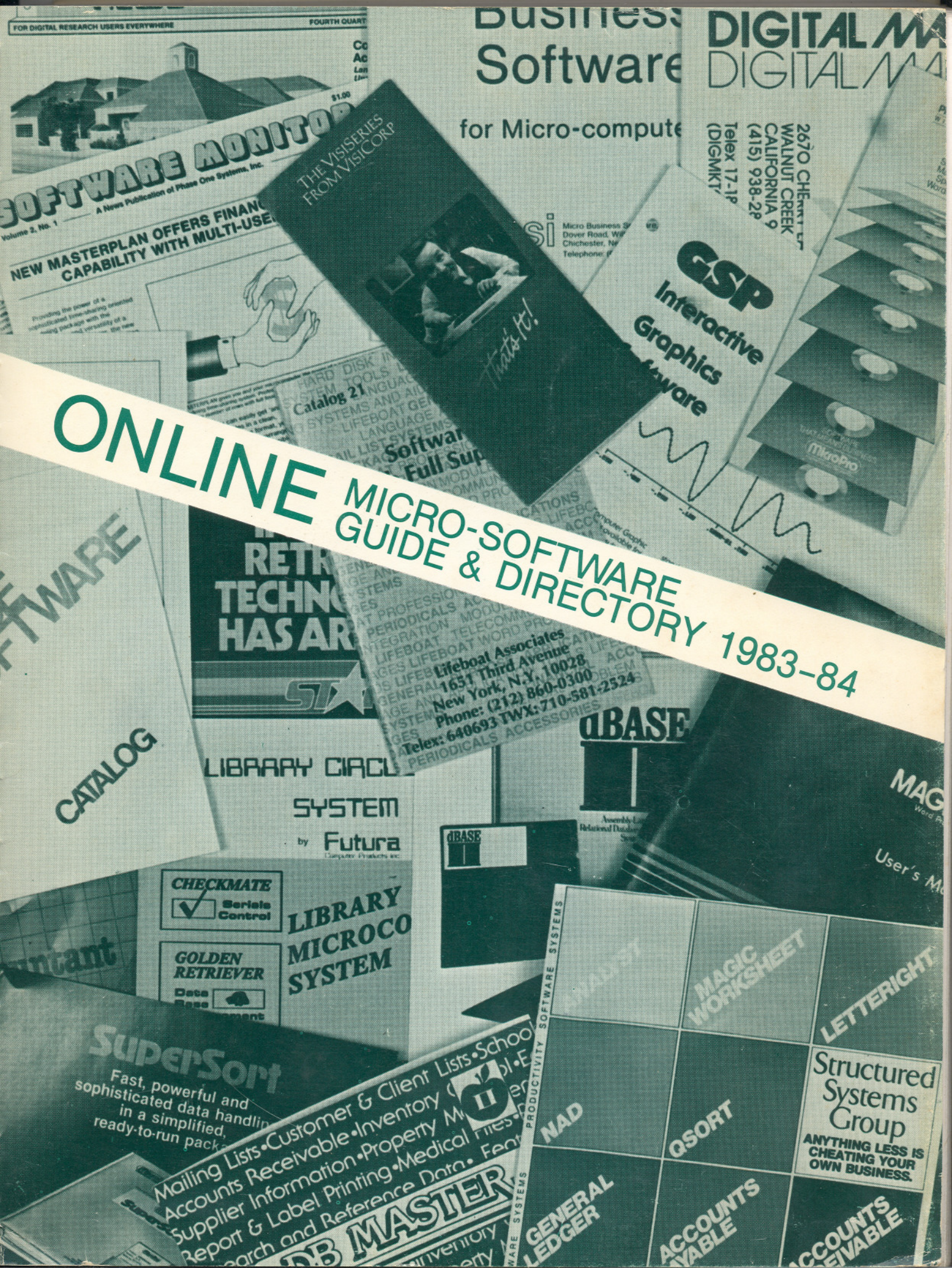
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A User's View of Operating Systems and Software Development Tools

by Richard L. Roth
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There tends to be a gap in understanding between the experienced computer expert and the uninitiated, those who computer people call 'the end user'. This gap shows itself most when one attempts to deal with the lower levels of the computer's operation, the levels at which the operating system resides and the programmers work.

The computer is a complex device, but there are many equally complex technical machines in our every day life. The real difference lies in the common image that is shared, of the use and purpose of the machine. Any adult or teen in our society, understands the basic function of a car without any understanding of the chemistry or metallurgy or even mechanics that make that car operate. Similarly the common image of purpose exists for a radio, tv or even the highly complex video recorders and micro-wave ovens that are now commonplace.

No such basis for discussion exists for computers, therefore it is necessary to make some very vivid parallels to explain how the deeper aspects of the computer function, without dealing on a bits and bytes level. It behooves 'computer people' to help establish this common image, or what has come to be called 'computer literacy'.

OPERATING SOFTWARE

Let's start by drawing a picture of the computer system as a tranquil lake with boats carrying cargo and passengers. The water smoothes the rough bottom of the lake and presents the boats with an even, regular surface to move upon. The boats move under direction of their captains, from one place to another. The results of each boat's motion is the transfer of cargo or passengers; or the simple pleasure of a day's outing. This whole picture parallels a computer's operation.

The obvious parallel is to consider the boat captains or the motors as the computer, but let's try a different image. We will consider the world, or the earth as the computer system. The bottom of the lake with all its' holes and mountains represents the differences and variations between different types of hardware. These hardware differences can be minor, like the speed difference between two printers; or major, like the differences needed to access a 5 inch 80 Kbyte (thousand characters) floppy disk versus a 40 megabyte (million Characters) hard disk unit. The water is the operating system of our computer; it smooths out all the differences so that all printers look alike and disk units are different only in that one is vastly bigger than another.

For our boats, we see the computer languages--they 'support' the required tasks that are to be accomplished. They in turn are supported by the water (read operating system) so they do not need to be concerned with the details of the 'world' under the water (read hardware specifics). Note that there are different types of boats (languages). Some for teaching, like PILOT and LOGO; and some for multiple functions, like BASIC and FORTRAN. There are even 'submarines', languages for those who need to delve deeper into the depths of the workings of the ocean (computer) such as assembler and 'C'.

Up to now we've only been dealing with building the base upon which to accomplish tasks. The tasks themselves are defined by the captains of the boats, these are the application packages that direct accounting tasks, or word processing or the myriad tasks to be

done. Even pleasure boats have captains; the chess, adventure or star trek games that can be so distracting.

The final component of our picture is the cargo or passengers - 'the data' that the end user is trying to 'move' to the accomplished functions.The payroll rates and weekly time sheets that go to pay checks. The order entries that go to shipping reports and customers bills. Even the keyboard presses and joystick motions that become game actions.

We have now painted a relationship picture between software aspects of a computer. The image tends to be unclear for many people, only because they try to connect a physical box with these actions and that tends to fog the issue with aspects of hardware functioning. If one deals with the actions or characteristics, and ignores details of hardware or software operation, than a much clearer image can be seen.

THE FUNCTION OF AN OPERATING SYSTEM

For this discussion, we will concentrate upon the computer's operating system itself. Most of the functions within an operating system are complex, even to most programmers, so we must draw more images to simplify our task. The most important job of the operating systems is that one we just portrayed as the water in the lake, to smooth the way for programs to accomplish their tasks.

The O/S (an abbreviation used commonly for 'operating system') does this just like a post office. The many 'P.O. Boxes' lining the walls of the post office correspond very well to the way the O/S handles the space available to the computer user. There are two general types of gadgets connected to a computer; we will call them 'devices and disks'. A device is like the mail drop or the stamp machine at the post office: mail drops only take mail (output) and stamp machines only give stamps (input). These correspond to printers (output) and keyboard (input).

All simple input or output functions can be imagined as 'give me a letter' (input) or 'take a letter' (output). The complexities of how the letter comes or goes is hidden behind the post office (read operating system). Our 'letters' are printable characters - letter, number and symbol; these are coded in some form by the O/S and computer for moving and storage. The important feature is that the devices at both ends agree on each character and if they don't, then someone must translate; just like a letter is translated from English to another language, e.g., French. There are a number of character codes; the two most common are ASCII (American Standard Characters for Information Interchange, NOT ASC 2); and EBCDIC (IBM's character set: Extended Binary Coded Decimal Information Code). Now that you know ASCII, forget the details; the rest is irrelevent.

Our computer can now get information from us using the keyboard (input) and return it to us using the screen or printer (output). But that's not of much use by itself.The important thing is we now have a set of images that relate our computer's workings to every day activities. (We do have a set of images, don't we? If not, go over the first part again or discuss it with someone.)

THE FILING CABINET

Mass Storage

There are two features that give the computer its power, one is its speed and the other, the massive amounts of information it can store. Handling the storage is the key job of the operating system. Lets go back to the post office and look at those walls of P.O. Boxes and imagine each one had a file drawer in it. Each drawer has a name or a box number, and each folder in each drawer has a name or a number. So, to find any folder we just need to know the P.O. Box number and the folder number.

That's just like our computer's disks; each post office is a 'disk directory' with its list of P.O. Boxes or 'disk files'.Within each disk file, record numbers or record keys (names) are used to find the requested information. The operating system gets a disk file for a program when the program 'opens' the file by giving the O/S the 'file name'. The O/S then keeps a record pointer to the 'current' record being used. The user can flip through the file drawer, one record at a time by just getting the next record. This is sequential access. Or the program can ask for a specific record or key. This is random access. When a key is used, it is also indexed access, since the O/S must have an index for each file that allows keys to look up the location of the key, i.e., the page number of that record.

A more sophisticated operating system has a feature called 'device independence' which allows it to hide the differences between even devices and disks. For example, a large mailing house will presort its mail before it goes to the post office so its post office gets the letters after an intermediate mail box. So too, the O/S can 'spool' large print-outs to a disk file and save them until the printer might be free and only then print them. But for this to work, the program 'printing' to the disk must not even know it's going to the disk instead of the printer.

IN CONCLUSION

The computer user relies on the computer's software to function.By using images, we can better understand the functions taking place, to better make use of them. The operating system (O/S) smooths and supports the user's applications programs, and hides the hardware differences. The O/S handles devices and disks; devices, such as printers and keyboards, provide output and input, but store no data. Disks are the massive filing cabinets, with a disk directory listing the file names. Each file is accessed via a pointer that can be read either sequentially, in order, or may be read randomly, by requested record numbers or keys. A more powerful operating system can even hide the differences between devices and disks.

Software used: WPDAISY (InfoSoft) and I/OS (operating system).

Hardware used: IMSAI, Diablo 1620 Printer, Perkin-Elmer Fox Terminal and Digital Systems Disk.