

- Subtract 1 from 1 to get 0. Subtract 1 from P to get -1.
- P is now less than zero, so we stop.

10.7 Another algorithm for converting decimal to binary

However, this is not the only approach possible. We can start at the right, rather than the left.

All binary numbers are in the form

$$a[n]*2^n + a[n-1]*2^{(n-1)} + \dots + a[1]*2^1 + a[0]*2^0$$

where each $a[i]$ is either a 1 or a 0 (the only possible digits for the binary system). The only way a number can be odd is if it has a 1 in the 2^0 column, because all powers of two greater than 0 are even numbers (2, 4, 8, 16...). This gives us the rightmost digit as a starting point.

Now we need to do the remaining digits. One idea is to "shift" them. It is also easy to see that multiplying and dividing by 2 shifts everything by one column: two in binary is 10, or $(1*2^1)$. Dividing $(1*2^1)$ by 2 gives us $(1*2^0)$, or just a 1 in binary. Similarly, multiplying by 2 shifts in the other direction: $(1*2^1)*2=(1*2^2)$ or 10 in binary. Therefore

$$\{a[n]*2^n + a[n-1]*2^{(n-1)} + \dots + a[1]*2^1 + a[0]*2^0\}/2$$

is equal to

$$a[n]*2^{(n-1)} + a[n-1]*2^{(n-2)} + \dots + a[1]*2^0$$

Let's look at how this can help us convert from decimal to binary. Take the number 163. We know that since it is odd, there must be a 1 in the 2^0 column ($a[0]=1$). We also know that it equals $162+1$. If we put the 1 in the 2^0 column, we have 162 left, and have to decide how to translate the remaining digits.

Two's column: Dividing 162 by 2 gives 81. The number 81 in binary would also have a 1 in the 2^0 column. Since we divided the number by two, we "took out" one power of two. Similarly, the statement $a[n-1]*2^{(n-1)} + a[n-2]*2^{(n-2)} + \dots + a[1]*2^0$ has a power of two removed. Our "new" 2^0 column now contains $a[1]$. We learned earlier that there is a 1 in the 2^0 column if the number is odd. Since 81 is odd, $a[1]=1$. Practically, we can simply keep a "running total", which now stands at 11 ($a[1]=1$ and $a[0]=1$). Also note that $a[1]$ is essentially "remultiplied" by two just by putting it in front of $a[0]$, so it is automatically fit into the correct column.

Four's column: Now we can subtract 1 from 81 to see what remainder we still must place (80). Dividing 80 by 2 gives 40. Therefore, there must be a 0 in the 4's column, (because what we are actually placing is a 2^0 column, and the number is not odd).

Eight's column: We can divide by two again to get 20. This is even, so we put a 0 in the 8's column. Our running total now stands at $a[3]=0$, $a[2]=0$, $a[1]=1$, and $a[0]=1$.

We can continue in this manner until there is no remainder to place.

Let's formalize this algorithm:

1. Let D = the number we wish to convert from decimal to binary.
 2. Repeat until $D=0$:
 - a) If D is odd, put "1" in the leftmost open column, and subtract 1 from D .
 - b) If D is even, put "0" in the leftmost open column.
 - c) Divide D by 2.
- End Repeat

For the number 163, this works as follows:

1. Let $D=163$
2. b) D is odd, put a 1 in the 2^0 column.
Subtract 1 from D to get 162.
c) Divide $D=162$ by 2.
Temporary Result: 01 New $D=81$
 D does not equal 0, so we repeat step 2.

2. b) D is odd, put a 1 in the 2^1 column.
Subtract 1 from D to get 80.
c) Divide $D=80$ by 2.
Temporary Result: 11 New $D=40$
 D does not equal 0, so we repeat step 2.

2. b) D is even, put a 0 in the 2^2 column.
c) Divide D by 2.
Temporary Result: 011 New $D=20$

2. b) D is even, put a 0 in the 2^3 column.
c) Divide D by 2.
Temporary Result: 0011 New $D=10$

2. b) D is even, put a 0 in the 2^4 column.
c) Divide D by 2.
Temporary Result: 00011 New $D=5$

2. a) D is odd, put a 1 in the 2^5 column.

Subtract 1 from D to get 4.

c) Divide D by 2.

Temporary Result: 100011 New D=2

2. b) D is even, put a 0 in the 2^6 column.

c) Divide D by 2.

Temporary Result: 0100011 New D=1

2. a) D is odd, put a 1 in the 2^7 column.

Subtract 1 from D to get D=0.

c) Divide D by 2.

Temporary Result: 10100011 New D=0

D=0, so we are done, and the decimal number 163 is equivalent to the binary number 10100011.

Since we already knew how to convert from binary to decimal, we can easily verify our result. $10100011 = (1 \cdot 2^0) + (1 \cdot 2^1) + (1 \cdot 2^5) + (1 \cdot 2^7) = 1 + 2 + 32 + 128 = 163$.

10.8 Hexadecimal

Binary is an effective number system for computers because it is easy to implement with digital electronics. It is inefficient for humans to use binary, however, because it requires so many digits to represent a number. The number 76, for example, takes only two digits to write in decimal, yet takes seven digits to write in binary (1001100). To overcome this limitation, the *hexadecimal number system* was developed. Hexadecimal is more compact than binary but is still based on the digital nature of computers.

Hexadecimal works in the same way as binary and decimal, but it uses sixteen digits instead of two or ten. Since the western alphabet contains only ten digits, hexadecimal uses the letters A-F to represent the digits ten through fifteen. Here are the digits used in hexadecimal and their equivalents in binary and decimal:

Hex	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Binary	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111

Let's count in hexadecimal. Starting from zero, we count 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F. At this point there are no more digits, so we add another column. Continue counting: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1A, 1B, 1C, 1D, 1E, 1F. Once

again, we are out of digits in the first column, so we add one to the next column. Continue counting once again: 20, 21, 22, ..., 29, 2A, 2B, 2D, 2E, 2F, 30, 31, 32, ..., 3E, 3F, 40, 41, 42, ... 99, 9A, 9B, 9C, 9D, 9E, 9F, A0, A1, A2, ... F9, FA, FB, FC, FD, FE, FF, 100, 101, 102, ... Watch the pattern of numbers and try to relate this to the way you count in decimal or binary. You will see that it is the same procedure, but with sixteen digits instead of 10 or 2.

Each column in hexadecimal is worth 16 times the column before, while each column in binary is worth 2 times the column before. Since $2 \times 2 \times 2 \times 2 = 16$, this means that each hexadecimal digit is worth exactly four binary digits. This fact makes it easy to convert between binary and hexadecimal.

To convert from hexadecimal to binary, simply look at the chart above and replace each digit in the hexadecimal number with its corresponding four-digit binary number. For example, 8F in hexadecimal is 10001111 in binary, since $8=1000$ and $F=1111$.

To convert from binary to hexadecimal, reverse the procedure and break the binary number into blocks of four digits. Then, replace each block of four digits with its corresponding hexadecimal digit. If you cannot divide the binary number evenly into blocks of four digits, add zeros to the left side of the number to make it work. For example, to convert 110101 to hexadecimal, first add two zeros at the beginning of the number to make it 00110101. Since 00110101 has eight digits, it can be divided into two blocks of four digits, 0011 and 0101. Since $0011=3$ and $0101=5$, the corresponding hexadecimal number is 35.

10.9 Chapter review questions

1. What is the largest number that can be held in 8 bits?
2. Convert the following binary numbers to decimal
 - a) 0011
 - b) 0110
 - c) 1010
 - d) 01000001
3. Convert the following decimal numbers to binary
 - a) 50
 - b) 75
 - c) 250
 - d) 67
4. Perform the following binary calculations
 - a) $0110 + 0101$
 - b) $1111 - 1010$
 - c) $0101 * 1101$
 - d) $1010101 / 0101$
5. Convert the following decimal numbers to hexadecimal
 - a) 19
 - b) 45
 - c) 77
 - d) 101

10.10 Suggested Readings

<http://www.math.grin.edu/~rebelsky/Courses/152/97F/Readings/student-binary>

REVIEW QUESTIONS ANSWERS

Chapter 1.

1. C 2. D 3. A 4. D 5. True

Chapter 2

1. D 2. B 3. B 4. D 5. C

Chapter 8

1 C, 2, B 3, A 4. tracks and sectors

Chapter 10

Answers

1 255

2. a) 3 b) 6 c) 10 d) 65

3. a) 110010 b) 1001011 c) 11111010 d) 1000011

4. a) 1011 b) 0101 c) 1000001 d) 10001

5 a) 13 b) 2D c) 4D d) 65

SAMPLE QUESTION PAPERS

Mt Kenya



University

UNIVERSITY EXAMINATION 2009/2010

SCHOOL OF APPLIED AND SOCIAL SCIENCES
DEPARTMENT OF INFORMATION TECHNOLOGY

SEMSTER I EXAMINATION FOR BACHELOR OF SCIENCE IN BUSINESS
INFORMATION TECHNOLOGY

COURSE CODE: BIT 1105
COURSE TITLE: COMPUTER ARCHITECTURE

DATE: NOVEMBER 2009

TIME: 2HRS

INSTRUCTIONS

Answer Question One And Any Other Two

QUESTION ONE

- (a) Name the **two** major components of the Central Processing Unit (processor) and briefly describe what each does. (6 marks)
- (b) List **four** of the conditions an ALU tests for. (4 marks)
- (c) Explain the use of registers in the CPU. (2 marks)
- (d) Convert the following into decimal showing your working:
(i) 010111 (ii) 101101 (2 marks)
- (d) Convert the following into binary showing your working:
i) 45 ii) 97 (2 marks)
- (e) Differentiate between RAM and ROM (2 marks)
- (f) What is a computer bus? State three types of computer buses (4 marks)
- (e) Computers have evolved through many generations over the years. State and explain the five generations the computers have evolved through. (8 marks)

(Total 30 marks)

QUESTION TWO

- (a) As you know, computers rely on accurate data input in order to provide reliable outputs. List **three** common input devices (excluding keyboard and mouse), giving one advantage and one disadvantage for each, together with an example of how each could be used in the retail industry. (12 marks)

(b) Input and output devices usually connect to a PC via “ports”. List the names of **four** different ports found on modern computers, together with a type of device usually associated with each port. (8 marks)

(Total 20 marks)

QUESTION THREE

The Managing Director of Traco Sacco wants to assemble his own personal computer:

- I. Outline the major components of system unit he needs to acquire. (8Marks)
- II. Advise him on the basic input and output devices he needs to buy. (2 Marks)
- III. He realize that he needed to watch television and listen to radio on the same machine. Identify the type of card and slot where he need to plug it. (2 Marks)
- IV. Later he bought a digital camera. Advise him on which port he needs to connect it to. (2 Marks)
- V. Explain the two major types of software he needs to install in the computer. Give two examples. (6 Marks)

QUESTION FOUR

- (a) Describe how data is organised in a magnetic disk drive. Clarify your answer using a clearly labeled sketch. (12 marks)
- (b) Disk performance is greatly dependent upon access time, the time required to directly access data on the disk. Describe the **three** major factors on which access time depends. (6 marks)
- (c) How can physical access time be improved? (2 marks)

(Total 20 marks)

QUESTION FIVE

- (a) Explain the difference between serial and parallel data transmission, and describe an example of a hardware device or communication channel that uses each method. (8 marks)
- (b) Expand the following abbreviations and give a brief description of each term:
 - (i) CPU
 - (ii) ALU
 - (iii) ASCII
 - (iv) CMOS
 - (v) GHz
 - (vi) BIT

(12 marks)

(Total 20 marks)

Mt Kenya



University

UNIVERSITY EXAMINATION 2010
SCHOOL OF APPLIED AND SOCIAL SCIENCES
DEPARTMENT OF INFORMATION TECHNOLOGY
SEMSTER I EXAMINATION FOR BACHELOR OF BUSINESS
INFORMATION TECHNOLOGY
COURSE CODE: BIT 1105
COURSE TITLE: COMPUTER ARCHITECTURE

DATE: APRIL 2010

TIME: 2HRS

INSTRUCTIONS

Answer Question One And Any Other Two

Question One

(a). i) Define the following computer terms

- | | |
|-----------------|--------|
| (a). Computer | (2mks) |
| (b). Input | (2mks) |
| (c). Output | (2mks) |
| (d). Processing | (2mks) |
| (e). VDU | (2mks) |

(ii). Differentiate between RAM and ROM (2mks)

b. (i). Computers have evolved through many generations over the years. State and explain the five generations the computers have evolved through.

(6mks)

(ii). (a). What is a computer bus? State three types of computer buses

(3mks)

(b) State and explain any FOUR motherboard form factors while stating their dimensional differences.

(4mks)

(c). State the four different ways they are used to characterize motherboards.

(2mks)

(iii). What is an application software? State and explain two types of application software giving examples in each case.

(3mks)

Question Two

a. Describe four ways of classifying computer memory (4mks)

- b. Using an illustrative diagram, describe the characteristics and components of a computer architecture based on the Von Neumann Model. (8mks)
- c. Define the following disk performance terms.
 - i. Access time
 - ii. Seek time
 - iii. Rotational relay
 - iv. Transfer time
 - v. Latency (5mks)
- d. Explain how RAID hard disk technology is used for performance and reliability. (3mks)

Question Three

- (a). Define of the following computer terms while giving appropriate examples.
 - (i). Chipset (2mks)
 - (ii). CMOS battery (2mks)
 - (iii). BIOS (2mks)
 - (iv). PCI (2mks)
 - (v). AGP (2mks)
- (b). Perform the following binary calculations/arithmetic operations.
 - (i). $01110 - 10111$ (2mks)
 - (ii). $10111 + 01101$ (2mks)
 - (iii). $10111 - 01110$ (2mks)
 - (iv). $0110 * 1011$ (2mks)
 - (| v) Convert 65 to binary (2mks)
- (c). Indicate which kind of upgrades do the following fall under?
 - (i). 1.73 GHz to 2.56 GHz
 - (ii). 256MB to 512MB
 - (iii). 40GB to 120GB (3mks)
- (d). As you know, computers rely on accurate data input in order to provide reliable outputs. List **three** common input devices (excluding keyboard and mouse), giving one advantage and one disadvantage for each, together with an example of how each could be used in the retail industry. (7mks)

Question Four

- (a). Define computer data storage. (2mks)
- (b). Storage technologies at all levels of the storage hierarchy can be differentiated by evaluating certain core characteristics as well as measuring characteristics specific to a particular implementation. State and explain any five characteristics of storage. (10mks)

(c). There are THREE main types of computer storage devices, state and explain these three types. (8mks)

Question Five

- (a). Discuss the THREE main types of computers giving their features, advantages and disadvantages. (10mks)
- (b). Draw the internal structure of a computer, showing the six major parts and giving at least two functions of each part. (10mks)