INTRODUCTION TO MICROCOMPUTERS

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ABSTRACT: It has become impossible to pick up any periodical, newspaper, or professional literature without reading about the microcomputer revolution and it's coming effects on our personal and professional lives. Microcomputers have been called the fuel of the information age and the pencil of the eighties. From most accounts, it sounds as if through the simple pushing of a few buttons, anything we care to do is magically done for us by the microcomputer. Unfortunately, the reality of microcomputer usage is not that simple. While microcomputers are nothing more than electronic machines that are not difficult to understand, much of their actual use is clouded in mystique and jargon, Therefore, the aim of this paper is to provide an explanation of the components, terms, and usage of these marvelous machines to cast you off into the computer revolution.

While the advent of the computer could be traced to the ancient abacus, the first computer was built after World War II by Army engineers intent on discovering a quick method of computing the trajectory of missles. Their first computer utilized vacuum tubes, occupied two entire floors of a building and employed several people to constantly change tubes which blew out on an average of once every four seconds. With all it's size, that first computer had less capacity than most of today's microcomputers. The development of the microcomputer can be taken back to the mid 1960's with the formation of the Amateur Computing Society whose goal was to place computers in the hands of the general public. This was closely followed in the late sixties with the development by the Intel Corporation of the first microprocessor which moved computing circuits onto a small chip. This was followed by the first computer kit in 1971 and the first available microcomputer system in the mid seventies.

There are currently four types of computers available which all work in the same manner, however they are classified by their size. Most people are familiar with the mainframe computers which generally take up a large part of specially controlled room and have the capacity to handle many tasks at the same time (multitasking) and can handle a great number of users at the same time (multiuser). It is not unusual for a mainframe computer to have over 200 terminals hooked to it at remote sites and be working on thousands of operations. With a larger capacity are super computers which are used for gigantic number crunching problems as might be encountered in the space program. These supercomputers deal with billions of bits of data so rapidly that they take a mainframe computer to input and output the data. One step down from the mainframe is a minicomputer which has multitasking and multiuser capability however,

they are generally set up for less than 20 input terminals. At the smallest end of the scale are micro, alias home or personal computers which are typically set up to service a single user and perform fewer calculations in a slower manner than the previous types. As computer size continues to shrink and capacity continues to increase, these divisions become increasingly diffuse to the point where it is expected that future computers may be as small as calculators and have the capacity of today's supercomputers. One other artificial division among computers is the dedicated computer or microprocessor which is utilized to do only a few functions and the non-dedicated computer which can be programmed to do any function capable by a computer. A machine which only performs word processing is an example of a dedicated computer while a personal computer capable of playing games, working math, or doing word processing is an example of a non-dedicated computer.

How Computers Work

Computers are electronic machines which can only recognize electronic signals or current which is on or off. Thus, all information dealt with by the computer comes into the machine in a series of "on and offs", which can also be conceptualized plus and minus or 1 for on and 0 for off. Since such an elemental process is being dealt with by the computer, computer programmers utilize a system to communicate with the computer which exclusively uses the 1 for on and 0 for off concept, known as the binary or base 2 system or arithmetic. In the decimal or base 10 system with which most of us are familiar, each successive number from the right represents ten times the number. Therefore, in the number 256, the six is in the units place and stands for six times one, or six; the five is in the tens place and stands for five times 10 or 50; and the two is in the hundreds place and stands for two times 100 or 200. The number then becomes two hundred fifty six as it is represented in the decimal or base 10 system. In binary code or base 2, the first digit on the right stands for one, the second stands for two, the third for four, the fourth for eight, the fifth for sixteen, and so forth, so that each succeeding digit to the left represents double the amount of the last digit. Rather than being represented by digits 0 through 9 as is done in decimal, binary only uses 1 for on and 0 for off.

A binary representation of the decimal number 6 would be 1 1 0 where the rightmost digit is off meaning it is not counted, the second digit which stands for two is on and the third digit which stands for four is on. You can then add the third and fourth digit to get the total of the number. Another example may help. The binary number 1 1 1 0 0 1 1 1 is the equivalent of the decimal number 231. To convert it, start with the right most digit and add one because it is "on". The second digit to the right represents 2 which is added to the 1. The third digit represents four which is added. The fourth digit represents 8 but it is not added since it is 0 or "off". While this seems a cumbersome system to utilize, it actually uses fewer digits to represent large numbers than the decimal system to which we are accustomed and it places numbers in a form the computer readily understands. Although any number of digits can be utilized in the binary system, Computers are usually organized around multiples of eight digits. Each digit is called a "bit" and a set number of bits, often eight, makes up one number which is called a byte. Everything inputted to the computer is done so in binary form often utilizing eight bit bytes. Therefore, every key on the keyboard (which is similar to a standard typewriter keyboard) is represented in the computer by a byte, which is most often an eight bit binary number. There is a standard

number system conversion named American Standard Code for Information Exchange, or ASCII for short, which provides the same internal numbering system representation of the keyboard for microcomputers utilizing this code and makes it possible for them to talk to one another. Therefore, in ASCII code which most microcomputers utilize, when you type a lowercase letter "a", that letter is converted to the number 97 and enters the computer in the binary code 01100001 which stands for "a" and is one byte. As you can see, it does not take long to stack up quite a few 1's and 0's in the computer memory. However, most microcomputers have at least 48,000 bytes of working memory and can handle lots of 1's and 0's, or bits.

What, you may ask, does the computer do with all those bytes? Basically, it stores them in it's memory or manipulates them in it's registers. Imagine a postman standing in front of a hugh group of pigeonhole boxes numbered one at the top left to 1024 at the bottom right. As a byte or character comes to the postman, he places it in the topmost available pigeonhole and he remembers both what is in each hole and what the address is of each hole. After receiving all his data, instructions come to the postman to do things with the bytes stored at certain addresses. For example, he may be instructed to double the number in hole 200, add it to the number in 215 and store the result in 1021. That is exactly what a computer does. As you can see, the more pigeonholes available results in more which can be stored. 1024 of these bytes makes up a Kilobyte or K for short and the more K's of working memory available provides increasing capacity to store and process information. Microcomputers often come with at least 48 or 64 K storage and can often be expanded to 640 K or more. As software programs become more sophisticated, they require increasing amounts of memory so that often in this case, more is better. Computer memory is of two types, Random Access Memory (RAM) or Read Only Memory (ROM). RAM is memory which is lost each time the machine is turned off and to which the user can read or write. ROM is memory which can only be read by the user and which usually remains in the machine after it is turned off. RAM is often the memory for the user while Rom is often the memory utilized by the machine to make a program run. Now that you understand the workings of a computer, it might be helpful to know the hardware.

Hardware

All the storage memory, addresses, bits and bytes, registers, and other assorted things mentioned so far occur in the center of the computer known as the Central Processing Unit (CPU) which is where the action occurs. In order for information to get around in the computer it must be input with some device and it eventually is output to some device for the user to make sense out of the manipulations. During this process, the bytes travel along a common route which connects all the various parts known as the BUS. Theoretically, the fastest the information can move through the computer is the speed of light however, it moves much slower in actuality due to the resistance of the materials used in the circuits which causes some heat build up in the computer.

The most common way to input information is the use of a keyboard which can range from a standard typewriter-like keyboard to a large board filled with special function keys. Input can be accomplished by any device or means which can convert energy to numbers. Therefore, common devices include joysticks, bar code readers, light pens, touch tablets, digitizing cameras, switches, scanners, eye tracking mechanisms, air puff recorders, and even sensors which read brain waves. Since the

introduction of IBM's MacIntosh, a device called a mouse has become popular. It utilizes a light or mechanical ball which can be moved on a surface and control a corresponding cursor on the computer monitor. With an ingenious placing of menus on pull down windows on the screen, the mouse can be a quick method to indicate instructions and it probably is at its best as a pencil control to do computer graphics. Computers can also be activated through voice recognition; however this technology is in it's infancy, and we are likely to encounter a great many other methods of inputting data in the next few years, particularly novel methods which can be used by the disabled and those of us rusty in our typing skills.

To output from the CPU, the computer sends it's binary output electrical signals, which can be read by another computer through the use of a modem, that is most commonly displayed on a monitor or printer. Monitors differ from a regular television in that they contain many more dots of light, or pixels and give much better resolution. For working frequently with numbers and letters, it is recommended that a monochrome monitor, usually available in phosphorus green or amber, be utilized while a color monitor is must used with graphic displays. The other most common output is to a printer. Of the printers, three types have become most popular. The dot matrix printer contains an impact device behind a ribbon which has a number of dots which can be impacted on the paper to form characters. The results look like the printing on a cash register tape and while legible, are not considered letter quality. Dot matrix printers offer the advantages of speed (measured in characters per second CPS), the ability to do graphics, and low cost. Another type of impact printer utilizes the typing letters on a wheel resembling a daisy and provide a letter quality print. These are often used in office settings and offer the advantage of appearance but cost more and are slower. Lastly, the ink jet printers have gained in popularity as their price has dropped due to their advantage in quality of print and speed. Other possibilities are: laser printers which use a laser to print on a drum and produce and entire page at a time in a process similar to a copying machine but have been expensive; a printer using heat sensitive paper which is cheap but produces inferior results; a plotter which can produce graphics in color; and combinations and expansions of the above.

Two other forms of output popular particularly in blind rehabilitation are braille tape and speech synthesizers which do a remarkably good job of speaking the output. If you are purchasing any of these input or output devices, keep in mind that they need to have a way to interface or hook up with the CPU. Many microcomputers require the additional purchase of an interface card in the $50 - $2000 range in order to make the input/output or peripheral devices work.

At this point, you understand how a computer works in it's CPU, and how to get information into and out of it's working memory. It would however, get old to have to start over with every program you wanted to work on after each time you turned the machine off and cleared the memory. For the purpose of saving data or storing it on a more permanent basis, a disk is used. There are several types of disks with the most popular being floppy disk in the 5 1/4 inch size. A floppy disk is a circular iron coated plastic disk inside a square plastic protective sleeve. It is used like a record in that it is inserted in a disk drive which has a hub in the center which turns the disk and a read/write head which reads the disk much like a record player tone arm. To use a floppy disk, you slip it in the drive with the label on the top and to the back,

close the door to the drive and turn on, or reset the computer which will cause the disk to be started and read (called booted). In looking at the disk, you can notice a shiny oblong slot in the jacket which exposes the inner disk. That is the area read by the read/write head and should not be touched as the slightest bit of oil from your hands or smallest particles of debris such as a cigarette ash which can interfere or clog up the read/write head. While the workings of a disk is similar in appearance to a record, it is most like a magnetic tape which is exactly how information is stored and retrieved. Thus, you can write on a disk and erase a disk just the same as you do an audio tape. Also like an audio tape, a floppy disk has a notch cut into the right side at the tip which allows you to write on the disk. If you do not want the disk written on as may be the case in a program disk, you simply cover the notch and the disk can subsequently only be read. Disks vary in price and quality and in the available usage of a single side or both sides and in the density. Therefore, you need to know before buying a disk which kind your machine requires.

In addition to the 5 1/4 inch floppy disk, you can buy disk drives for an 8 inch disk which holds more information and the newer 3 1/2 inch disk which surprisingly holds as much as the 5 1/4 inch. They all work the same however. Your computer will require that you prepare the disk before use. In the operation, a disk is divided into sectors of information. The computer reads concentric circles or tracks of data from the disk and it additionally will sector the tracks into pie shaped sectors of a fixed number of bytes each. Since each machine sectors differently, disks prepared for one brand of machine will not run on another brand unless it is made to be compatible.

When purchasing a disk drive, it is advantageous to utilize a disk which will hold as much information as possible. Therefore, a double sided disk or one which compacts the sectors to hold more bytes is preferred. It is also desirable to have two disk drives as a number of programs require two or make it more convenient to use two. It is difficult in this area to make definitive statements however, as this technology is improving weekly. Once you use floppy drives for a short time, you become aware of their major disadvantage. That is, if you have a large program to be read into RAM, it takes a few minutes and you quickly become tired of waiting on the machine and/or of filling up floppies. One solution to those problems is to purchase a hard disk drive. They work in the same manner as the floppy disk except the disk is rigid allowing it to hold much more information, on the order of 10 to 100 million bytes as opposed to 100 to 400,000 on the floppy, and reading and writing is instantaneous. Generally, they are enclosed in the machine which makes it less likely to have your data destroyed, however the drive unit is more expensive than a floppy drive unit. This concludes the usual types of hardware which may be desired and leads us to an examination of the software which contains the operating system, languages, and commercial programs.

Software

In order to have the CPU know how to accept, keep up, and output data, it needs instructions. While this can and is partially or wholly placed in ROM, some part of those instructions or all of them are contained in an operating system which is programmed for a particular machine and usually comes on a floppy disk. These instructions are know as the Disk Operating System or DOS and usually are included with the cost of purchasing a machine. However, they are updated frequently to add different commands or expand the range of what your machine can

do and you are expected to keep up and purchase the updates if you desire them. Also, on some machines several companies make different special purpose operating systems or you will find that some other DOS than the one you were supplied with has gained in popularity. Regardless, your first task as a new user will be to learn the operating system with which you are working. Commercial programs are written more for an operating system than for a particular brand of machine so that even those will require you to be familiar with your DOS. Once you have gained that familiarity, you should be able to issues commands to your computer which will make it perform it's functions. As you might expect, operating systems differ among different brands of microcomputers which will prevent you from using one piece of software on different machines unless they use the same DOS. One type of DOS called CP/M has tried to become universal and has met with some success but still is not a universal system.

Most individuals are interested in using a microcomputer and are less interested in programming one as programming takes a great deal of skill and time. To use a computer requires only that you understand your computer's DOS and purchase i.e., already programmed, program on a compatible disk which you can quickly learn to use. For example, for any microcomputer you can purchase word processing or financial management or data management programs which you can learn to operate. These range in complexity and cost and are regularly reviewed in popular computer magazines. It is easy and fun to keep up with various types of programs and many people enjoy being the first kid in their block to obtain a copy of the hottest, newest thing.

If you are not pleased with the commercially available programs for your purpose, or if you find the urge to sit in front of a monitor for endless hours is irresistible, then you may want to explore the next level of computer usage through programming. With programming, you write the code to make the computer do what you want - the glory of ultimate control. While you might discover that you can do a better job of designing a program for your needs, prepare yourself to spend a great deal of time. One of the rewards of such an effort however is to make something which works and in some cases to sell something which you have created. Programming requires the understanding of a computer language which can be learned in self-instructional books or in continuing education or university courses. Languages range from those which are closest to the binary computer talk called low level, such as machine or assemble language to languages which are most similar to english (high level) such as basic. The low level languages often provide much greater speed of operation and can be more complex to learn while the high level languages are simpler to start out on but slower. Most people start with Basic and may move on to more complex languages if they like programming. Other popular languages include Fortran, Cobal, APL, Forth, and C. Some of these are special purpose and are more applicable to different situations. It is not unusual for a novice to be unsure of what a computer can do to be of assistance to them and at times it appears that it might be faster and easier to do things by hand than to invest in a computer. If checkbook balancing and recipe storage are the only requirements of a user, then a computer does not make sense, however there are some things the computer does better, particularly if they are operations that are often repeated.

What Computers Do Well

Microcomputers can be used for many purposes however, they do the following five things extremely well: 1) They can store high amounts of

information; 2) They can quickly search and retrieve stored information; 3) They compare information quickly; 4) They manipulate graphic symbols; and, 5) They rapidly perform mathematical functions. For human service workers, the ability of computers to deal with information in the first three areas have proven valuable. For example, many office workers deal with words, files, and information which are tailor made to be computerized to make dealing with those faster and simpler. In vocational rehabilitation for example, it is fascinating to be able to compare a worker's aptitude and ability profile with every other job in the Dictionary of Occupational Titles in a matter of a few minutes. Such a process done by hand used to take days. It is equally intriguing to be able to move paragraphs within a typed document around in seconds or make editorial changes and have documents retyped in minutes instead of hours. For you to discover what a computer can do for you, it is recommended that you get one and get started. You will find more and more reasons to justify it after you begin.

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