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BASIC NOTIONS ABOUT COMPUTERS

All the books I consulted in the Reference section of the Federal University of Technology, Owerri Library convinced me of the need to discard the word 'NOTIONS' in my brief for the word 'NOTION'; to ensure a mwaningful consideration. Of the three definitions given by Webster's Third New International Dictionary, I976, the thist appeals to me :

> a mental apprehension or picture of whatever might be known or imagined : the meaning or content assigned by the mind to a term.

But whose mind is to be used as the yardstick ? We all realze how difficult it is to use words to describe any concept such that it leads to an unambiguous understanding of the entity being described. I am relying therefore on the Latin origin of the word NOTION, i.e. noscere, which means, "to know". We in the computer industry always understand computer knowldge to embrace

(a) history of computers;
(b) computer types and structure;
(c) systems analysis and design;
(d) computer programming; and
(e) the social impact of computers.

To do justice to any of the above I would have required the total time allocated to the current lecture series. Happily for us, the organizers have allocated next week's slot to applicatios. I intend only to scratch the surface by discussing globally a brief history, types and structure, and programming in the hope that I might have sufficiently aroused your interest and kidled the fire of enthusiasm in you to find out more about the fastest-growing industry today.

HISTORY

Man's earliest counting device is his finger. The ten fingers later proved inadequate, hence the resort to pebbles and grains of corn. The Chines invented the Abacus in 2600 B.C.The Japanes call it SOROBAN. One of the major obstacles to the development of counting devices is the non-acceptance of the Arabic numerals in Europe. Major developments took place during the Scientific Revolution (1543 - I687). The discoveries of the time include John Napier's logarithm (I6I7), William Oughtred's slide rule(I62I), Blaise Pascal's calculator (I642), and Gottfried Leibnitz' calculating machine.

Charles Babbage built a difference engine and outlined the basic idea for the building of an analytical engine which was not built at the time because the technology of his time was not advanced enough. Babbage is generally regarded as the father of computers because the idea he outlined - punched card input, I000 words of 50-digit each store, mill that

could add and subtract in one second but multiply and divide in one minute, automatic punched crds or printed printout, sequential program control, and 20-place accuracy - meant a prototype computer that was 100 years ahead of its time and which has remained the basis of all modern computers. In 1890 the United States Census Bureau was faced with the problem of not completing manually the compilation of the census returns before another one was due in 1900. The Bureau employed Herman Hollerith who developed a series of punched card machines which operated so efficiently that staff of the Bureau turned them off occasionally to protect their sinecures. The World War II time was particularly fertile for computer invention. The Germans built machines that calculated wing designs for the military aircraft industry; George Stibitz built a similar machine in the U.S. in 1939; the British built Collossus I that helped to break German codes. These three machines were the first computers to use the binary system, the standard internal language of present-day computers.

With engineering assistance from the International Business Machines (IBM), Howard Aiken developed the Automatic Sequence Controlled Calculator popularly called Mark I at Harvard University. The machine used relays (electromechanical on-off switches). Aiken later developed Mark II for the U.S. Navy, Mark III and Mark IV. Electronic Numerical Integrator and Calculator (ENIAC), the first machine to use electrical switches, was built at the University of Pennsylvania in 1946. ENIAC weighed 30 tons, contained more than 18000 vacuum tubes, and required more than 1,500 square feet of floor space. In 1949 the Electronic Delayed Storage Automatic Computer was built at the University of Cambridge. EDSAC only managed to beat EDVAC by a few months. Elecronic Discrete Variable Automatic Computer was built at the University of Pennsylvania in 1950 and became the first computer to utilise the Von Neumann stored program concept. The Universal Automatic Computer - I (UNIVAC-I) was manufactured in 1951. These vacuum tube computers are of the first gegeration.

In our bid to make the computer as small as possible and prodded by advances in electronics technology and solid state physics we have moved rapidly from the first generation to the promised FIFTH (early 1990s) within 40 years. We had the second generation of transistor-based computers in 1958; third generation small scale integrated cicuitry in 1963; fourth generation large scale monolythic integrated circuitry (chips) in 1972; and the intelligent computers promised to be manufactured by the Japanese in 1991 which we can only now speculate would be built with ULSI (ultra large scale integrated circuits).

COMPUTER TYPES

There are many criteria for classifying computers; we shall limit this in this discussion to two. What is the purpose for which a computer is built and what are its performance criteria? There are special-purpose computers

which are built to perform a particular function; ther are also general-purpose computers which would for our present exercise will be regarded as "jack of all trades" and master of all. According to this same criterion computers are categorised as analog (those that measure e.g. speedometer on car dash boards) and digital which count. There are also hybrid computers which incorporates the two in a single system. The special purpose are popular in military applications, digital in scientific and business, while the analog takes the pride of place in manufacturing control applications. The size of computers was used as an unquestionable basis for classifying machines until miniaturization made it meaningless. It was fashionable before the mid 1960s to talk about a big-sized computer as mainframe, a medium-sized computer was called a mini, but the micro had not come into existence by then. There are now microcomputers, minicomputers, mainframes and "monsters" (supercomputers) and the line of division seems to be fading from day-to-day.

I am sure that I am treading on dangerous grounds by attempting a definition of COMPUTER; most books shy away from the task. I am doing so because I believe that it is unconscionable to discuss computers without understanding what the term means. Computer is any machine that accepts data in a prescribed form, processes the data as demanded by a main program which is stored in its memory withoutany human intervention except for the purposes of supplying further data, and outputs the required results in a specified form to an output medium or as information or signal to control another machine or process.

COMPUTER STRUCTURE

Any computer system is made up of hardware, software, and 'liveware'. Since the latter refers to the computer professionals - the Data Processing Manager, the Systems Analysts, the Programmers, the Computer and other machine Operators, and the Data Control Staff - it is appropriate to leave them out of the Computer Structure discussion.

Hardware

This includes all the physical units in a computer centre. Broadly speaking these are the Central Processor Unit (CPU), the Input Units, and the Output Units. The CPU is made up of the main memory, the Arithmetic and Logic Unit (ALU), and the Control Unit.

The input units are physical entities that reads human-readable information, converts it into machine-readable form, and transfers same to mass storage units or direct into the computer memory if so requested. These include card readers, optical character readers, magnetic ink character readers, paper tape readers, light pen, etc.

The output units convert machine-readable information into human-readable form , for example the video display unit (VDU) , [illegible] printer,

card punch output, etc.

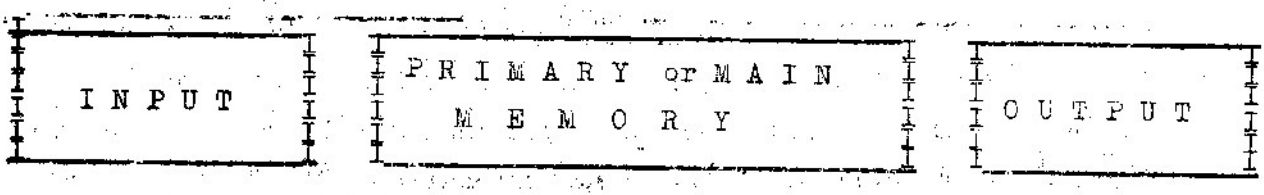
The power of the computer lies in its ability to transfer and process data in binary form. This would have been a major hinderance since a long chain of zero's and one's would have been required to represent large numbers but for the clever way in which storage is organized to utilize the speed of light. Main memory storage components are either magnetic core or semiconductor, the latter being either of the metal-oxide semiconductor or bipolar semiconductor chip type. The magnetic cores are wires through which electricity may pass and as a result magnetize doughnut-shaped cores through which they pass, reversing the direction of magnetization when the direction of electricity is reversed. Core storage is nonvolatile, i.e. core remains magnetized even after current stops flowing through the wires. Semiconductor is a combination of transistor (which is like a mechanical ON/OFF switch) and capacitor (which stores an electric charge while the transistor is in the ON position). This is a volatile storage; in fact, data may be lost in the event of power failure. Bipolar semiconductor chips are more expensive and are faster in operation than MOS, hence the use of the former in the construction of ALUs. The less expensive MOS is used as the building block of the main memory.

A new switch - the Josephson junction - is ten times faster than any switch in existence. It is a superconducting switch but has a big flaw which is likely to push its practical use a few years forward, the circuits must be wrapped in liquid helium and cooled to absolute zero.

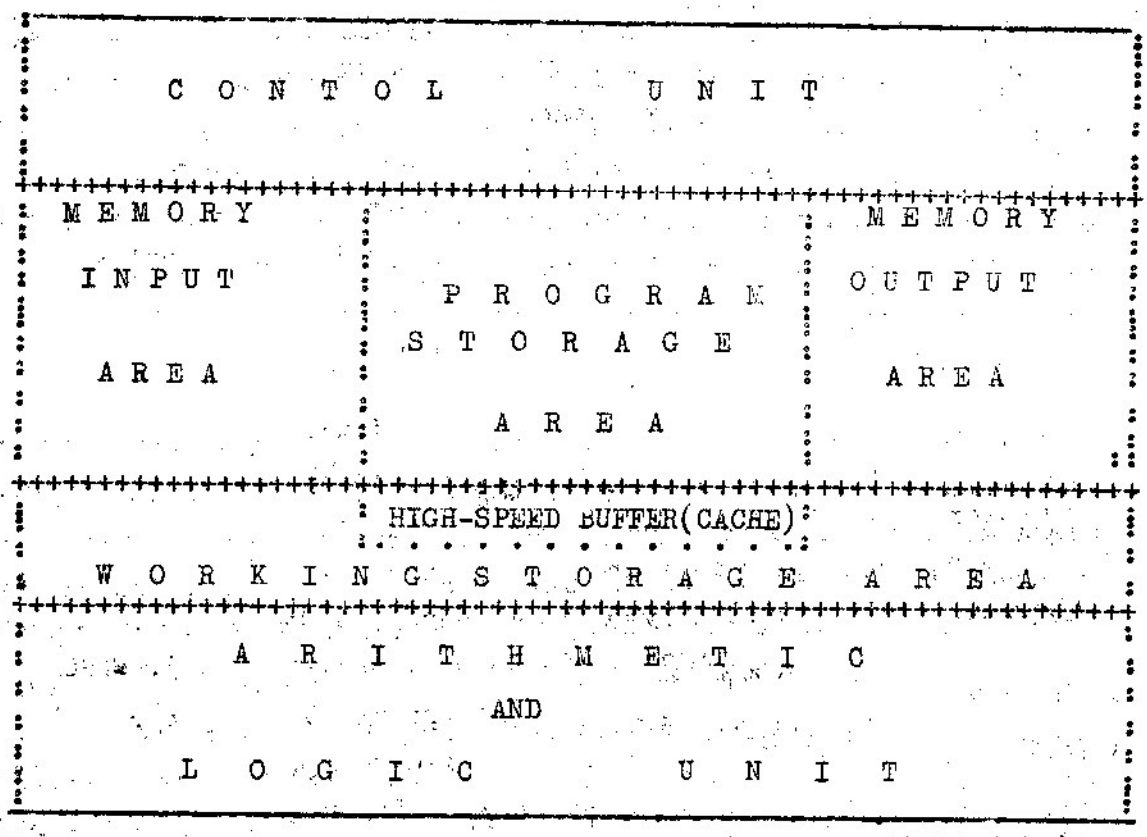
The basic unit of memory is the BInary digiT (BIT) and it can hold either a ONE or a ZERO. A group of bits make up a BYTE and this usually comprise of eight bits (International Computers Limited, ICL, has six bits to a byte). Byte is the minimum addressable portion of memory, i.e. it can store only one of the legal characters. A set of bits (between eight and sixty) make up a word of computer memory. Memory is divided in two - ROM (Read Only Memory) area and RAM (Random Access Memory) area. Rom is used for the controlling program - the operating system - which resides permanently in main memory. The Operating System is software which is essential even for the start-up of the system and is usually implemented in hardware, hence the reference to it as firmware. Only the RAM area is available for user programs.

RAM area is subdivided into four areas, input storage, output storage, working storage, and output storage. For fast processing purposes part of the working storage area is used as high-speed buffer with cache memory that is faster than main memory. The buffer is used as scratch pad for data and instructions likely to be retrieved many times during a particular program's execution. The size of memory and other peripheral storage media is always stated in kilo (2E+IO or IO24), or megabytes or megabits. Data is represented in the industry in one of the most popular 8-bit codes systems - the IBM's Extended Binary Coded Decimal Interchange Code (EBCDIC) or the American Standard Code for Information Interc[illegible]

fig. I : Computer Hardware Structure



(a). global hardware units.



(b). primary memory components.

(operating systems') programs . Any processing is either calculating or comparing. The Control Unit has instruction register(s), sequence register, address register, and decoder which select and interprete program instructions and ensure that they are executed.

SOFTWARE

This embraces any program meant for the execution of a specific function by a computer. A program is an exhaustively-detailed instruction showing the processes involved in converting input data into desired information or output and it must obey to the letter all the rules of grammar (syntax), rules of sense (semantics), logically correct, and compatible with the machine it is meant for. There are sources of software for computers- firmware from the computer manufacturer, applicati programs usually supplied by the manufacturer at a nominal price to their clients, packages bought from specialist software houses or commissioned agents, and programs written by individual registered users for computer

professionals in the computer centre. Faced with the uncomfortable situation of deciding whether to purchase packages or write own programs in the Nigerian context, one has to consider many factors. The price of the package in question, especially if it has to be purchased from a middle man; the maintenance and upgrading facilities to be provided; as well as the ability of the computer centre staff to write customised programs. It must always be bourne in mind that no application package can run on all computers. Those that would run are tailored to the needs of the firm for whom it was originally developed; of course, there are a few exceptions e.g. the Statistical Package for Social Sciences which has been successful mainly with IBM mainframe computers. Nigeria is still paying subsistence wages to most of her computer programmers; except in situations where time is of the essence in-house program develop development might be advisable for now. It is also important for self-development and the growth of the industry in this country.

PROGRAMMING

Programming is the art and science of writing, debugging, testing, and running (executing) a set of logical instructions for performing a computer task. There are in existence more than 300 computer languages although the popular ones are less than a dozen. They include BASIC (Beginners' All-purpose Symbolic Instruction Code), FORTRAN (FORmula TRANslator), COBOL (Common Business Oriented Language), PASCAL, ALGOL (ALGOrithmic Language), RPG (Report Program Generator), e.t.c. The examples above are those of high level languages (those which allow the programmer to write in modified English Language constructs. BASIC is of particular interest; programs can be written in IMMEDIATE mode (this enables the programmer to use the computer as a non-programmable calculator), or in DEFERRED/PROGRAM mode for future line-by-line interpretation.

A program may also be written in low level language, otherwise referred to as assembler programming. Low level language is closer to the machine code of the computer but it is tedious to learn and write although it compiles very fast on the computer. The third type of program is the series of zeroes and onesof the computer called the machine code. This is an almost impossible task.

Before one attempts to write a program it is necessary to understand the problem very well, draw a flowchart detailig the major steps planned to arrive at a satisfactory destination or alternatively write an algorithm.

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