# **MICROCOMPUTERS FOR NURSERYMEN--1990 UPDATE** Reed D. Taylor and James R. Dayton, The Ohio State University

The two major divisions of a computer system are hardware and software. Hardware consists of the physical components of the system, while software comprises the various types of instructions necessary for a computer to perform useful work. Hardware developments in computers have been expanding at a rapid rate. One could even say "exploding." This is especially true in the lower cost range, often referred to as personal computers. These rapid developments have made the distinctions between classes of computers very difficult to define. Keeping in mind these difficulties, most in the computer industry would never the less classify computers as mainframe, mini, and personal computers. In classifying, however, one must remember that things are always changing. For example, a top of the line "personal computer" now has as much, and in many cases more, capacity than a small "mainframe computer" of a decade ago. A mainframe computer is generally considered a very large machine costing into the millions of dollars. It is a very fast, multi-user, multitask, multiple input/output device, with many units of various types of storage devices, and an array of very fast printers. A mini-computer is also a very capable machine, usually costing tens of thousands or hundreds of thousands of dollars, fast, multi-user, multitask, several input/output devices, with one or more medium or high speed printers. While remaining very capable, it would have less capacity than a mainframe unit.

Developments in the personal computer area have been especially rapid. Personal computers normally cost less than \$2,000, are single user, with some of the more expensive units being able to handle multitask, with limited input/output devices and usually one printer. They normally sit on a desk top or in a specially designed desk configuration. Their main purpose has been to meet the needs of small businesses and professional people. They also have been used heavily in school systems.

It is apparent that cost directly correlates with the capabilities of a computer. Personal computers are often considered "computers on a chip." This is because their "brains" or central processing systems are often contained on a single piece of silicon about 1/4 of an inch square. This discussion will concentrate primarily on the personal computer.

One term often used to describe the capacity of a computer is "how many K's does it have." A "K" literally stands for kilo or 1,000, but because of how a computer "thinks," it is a term used to represent multiples of 1,024 bytes. A byte represents eight bits and is usually the amount of capacity needed to

represent an alphanumeric character. A computer works with binary numbers (uses the digits 0 and 1 and has the base two). An "M" literally stands for mega or million. In computer language, however, it stands for 1,048,576 bytes of information (1000K bytes). Another way of comprehending computer capacity is to realize that it takes approximately 1.5 Kbytes to hold one double spaced typewritten page in main memory or in storage, which translates into 150 Kbytes to hold 100 double spaced typewritten pages. A discussion of hardware for personal computers can be broken down into: (1) CPU, (2) memory, (3) storage, (4) keyboard, (5) visual display, and (6) printer.

# **Central Processor Unit (CPU)**

The CPU, or central processing unit, is the brain of the computer. It contains the circuits that control the interpretation and execution of instructions, and consists of the control section and arithmetic/logic unit of the computer. Many would also consider the memory to be part of the CPU, but in this discussion it will be handled separately. In discussing personal computers, one often hears of either 8, 16, or 32 bits of information at a time. The advantage of more bits moved at a time is faster operation. While there are many complicating factors, a lay person could essentially consider a 32 bit CPU as being four times as fast as an 8 bit CPU. A few of the most capable



personal computers now have 32 bit CPU's and computer experts expect 64 bit CPU's to be introduced in the near future. In IBM or IBM compatible computers, one often hears CPU's termed as 8088s, 80286s, 80486s. These are model numbers of CPUs, with their capacity and quickness of operation increasing as one goes from the 8088s to the ultrafast 80486s.

Another measure of capacity for CPUs is their processing speed, often known as "clock speed." This is essentially the "internal heartbeat" of the computer. It measures the time it takes the CPU to access memory. It is measured in Megahertz (MHz). One megahertz is one-million cycles per second. A computer with 10 MHz means it can cycle between the CPU and memory 10 million times per second. PC's are available that have 25 or 33 MHz CPU's.

## Memory

Memory, also known as main or primary storage, consists of electronic or magnetic cells, each of which can contain information. It is very similar to the human brain. The CPU has direct access to memory, which is the location where instructions and data are placed for access by the CPU. After data is processed by the CPU, the results are sorted in memory. The CPU can interact very rapidly with memory (in a personal computer, usually in the range 4-16 MHz) since everything is stored electronically and there are usually no moving parts within the CPU



and memory. Memory in personal computers is often divided into ROM (read only memory) and RAM (random-access memory). ROM storage that cannot be changed by the computer user and consists of nonalterable programs and constants. If one compares it to a calculator, it would be like the "squareroot key." When one pushes the "square-root key on a calculator, the calculator executes a "ROM" program that takes a number in display and converts it to its square root. Usually the more nonalterable programs and constants in ROM, the more useful and automatic the computer. RAM is memory that is directly usable by the computer operator. During the execution of a program, it will often contain system operating instructions, application program instructions, and data. RAM is memory that can be easily erased when the power is turned off. When one refers to a 16K, 32K, 64K, 256K, 512K, 640K, and/ or megabyte(s) personal computer, they are usually referring to RAM memory. The amount of RAM available is important to the personal computer user because it defines the limits to program and data that can be interacted with the CPU at one point in time. The larger the usable RAM, the larger the work section can be. It is useful to refer to usable RAM because the operating system often consumes part of RAM. In some personal computers a lot or all of the operating system is in ROM, but in the majority, at least part of it is contained on diskettes or the hard disk and must be loaded into RAM. One highly positive feature of RAM is that it has become cheap when compared to other computer components. It is a fraction of the cost per unit of capacity compared to a few years ago. A 16K personal computer used to be considered a rather large machine. Now we would not advise a nurseryman to purchase a personal computer with less than 4 Megabyte (250 times as large as the old 16K machines).

An important feature when considering purchase of personal computers is memory expendability. While a 1 Megabyte machine may seem quite adequate to begin with, it would be nice, and perhaps essential, to be able to expand it several times beyond its original capacity. Most good computers have the capacity to expand memory up to 32 Mb ram.

The CPU and memory considered together make up the main portion of a computer, with all the other pieces of hardware known as peripherals. Every computer will contain a CPU and a memory, but the types and numbers of peripherals differ greatly. Since RAM is normally erased (there are exceptions, especially in laptops) as soon as the computer is turned off, and because RAM capacity is relatively expensive when compared to other means of storage, secondary storage devices are provided. This allows data and information that has been developed in memory (primary storage) to be stored in a permanent or semi-permanent storage medium.

#### Storage

Storage differs from memory (also known as primary or main storage) in that it is secondary to primary, and data from storage must be "loaded" into memory before it can be directly accessed or used by the CPU. While magnetic tape is a storage device used by some personal computers (primarily for backing up hard drives), the most-used media are magnetic floppy disks or diskette that are loaded into diskette units when needed. A more recent development, the hard disk, is faster, more durable, reliable, and generally holds many times as much information as floppy disks or diskettes. The cost for hard disks has decreased rapidly. Eight years ago, a 5 Mbyte hard disk might have cost over \$3,000, while today a 210 Mbyte hard disk can be obtained for less than \$400. A floppy disk unit usually has the capacity to hold one or more diskettes, has a read/write head for each diskette surface, and a disk drive to turn the diskettes. The diskettes turn at a relatively high rate of speed, about 300 revolutions per minute, and the read/write head moves in and out, thereby having the ability to reach any portion of data demanded by the operator. A diskette or hard disk operates like RAM in that it is random access and can be changed. The data on a diskette or hard disk, however, is semipermanent. It is erased and/or changed upon demand, but is not erased when the computer is turned off or if power is lost.

Diskettes hold from 50K (approximately 33 double spaced typewritten pages) to over one Mbyte (approximately 667 double spaced typewritten pages) and are relatively cheap, costing from about \$0.20 to \$1 per diskette. Diskette may have information stored on one or both sides, and may be single, double, or quadruple density. Of course, the capacity of a diskette is maximized when it is "double sided, high density" (DSHD). Since the diskettes are exchangeable on the disk units, unlimited amounts of storage can be achieved by having multiple diskettes. If certain computer programs require large amounts of instructions and/or data readily available to be loaded into memory upon command, then multiple disk drives can be provided. Previously, almost all diskettes were 5 1/4" in size. Within the last few years, 3 1/2" diskettes have been introduced that have a greater storage capacity than most 5 1/4" diskettes. These 3 1/2" diskettes require special disk drives. This creates a problem with using the new 3 1/2" diskettes on older machines. To use them, new disk drives must be provided.

A nursery purchasing a new computer should seriously consider acquiring one or more hard disks. In fact, if a nurseryman is considering a personal business computer, a hard disk should be one of the specifications. An 80 Mbyte hard disk, or example, will hold the equivalent of about 52,400 doublespaced pages. Additional forms of storage are the Bernouli Box and laser disk. The Bernouli Box allows the exchange of high capacity floppy disks (encased in hard plastic shells) in a system, while the laser disk provides for even greater amounts of storage and higher speeds for retrieval. Currently there are two forms of laser storage disks. The first is known as CDROM (Compact Disk Read Only Memory). These act much like the compact disks used in late-model record players. They can be read repeatedly, but cannot be written on. The second is known as WORM (Write Once Read Memory). In these units, the user can write on the disk once and then repeatedly read from it. One cannot, however, write on it a second time. RAM (Random Access Memory), where one can repeatedly read and write on a disk is not yet commercially available and is based on laser technology.

#### Keyboard

The keyboard consists of the set of keys that allow the operator to transmit alphanumeric characters or symbols directly to memory. The information can then be immediately used by the CPU or stored for later use in a storage medium. Visual displays are the television-like screens that display information. Signals from the keyboard go into memory and are reflected onto the screen. Video screens vary considerably in their capability; they can be either black and white (also green and white, amber and white, or other colors) or colored, range in size from two or three inches diagonally to 14 inches and larger, be



high, medium, or low resolution, and display from 40 to 132 or more columns by 10 to 25 or more rows. An industry standard is developing that calls for screens displaying at least 80 columns by 25 rows. Some of the top-of-the-line personal computer monitors will display either 80 or 132 and more columns by 25 plus lines. They have high resolutions that display pictures and other graphics in considerable detail. Resolution is often measured by the number of pixels (picture element that is one point on a screen) that are available on a screen. Some personal computers have standard bit-mapped resolutions as high as 960 x 480 pixels, which can provide excellent quality graphics. Television guality resolution, for example, is about 320 x 240 pixels. Another feature of high quality video screens is split-screen window capability, whereby various parts of a large file or piece of information can be examined at various critical points. Black and white (green or amber and white, etc.) video screens supporting at least 80 column by 24 row displays should be adequate for most applications. Better quality visual displays are often referred to as EGA (640 x 320 pixels) or VGA (640 x 480 pixels). We would recommend at least a EGA.

## **Printers**

Printers come in all kinds, shapes, sizes, and capacities. Two major divisions for personal computers are dot-matrix and letter quality which can be further grouped into impact and laser. In fact, with the advancement of dot-matrix technology, letter-quality impact printers are almost a "thing of the past." Dotmatrix printers are cheaper, faster, and less prone to mechanical breakdown than was the case with impact letter-quality printers. Some high quality dotmatrix printers will print up to 240 characters per second (2400 words per minute), print bidirectionally, have various internal typewriter-style character fonts and international character sets, have variable horizontal character densities, and vary the number of lines per vertical inch, etc. Dot-matrix printers for personal computers start at about \$200 and range to over \$1,000, depending upon speed and other capabilities. Laser printers start at about \$1,100 and range to about \$3,000 for personal computers. They will print at about the same speed as the dot-matrix units but with much greater quality of print. Some owners of personal computers have both dot-matrix and laser printers. The dot-matrix would be used for all routine printing while the laser printer would be reserved for special jobs and desk-top publishing. In businesses, offices, and school settings where there are multiple personal computers, one often finds a dot-matrix printer supplied with each personal computer, and one laser printer shared among several personal computers.

It should be mentioned that dot-matrix technology has progressed rapidly. Most dot-matrix units had 9

pins in the print head; however, many models now have 24 pins in the print head. The quality of the better units is almost on an equal with the old slow impact, letter-quality printers.

## Problems

A problem, much more serious a few years ago, is incompatibility between makes and models. Often two models from the same manufacturer would have different operating systems and could not share diskettes even if they were the same size. If a programmer developed a program on one make and model of personal computer, often it became restricted to that make and model. This problem is pretty well a thing of the past if one buys an IBM or IBM compatible computer. With most of these machines, software written for IBM equipment will run on the majority of "compatibles," although at one time, not all compatibles were truly "compatible." If one buys a computer that is not IBM compatible, the problem of incompatibility will probably exist. If so, it can sometimes be reduced by sending files via communications links from the CPU of one make and model of personal computer to another make or model. This allows a nursery to by-pass the storage units in going from memory to memory. Once in the new computer, changes might have to be made, but at least a great deal of time can be saved over starting from scratch.

In the "computer world," one is always apprehensive about making recommendations -- things change too fast. However, we will take that dangerous step, with the understanding that we are talking about September 1990. If we were contemplating purchas-



ing a micro-computer for a nursery, we would recommend the following as a minimum hardware configuration: 1) Central Processing Unit: 80386 or preferably a 80486 or equivalent from a different manufacture, 2) Memory: 4 Mbyte plus, 3) Storage: 210 Mbyte hard disk plus at least one diskette drive, 4) Keyboard: One that is easy to use (Note: one does not always have much choice on the keyboard, once the major hardware purchase is decided), 5) Visual Display: at least medium (EGA/VGA) resolution, 6) Printer: medium to high quality dot-matrix (24 pins in the print head), 7) Expansion: check out the possibility of adding additional memory and other features, 8) Service: Be sure you can obtain rapid service for the equipment you purchase. This hardware recommendation (minimal) should get a nursery started. The recommended hardware configuration (if one watches for specials) should be obtainable for about \$2,500. We would also recommend a system that has good software support. Software and software costs can range all over the place. Some estimates are as follows: 1) Accounting: \$500 to \$3,000, 2) Word Processing: \$200 to \$600, 3) Spreadsheet: \$200 to \$700, 4) Data Base Management: \$200 to \$1,000. In looking for computerware, both hardware and software, a nursery might want to start the investigation by checking out IBM and/or IBM compatible equipment and the software that runs on it. There is more software available for IBM equipment and "compatibles" than for any other type of microcomputer. A small business may well find that other brands with their corresponding software will meet its needs as well or better, but that will only be determined through investigation.

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# 10 Customer Service Priorities

- \* Call back when you say you will.
- \* Explain what caused the problem.
- \* Let customers know the number to call and whom to question or complain to.
- \* Give customers access to people who have the authority to resolve problems.
- \* Tell customers how long it'll take to resolve a problem.
- \* Call back with progress reports if problems can't be solved immediately.
- \* Contact customers promptly when problems are solved.
- \* Offer alternatives if problems can't be solved to customers' satisfaction.
- \* Treat customers like people, not like account numbers.
- \* Advise customers on ways to avoid future problems.
- Source: The Working Communicator, January 1993, 212 W. Superior, Suite 200, Chicago, Ill. 60610.

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