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Contents



News and Announcements

Zenith Changes

- Z-386 SX 17
- SupersPort 286e 17
- SupersPort SX 24
- TurbosPort 386e 24
- Portable Power Requirements 24

New Publication

- for Software Developers 24

Reviews and Services

- Survey: Printer Technology 18
- SuperLaserSpool 21
- Training Resources 26

Columns

- Site License Forum 25
- Engineering Services Notes 25
- Macintosh Portable Warning 26
- Ma Micro Notes
- Hard Spaces: Working Smarter 23
- WordPerfect Sort on the IBM 23
- Book Center Notes
- Claris CAD Special Promotion 27
- On-Going Discount Program 27
- And Books, Too 27

Winter Quarter Short Courses

- Registration (625-1300) 28
- Course Descriptions 28
- Course Schedule 30

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News and Announcements

● Zenith Changes

Recently four new Zenith microcomputers were added to the University's Microcomputer Discount Program: Z-386 SX, SupersPort 286e, SupersPort SX, and TurbosPort 386e. Brief descriptions and the Book Center's prices for these machines are in the paragraphs below. At press time the Microcomputer HelpLine did not have any of these machines available for your inspection.

Complete information about the Zenith microcomputers available through the discount program is in our *IBM and Zenith Microcomputers* handout. This handout is available in the Microcomputer HelpLine, in the hallway outside 125 Shepherd Labs, and from the Mac Information Server.

Z-386 SX

The Zenith Z-386 SX desktop microcomputer has a 16MHz 386SX microprocessor with support for an optional 80387SX numeric co-processor. The machine comes with a 3.5-inch 1.4MB floppy disk drive, two serial ports, one parallel port, a 101-key keyboard, MS-DOS 3.3 Plus, and 1MB of RAM. RAM is expandable to 5 or 8MB on the system board (the system supports a maximum of 16MB RAM; up to 7MB of RAM can be configured as EMS memory). The Z-386 SX's VGA video adapter supports EGA, CGA, MDA, and Hercules video standards.

SupersPort 286e

The portable SupersPort 286e has a dual speed (12/6MHz) 80286 microprocessor with 0 wait states, a socket for an optional 80C287 numeric co-processor, a 3.5-inch 720K floppy disk drive, one 9-pin serial port, one parallel port, a 79-key keyboard, MS-DOS 3.3 Plus, and 1MB of RAM. RAM is expandable to 2MB with a 1MB card or 3MB with a 2MB card.

You can tilt the backlit black-on-white VGA-compatible LCD (Liquid Crystal Display) screen 180 degrees; the screen has 16 shades of gray for color emulation. Other standard features include: a clock/calendar; an RGB port; a 25-pin floppy drive connector; a slot for an optional 300-2400 baud Hayes-compatible modem with RJ-11 connector; and an expansion bus with an XT level connector; its shipping weight is 32 pounds.

Survey: Printer Technology

The ultimate product of most work done with desktop computers is a printed document. Whether writing a memo, using a computer-aided design package, budgeting with a spreadsheet, or performing statistical analysis, the final step generally is printing something on paper. Because committing words and graphics to paper is such an integral part of computing, print and imaging technology are crucial to what makes desktop computers useful tools.

There have been significant advances in printer technology over the last few years, and as a result printer prices are falling. At the same time, the imaging software that controls printers has become more flexible and tightly integrated with the desktop computer's system software. Affordable high-resolution printers and sophisticated imaging software is raising the standard for computer-generated documents. What was acceptable print quality four years ago may now appear substandard.

This survey examines the changes in printer hardware and software that have occurred over the last five years and what these changes mean for microcomputer users.

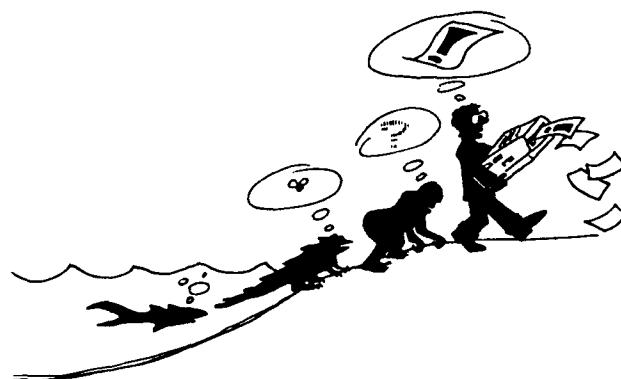
Evolution of Printer Hardware

Dot Matrix Printers

In the early days of microcomputers the most popular printers were impact dot matrix printers. Impact printers make an impression on paper by striking an inked ribbon. An impact dot matrix printer's printhead strikes a ribbon with different combinations of small pins, and each character is printed by putting a pattern of dots onto paper. For dot matrix printers, a good measure of print quality is the number of dots per inch (dpi) that the printer is capable of printing. Higher-quality dot matrix printers print with more dots per inch than their cheaper counterparts. Since the dots that make up the printed characters are smaller and closer together when printed on a high-quality dot matrix printer, its output looks less grainy than that of lower-resolution printers.

Originally, most dot matrix printers had 9-pin printheads and printed at around 75 dpi. To satisfy the demand for better quality print, dot matrix printers with more pins in the printhead were brought to market. The 24-pin dot matrix printers, with resolutions ranging from 180 to 200 dpi, quickly pushed 9-pin printers to the low end of the market. Although documents produced on 24-pin printers approach the quality of those produced on typewriters, their output is still clearly distinguishable from typewritten materials; their dots show. The greatest strength of dot matrix printers is that they can print graphics and a variety of typefaces, styles, and sizes. With the right software, a

dot matrix printer can (in principle) print anything you create with your computer – be it text, graphics, or specialized symbols such as musical notation.



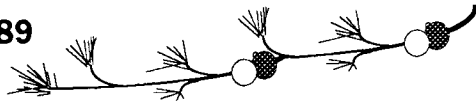
Daisywheel Printers

During the dark ages of desktop computing (six years ago), most people turned to daisywheel printers for high-quality print. Daisywheel printers are good at producing documents that look typewritten, but this technology has serious limitations. Daisywheel printers are essentially computer-controlled typewriters with the same mechanism as a standard typewriter. The drawbacks of daisywheel printers are serious enough that few people lament their demise. (For those who have never used a daisywheel printer, they are noisy, print slowly, can only print one typeface at a time, and cannot print graphics or special symbols).

Laser Printers

About four years ago inexpensive laser printers became available for microcomputers. These printers were widely heralded as a huge improvement over daisywheel printers. Laser printers are non-impact printers; they don't print by striking a ribbon. Instead, laser printers are basically computer controlled photocopiers. Laser printers print by heat-fusing tiny plastic particles (called toner) onto paper. Since toner particles can be quite small, the dots that make up a character are small enough to be almost indistinguishable. Typical desktop laser printers print at 300 dpi resolution at speeds of 4 to 10 pages per minute.

Because desktop laser printers print at such high resolution (300 dpi), their output is the equal of daisywheel printers. Since laser printers form characters from small dots, they can (in principle) print any character or graphic. The success of laser printers isn't surprising given that they combine the strong points of both dot matrix and daisywheel printers. Although laser printers originally were quite expensive, the combination of flexibility and high-quality output was enough to nearly destroy the demand for daisywheel printers and drive down the prices of 24-pin dot matrix printers. Lower prices for 24-pin dot matrix



printers have, in turn, nearly driven 9-pin dot matrix printers from the market. These trends are likely to continue since a third generation of laser printers is now hitting the market. The least expensive of the new laser printers sell for roughly the prices that high-end 24-pin dot matrix printers fetched two years ago.

Inkjet Printers

Inexpensive laser printers aren't the only competition for dot matrix printers. Second generation inkjet printers (such as Hewlett-Packard's DeskJet and DeskWriter) print at the same resolution as laser printers (300 dpi). These inkjets typically cost the same as mid-range 24-pin dot matrix printers or one-third the cost of desktop laser printers.

Inkjet printers are non-impact printers; an inkjet printer sprays tiny droplets of ink onto the paper. Since it is possible to make very small ink droplets, the dots that make up a character are small enough to be nearly indistinguishable. Documents printed with inkjet printers may not look quite as good as those printed with laser printers because the ink has a slight tendency to spread on some paper before it dries. Still, on most papers spreading is not a problem. Because inkjet printers print by placing small dots onto paper, they share the advantages of typeface flexibility and graphics capability that make laser printers attractive.

The real strength of the newest inkjet printers is that they are inexpensive yet they print with almost laser printer-quality. This combination has had a drastic effect on the dot matrix printer market. The Hewlett-Packard DeskJet destroyed the demand for dot matrix printers for IBM PCs at the bookstore; the Hewlett-Packard DeskWriter is in the process of doing the same thing in the Macintosh printer market.

Trends

When looking at how printing hardware has evolved over the last five years, it is clear that two trends are at work. First, there is an insatiable demand for better-looking printed documents, and this demand drives a continual refinement of existing technology (for example: 9-pin dot matrix printers evolved into 24-pin printers). The second trend is the move toward more flexibility in what can be printed (for example: daisywheel printers were displaced because they could only print one typeface at a time). These two trends have consistently favored non-impact printers over impact printers. The newer laser and inkjet printer technologies have made high-quality printed output affordable for most desktop computer owners.

Advances in printer hardware are only half the story. To take advantage of new printer hardware, the software that runs printers has also evolved. In the second half of this survey, we will look at how printer software has changed.

Printer Software

While printing characters may seem a simple task, there is more going on than meets the eye. Since computers use numerical codes to represent characters, printing a character requires a translation from a numeric code to the pattern of dots the printer puts on the paper. The software used to create a concrete representation of a character or a graphic element is called the *imaging software*. Since characters and graphics displayed on computer screens are formed from patterns of dots, imaging software is also an important part of how characters are drawn onto computer screens.

Bit-mapped Fonts

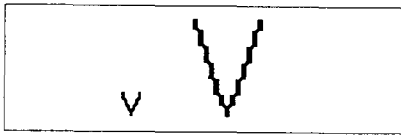
With less powerful processors than are available today, microcomputer and printer designers in the past sacrificed flexibility for acceptable performance from the imaging software. The least flexible (but fastest) way to translate a code representing a character into a pattern of dots is to look the answer up in a table. The table contains the dot patterns (called *bit-maps*) corresponding to each letter in the typeface. For instance, if the letter 'V' is to be displayed, the imaging software looks up the pattern of dots that represent 'V' in the table and then copies that pattern to the printer (or screen). Each dot is a bit in the bit-map; if the dot is to be printed, it is black.



While looking up dot patterns in a table is fast, it is not very flexible. Characters in the table are defined at specified sizes and resolutions and cannot be scaled up or down without a serious loss in quality. The characters cannot be scaled because the table describes the typeface only in terms of a bit-map; there is no information in the table to tell the imaging software how to make a character twice as large as the character in the table. For example, the best that bit-mapped imaging software can do when asked to display a character that is not in its table is to interpolate from a character that is in the table. The result of this

interpolation will generally be a character with jagged edges (called *jaggies*) like those shown in Figure 1.

Figure 1: Scaled Bit-mapped V



Examples of fonts stored as bit-maps abound. The popular Hewlett-Packard LaserJet printers have bit-mapped representations of the fonts built into them. LaserJet owners can also purchase font cartridges (which contain bit-mapped representations of fonts in specific sizes) that print characters in larger sizes and in different fonts. Because bit-mapped characters scale poorly, the LaserJet will not print characters in any size for which the printer does not have a bit-map.

Most Macintosh users are familiar with the idea that bit-mapped fonts scale up poorly. The Mac's System file contains bit-mapped representations of the fonts that can be displayed on the screen and printed. Mac users can add bit-maps for frequently used fonts with a program called *Font/DA Mover*; however, to store a bit-map for every possible size of a font would take up a tremendous amount of disk space. Because you can select a variety of fonts and sizes with Macintosh software, it is possible to display fonts in sizes for which a bit-map is not available. As you would expect, the result can be severe jaggies.

Outline Fonts

There is another approach to imaging software that solves the problems inherent in a bit-mapped representation of fonts. As more powerful microprocessors became available and the demand for more flexible imaging technology developed, another technology became popular: *page description languages*. Since a page description language does not map out characters dot for dot, it is resolution independent; that is, it allows programs to specify where each element should be printed on a page independent of the resolution of the printer. This independence also means you can scale an image up or down in size without getting jaggies.

Page description languages make fonts independent of printer resolution by storing the characters as *outlines* rather than bit-maps. The outline for a character is a mathematical representation of the character that can be scaled up or down without loss in quality. The outline representation of a typeface can be used to create the dot pattern that is printed or displayed for *any* size character you'd like. In contrast, bit-mapped representations are inherently tied to a specific type size and resolution. The flexibility of outline fonts comes at a price: outline fonts require significant processing power to translate from the

outline representation of a character to the dot pattern that is printed or displayed on the screen.

In addition to outline representation of fonts, good page description languages also include resolution independent representations of graphic elements such as arcs, lines, circles, and the like. As is the case with outline fonts, resolution independent representations of graphic elements make it possible to scale an image up or down without getting a case of the jaggies.



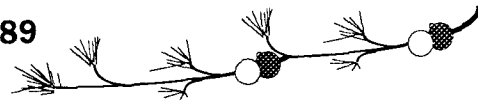
PostScript

An example of this sort of page description language is PostScript. PostScript is currently the most important page description language for desktop computers; it is used on several vendors' laser printers, including the Apple LaserWriter IINT and IINTX. PostScript is also used on the NeXT computer as both printer and screen imaging software. Earlier we saw that Hewlett-Packard LaserJet owners must purchase font cartridges to print large type. People with PostScript printers are able to print their fonts in any size without buying font cartridges because PostScript can scale the outline font to any size.

PostScript has been so successful that it has imitators; PostScript clones are starting to appear. Adobe (the company that created PostScript) charges hefty license fees to vendors who incorporate PostScript into products, so there is an incentive for others to reverse-engineer PostScript. Expect to see more printers that are "PostScript-compatible" (i.e. use a PostScript clone) on the market.

The Outline Font Wars

Beyond their use in printing, outline fonts are becoming an important part of how characters are generated on computer screens. The developers of the NeXT computer anticipated some of the developments that are now occurring on mainstream desktop systems, so it is useful to look at how NeXT's imaging software works.



SuperLaserSpool

NeXT uses the PostScript page description language for both the printer and the screen. The NeXT machine generates the characters displayed on the screen from PostScript outline fonts. This means that the NeXT computer can display fonts in any size without jaggies. Although NeXT was one of the first companies to use outline fonts to generate characters both for the screen and the printer, other vendors are not far behind.

Adobe has a product for the Macintosh called Adobe Type Manager (ATM) that brings the benefits of outline fonts to the Mac. After the ATM software is installed, it automatically generates characters from outline fonts for both the screen and the printer. This means that Macs with ATM don't see jaggies on screen or on the printer for the fonts supported by ATM. Contrary to some people's expectations, ATM will *not* make ImageWriter dot matrix printer output look like laser printer output; this is impossible because the ImageWriter prints at 75 dpi and laser printers print at 300 dpi. However, ATM *will* improve how fonts look on your Mac's screen and on output from non-PostScript printers for font sizes that are not represented in the Mac's system file; typically these are the large sizes, such as 24 or 36 point.

To further complicate matters, Apple has announced that its next major system software release (System 7.0) will include outline fonts for screen and printer use. Although System 7.0 will require 2 megabytes of RAM to run and isn't due until sometime in 1990, Apple's outline font technology will certainly have an impact on the market. This is especially true because Microsoft (the developer of Windows for IBM-PCs and co-developer of OS/2 with IBM) has licensed Apple's outline font technology. Expect to see an evolution toward outline fonts for both printer and screen use in the near future. Whether Adobe's PostScript, Apple's outline font, or some other technology becomes dominant remains to be seen.

Conclusion

Printer hardware and software technology have advanced rapidly over the last five years. How printers will evolve over the next five years is harder to ascertain, but color printing seems to be an area ripe for development. In the near term, outline fonts are certain to displace bit-mapped fonts because they offer greater flexibility without much of a performance penalty *on today's microprocessors*. Within the next year and a half, non-impact printers are likely to almost completely displace impact printers, except for specialized applications such as multi-part forms printing.

One certainty is that people will want output that looks at least as good as the other guys, and preferably much better. This "I want mine to look better than yours" attitude drives a never-ending arms race in printer technology.

Overview



SuperLaserSpool is software that frees your Mac for other uses, such as writing another memo, while it keeps track of the documents you have already sent to Apple's LaserWriters (including the LaserWriter II SC). When the printer is not busy, SuperLaserSpool takes the next document in its queue and sends it to the printer. This spooling software is especially useful in three circumstances.

Scenario 1

Because you only have 1MB of memory in your Mac, you don't use MultiFinder, which means you cannot use Apple's Print Monitor (discussed in the *Print Monitor* section below).

Scenario 2

You use MultiFinder and Print Monitor but want more control over printing, for example you want to be able to move important print jobs to the front of the print queue. (Unlike earlier versions of SuperLaserSpool, v2.0 works with MultiFinder.)

Scenario 3

Since you use the *Aldus* printer driver that comes with PageMaker to print your PageMaker documents, you cannot use Print Monitor. This means you must wait until your PageMaker document is printed before you can resume using your Mac.

We tested SuperLaserSpool under both the Finder and MultiFinder and sent print jobs to a LaserWriter IINT and a LaserWriter Plus. We had no problems using SuperLaserSpool under System versions 6.0.2, 6.0.3, or 6.0.4. In addition we ran SuperLaserSpool on two machines simultaneously and sent jobs to the printer from both machines. SuperLaserSpool worked without problems with all the software and all the options we tested.

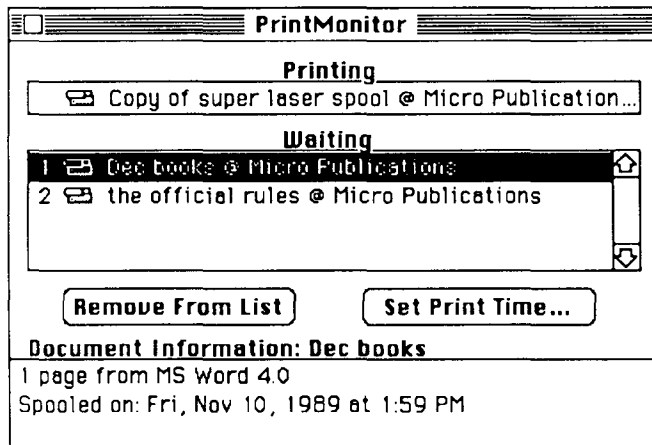
Apple's Print Monitor

MultiFinder supports background processes, such as Print Monitor. Background processes are behind-the-scenes routines that take place without disturbing you while you work on another task or application. This means if you set up Apple's Print Monitor, your documents will be printed while you work on other applications.



Figure 1 shows you Print Monitor's *Printing* dialog box. To cancel a waiting print job, select the print job's name, as we've done with *Dec books* shown in Figure 1, and click on the *Remove from List* (or *Cancel Printing* button; the button you see depends on which document you select; both buttons cancel the print job you have selected). Print Monitor does not have a feature to change the order of the print queue. The only way to get a high priority job to the front of the queue is to cancel all the other printing jobs.

Figure 1: Print Monitor



Print Monitor comes packaged with your Macintosh operating system software; you will usually find it on your *Printing Utilities* disk. You can read about it in the latest *Macintosh System Software User's Guides* in the *MultiFinder* section.

Installing SuperLaserSpool

Installing SuperLaserSpool is easy if you are familiar with Apple's *Font /DA Mover*. If you are unfamiliar with this application, SuperLaserSpool's manual will step you through installing the *Laser Queue* desk accessory. Laser Queue lets you manage and preview documents. Besides installing Laser Queue, you also must put the SuperLaserSpool icon in your System folder; if you have the Print Monitor icon in your System folder, you must drag it out of that folder. Your final installation step is to restart your Mac.

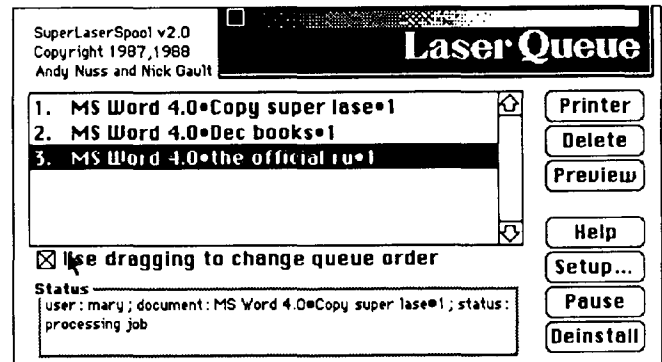
If you want to install more than one copy of SuperLaserSpool, you must purchase a separate copy for each Macintosh. Since each master SuperLaserSpool disk has a different serial number, if SuperLaserSpool finds that another Mac on the network is using the same serial number, both Macs will have trouble printing.

Using SuperLaserSpool

We used SuperLaserSpool to change the order of our print jobs; in our case we wanted the print job called *the official*

rules to move to the front of the queue. To do this we selected *Laser Queue* from the Apple menu and got the dialog box shown in Figure 2. Next we clicked on the small *Use dragging to change queue order* button. Then we selected the print job called *the official rules* and dragged it to the No. 2 position. We couldn't drag it to the top of the list because SuperLaserSpool doesn't let you move a job that is already at the top of the queue. This also means you need at least three print jobs in the queue before you can change the print order.

Figure 2: Laser Queue Dialog Box



Laser Queue has other options, such as a button to delete a job from the list. You can use the *Delete* button to cancel any print job, including a job at the front of the queue or one that is already printing.

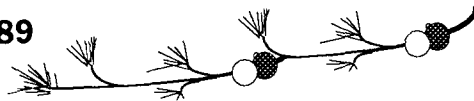
Downloadable Fonts

We printed an eleven page PageMaker document with at least nine downloadable fonts per page to see how SuperLaserSpool handles files when extra fonts are needed. We got such a high number of fonts because we used fonts called FranklinGothic, Galliard, and PIX Symbols Icons, in five styles - plain, italic, bold, bold italic, outline, and shadow. In many fonts, different styles, such as italic and bold, count as separate downloadable fonts. We did not have any problems with our test document.

Conclusion

SuperLaserSpool version 2 is a good companion for PageMaker users. Others may also find it useful enough to justify its \$149.95 price. SuperLaserSpool is available from SuperMac Software, 485 Potrero Ave, Sunnyvale, CA 94086. You can also order a 5-pack multi-user version for \$499 retail. For more information you can call SuperMac at 408/245-2202.





Ma Micro Notes:

● Hard Spaces: Working Smarter



Have you been frustrated because your word processing software breaks phrases in the wrong places? For example, it breaks up the phrase "\$50 off" in Figure 1.

Figure 1

If you mail us your receipt, you will get **\$50 off** our normal low price.

Sometimes you do not want names, dates, or equations to be broken up. Like our phrase "\$50 off" you want these phrases to stay together. Many people "fix" this problem by inserting a "hard" return (they hit the **Return** key) before the phrase so the phrase stays together. However, if you edit the document, this fix can backfire and produce the sample you see in Figure 2.

Figure 2

If you mail us your receipt before December 31st, you will get **\$50 off** our normal low price.

If you forget to proofread the section of your document that contains the hard return, you will miss correcting an ugly line. A smarter fix is to tell your word processing software to treat the phrase as one word. When you do this, the spaces between words are treated as hard spaces rather than as discretionary (soft) spaces. Hard spaces go under many names, such as fixed spaces or non-breaking spaces. Figures 2 and 3 have exactly the same wording. The difference between the two figures is that in Figure 3, we linked "\$50" and "off" to make them, essentially, one word. Unlike Figure 2, the text in Figure 3 wraps as it should because we did not insert a hard return before the phrase "\$50 off."

Figure 3

If you mail us your receipt before December 31st, you will get **\$50 off** our normal low price.

How you tell your software to treat a space as hard (fixed) instead of a soft (discretionary) space, usually differs from one package to another. Below are instructions for creating hard spaces in some popular word processing software.

WordPerfect on IBM

To get a hard space, hold down the **Home** key when you hit the **Spacebar**. For more information, look under *Hard Space* in the Help menu.

WordPerfect on Mac

To get a hard space, hold down the **Option** key when you hit the **Spacebar**. For more information, look under *Required Space* in the Help option under the **Apple** menu.

Word on IBM

To get a hard space, hold down the **Ctrl** key when you hit the **Spacebar**. For more information, look under the Index listing of *space, non-breaking* in the *Using Microsoft Word* manual.

Word on Mac

To get a hard space, hold down the **Option** key when you hit the **Spacebar**. For more information, look under *Special* in the Help option under the **Apple** menu.

MacWrite II on the Mac

To get a hard space, hold down the **Option** key when you hit the **Spacebar**. For more information, look under *Symbols* in the Help option under the **Apple** menu.

● WordPerfect Sort on the IBM



Hard spaces can have other uses besides those mentioned above in the *Working Smarter* section. Using WordPerfect's hard space command can solve a sorting dilemma. WordPerfect's *Sort* feature lets you sort a list of names by last name, for example the list in Figure 4.

Figure 4

Minnie Sota
Malcom Winchester III
Zeek von Eschen
John Smith

The sort-by-last-name option works for Minnie Sota and John Smith but usually does not work for Malcom Winchester III and Zeek von Eschen. It doesn't work because WordPerfect assumes that these last names (words) are III and Eschen instead of *Winchester III* and *von Eschen*. To sort this list correctly, put a hard space between Winchester and III and between von and Eschen. To get a hard space, hold down the **Home** key when you hit the **Spacebar**.




NEWS CONTINUED FROMPAGE 17
SupersPort SX

The portable SupersPort SX has a dual speed (16/8MHz) 80386-SX microprocessor with 0 wait states, a socket for an optional 80387-SX numeric co-processor, a 3.5-inch 1.4MB floppy disk drive, one 9-pin serial port, one parallel port, a 79-key keyboard, MS-DOS 3.3 Plus, and 1MB of RAM. RAM is expandable to 8MB with 2MB upgrades.

You can tilt the SupersPort SX's backlit page white fluorescent screen 180 degrees; the VGA-compatible screen has 16 shades of gray for color emulation. Other standard features include: a clock/calendar; an external miniaturized 20-pin floppy drive connector; a slot for an optional 300-2400 baud modem with RJ-11 connector; and an expansion bus connector; its shipping weight is 24 pounds.

TurbosPort 386e

The portable TurbosPort 386e has a dual speed (20/10MHz) 80386 microprocessor with 0 wait states, a socket for an optional 80387 numeric co-processor, a 3.5-inch 1.4MB floppy disk drive, one 9-pin serial port, one parallel port, a 79-key keyboard, MS-DOS 3.3 Plus, and 2MB of RAM which is expandable to 3MB.

The TurbosPort 386e's backlit page white fluorescent screen is VGA-compatible and has 16 shades of gray for color emulation. This portable includes an RGBi VGA-level color monitor connector. Other standard features include: a clock/calendar; a slot for an optional 300-2400 baud Hayes-compatible modem with RJ-11 connector; and an expansion bus connector; its shipping weight is 26 pounds.

Portable Power Requirements

The SupersPort 286e and SX can be used with a 50 or 60 Hz power source and come with a detachable rechargeable 48 WHr NiCad battery pack and an external 110/220V autosensing AC adapter/charger unit. The TurbosPort 386e also works on 50 or 60 Hz power and comes with a detachable rechargeable 53 WHr NiCad battery pack with two hours recharge time and an external 110/220V autosensing AC adapter/charger unit.

Part	New Zeniths Description	Discount Price
Z-386 SX		
<i>Model 40 with 28 millisecond access 40MB hard disk</i>		
ZM-316-X4	no monitor	\$ 2240
ZMA-316-X4	with ZMM-149-A amber monitor	2385
ZMP-316-X4	with ZMM-149-P black and white monitor	2385
ZMC-316-X4	with ZCM-1390-A/Z color monitor	2575
ZMF-316-X4	with ZCM-1490-Z FTM color monitor	2625

<i>Model 80 with 19 millisecond access 80MB hard disk</i>		
ZM-316-X8	no monitor	\$ 2625
ZMA-316-X8	with ZMM-149-A amber monitor	2770
ZMP-316-X8	with ZMM-149-P black and white monitor	2770
ZMC-316-X8	with ZCM-1390-A/Z color monitor	2965
ZMF-316-X8	with ZCM-1490-Z FTM color monitor	3015

SupersPort 286e

Model 20	20MB 28ms access hard disk	\$ 3110
Model 40	40MB 25ms access hard disk	3400

SupersPort SX

Model 40	40MB hard disk	\$ 3885
Model 100	100MB hard disk	4175

TurboSport 386e

Model 40	40MB hard disk	\$ 4175
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● New Publication for Software Developers

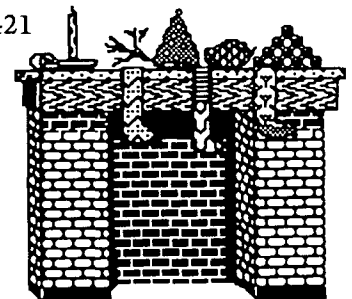
We are pleased to announce the premier of another Microcomputer and Workstation Networks Center publication. The *Developer's Review* is intended to address the needs of those who develop instructional software for desktop computer systems. If you are considering using microcomputers or workstations as part of a course or your research and you want insight into which tools will make the software development process easier, you will want to subscribe to the *Developer's Review*.

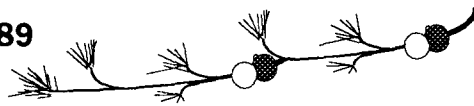
We plan to review authoring systems, computer languages, developing multimedia instructional systems, managing the development process, and more. Our first issue will include an article that explains object-oriented programming to the neophyte.

The *Developer's Review* will be published six times a year, starting January, 1990. Like the *Microcomputer Newsletter*, the *Developer's Review* is an information resource for the University of Minnesota and subscriptions are free but are mailed only within the U.S.

To get your name added to the Developer's Review subscription list, fill out the coupon on the next page and mail it to:

Developer's Review
 Microcomputer and Workstation Networks Center
 University of Minnesota
 Room 125, Shepherd Labs,
 100 Union Street
 Minneapolis, MN 55455-0421





Developer's Review Newsletter

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Faculty Staff Student Alumni Other

MathCAD from MathSoft is software for calculating, solving, and documenting technical problems; it provides a broad range of mathematical features and on-screen equation and text editing. MathCAD has two statistical application's packs that have been designed for those who occasionally require statistical analysis. The packs include tests and techniques that allow users to perform standard test procedures, to create their own test procedures, simulate experiments, and to model data from within their MathCAD document. The pack's features are shown below:

Statistics Pack I: Tests and Estimation

- Chi-square test for goodness of fit
- Two-way contingency table
- Choosing the sample size for a t test on means
- Other statistical testing models

Statistics Pack II: Modeling and Simulation

- Frequency distribution of data
- Multiple regression
- Forecasting by exponential smoothing
- Simulating a single-server queue
- Shuffling elements of an array
- Other modeling and simulation models

When a routine is loaded into a MathCAD document it can be used immediately to perform test procedures or it can be customized to meet specific requirements.

MathCAD Hardware Requirements

MathCAD requires the following hardware:

- IBM PC Series PS/2, or compatible computer with 640K memory and Hercules, CGA, EGA or VGA monitor
- Apple Macintosh SE, Plus, or II with 1MB memory
- A math co-processor is recommended.

Site License Forum

Sandra Welch, Forum Coordinator, 625-9091



In order to provide a forum for all University microcomputer users and make it easier to take advantage of licenses and discounts that the University offers, the Microcomputer Newsletter provides a forum for people who: 1) want to participate in a license or discount package that the University presently holds; 2) want to find participants for a license or discount they hold; 3) have a potential license or discount package and want to survey the University community for interested participants.

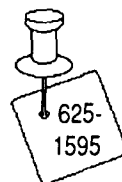
The forum is coordinated by Sandra Welch, Information Systems. Once the forum is aware of your interest, it still needs about three months to conduct a survey, evaluate responses, and decide whether or not to obtain site licenses or other discounts.

● **Proposed Site License: MathCAD**

Below is a general description of a statistical software package called MathCAD for microcomputers. For more information about MathCAD, contact Sandra Welch.

Engineering Services Notes

Don Clark, ACS Engineering Services

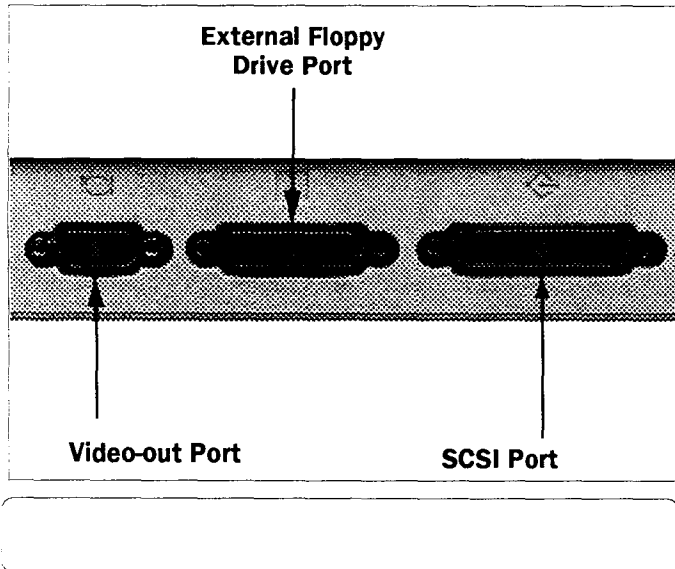


Engineering Services (ES) provides warranty service to University departments, employees, and students on most equipment sold through the discount program. We also provide service on equipment such as workstations, terminals, and peripherals. If you have trouble with your microcomputer equipment, your first call should be to the Microcomputer HelpLine. They will help you determine if the problem is with your hardware or software. If the symptoms point to the hardware, call us at 625-1595.

● Macintosh Portable Warning

Mac Portable users must be careful when they connect external monitors to the 15-pin connector on the back of the portable. To use the video port you need a cable and interface module that is not yet available from Apple. When the cable and interface module are available, you will be able to plug in Apple's RGB Color and High Resolution Monochrome Monitors. If you plug in a monitor without these special parts, *you can seriously damage your machine's CPU board.*

Figure 1: Back of Macintosh Portable



Training Resources



The Microcomputer Center owns training packages for many popular software programs. These training packages are available to University of Minnesota departments and current employees and students. There is no fee for using these packages, and you may check them out for 48 hours. However, before you can check them out, you must sign a *Usage Agreement* and leave your University of Minnesota ID with us. We will return your ID when you return the training materials. To use these materials you must supply your own equipment, such as a computer and cassette player. To reserve or check out materials, phone 625-1300 in room 132 Shepherd Labs, Monday-Friday, 8:00 am to noon and 1:00 to 4:30 pm.

Generally the PC/MS-DOS (IBM and compatible personal computers) disks are available on 5.25-inch 360K and 3.5-inch 720K disks; the Macintosh disks are 800K. The IBM-compatible packages are marked with a ♦.

New Material

We recently added the following Paradox and Lotus 1-2-3 training materials to our library.

♦ How to Use Paradox.

This is an audio training package from *FlipTrack* that includes four hands-on lessons that run a couple of hours each. In addition to the audio cassettes, you get a data disk with practice files and a *Quick Reference Guide*. In this course you will learn to:

- plan and create a database
- add, edit, and delete records
- search for specific records
- create reports and form letters
- use the Paradox Personal Programmer to automate complex jobs with Paradox's application building tool
- link tables, use passwords, and write scripts

Here is the detailed *How to Use Paradox* lesson plan.

Lesson 1 - Developing a Database: Your Disk Operating System; Installing Paradox; Starting Paradox; the Paradox function keys; the Paradox screen; Changing directories; Using mnemonics to select menu items; Viewing a table; Navigating tables; Clearing the image from the screen; Creating a database file; Entering and editing data; Exiting Paradox; Modifying a database file. (*The FlipTrack options are:* What is a database; Planning a database structure; Using the Paradox help system; Changing fields in a STRUCT table.)

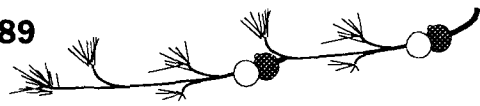
Lesson 2 - Manipulating Data: Deleting a record; the Undo command; Printing instant reports; Using Summary and numeric operators; Using the zoom key; Using wild-cards; Creating queries; Renaming tables; Importing and exporting files. (*The FlipTrack options are:* Field editing; NOT, BLANK and LIKE operators; Grouping reports by field names.)

Lesson 3 - Organizing Data - Sorting tables; Creating key fields; Copying tables; Using the CHANGETO function; Using example elements; Using the CALC function; Creating reports; Viewing a list of files. (*The FlipTrack options are:* Handling key violations; Searching tables with example elements; Creating form letters; Creating labels.)

Lesson 4 - Using Special Features: Changing the appearance of a table on screen; Setting validity checks; Creating Paradox scripts; Playing scripts; Debugging scripts. (*The FlipTrack options are:* Assigning passwords to tables; Creating and modifying graphs; Using the cross tabulation function; Using the Personal Programmer; Planning an application.)

♦ Lotus 1-2-3 release 3.

We have two new *Lotus 1-2-3 release 3* video training packages from *Anderson Soft-Teach*. Each package contains a VHS video tape, a *Personal Training Guide* with step-by-step instructions, extra tips and techniques, and a practice disk. The tapes are described below.



Lotus 1-2-3 release 3, Volume 1.

Here is Volume 1's detailed lesson plan. *Lesson 1 - New Worksheet Commands:* Exploring the screen; Retrieving a file; Turning on Undo; Displaying a worksheet "Map"; Formatting negative numbers; Using Undo; Quitting 1-2-3. *Lesson 2 - Working in the 3D Worksheet Environment:* Understanding multiple worksheets; Inserting new worksheets; Moving between worksheets: Using group mode; Copying data between worksheets; Using the ZOOM key; Saving multiple worksheets. *Lesson 3 - Consolidating Data from Multiple Worksheets:* Creating a summary worksheet; Copying labels to the summary sheet; Specifying a three dimensional range; Completing the summary sheet; Printing multiple worksheets. *Lesson 4 - Working with Graphs and Data:* Using graph group; Tilting your graph; Creating a graph window; Using hatch patterns and data labels; Naming your graph; Printing your data and graph; Saving and quitting.

Lotus 1-2-3 release 3, Volume 2.

Here is Volume 2's detailed lesson plan. *Lesson 5 - Working with Multiple Files:* Understanding multiple files; Making files active; Moving between active files; Copying data between files; Saving multiple files. *Lesson 6 - Linking Files and Graphing Data:* Understanding linked files; Linking files with formulas; Completing the Worksheet; Creating a graph automatically; Editing linked files; Creating a backup file. *Lesson 7 - Understanding Database Tables:* Sorting on multiple fields; Setting up a criteria range; Specifying the input range; Creating a report; Saving the report; Printing the report. *Lesson 8 - Creating a Macro Library and Using Record:* Creating a macro file; Using the record buffer; Recording a macro task; Copying the macro from the record buffer; Naming the macro; Documenting the macro; Running the macro; Saving the macro.



Book Center Notes



These offers are made to University departments, employees, and students; the regular Microcomputer Discount Program rules of eligibility apply. If you have questions about availability, phone the Electronics Desk at 625-3854.

● Claris CAD Special Promotion

The packaging of the Claris CAD Special that was announced in the August 1989 newsletter is not the same as CAD's normal packaging. The special does not include the tutorial disk. If you want the package with the tutorial disk, order the normal package. The special promotion price is \$105.

● On-Going Discount Program

To participate in the University's Microcomputer Discount Program, you must be a full-time employee, a full-time student, or purchasing items for a University department. Full-time students must be registered in a degree program and carry at least 12 undergraduate credits or 8 graduate credits. Full-time faculty and staff must work at least 75 percent and be eligible for the University's benefits package. To prove eligibility, faculty and staff must present a copy of their current paycheck stub to the Electronics Desk when they place an order.



And Books, Too

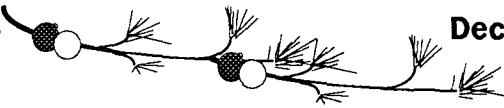


If you cannot find the computer books you want in the Book Center's Reference section, tell us what books you want to buy. Send specific titles or areas of interest to: Maureen O'Brien, 160 Williamson Hall, Minnesota Book Center, 231 Pillsbury Drive SE, Minneapolis, MN 55455.

Here's what is new in the Reference section.

- ✓ *DisplayWrite Quick Start* by Saxton, a Que publication for \$19.95.
- ✓ *Peter Norton's Assembly Language Book for the IBM PC, Revised and Expanded*, a Brady publication for \$29.95.
- ✓ *Mastering Macintosh Excel 2.2* by Hoffman, a Bantam publication for \$22.95.





Winter Quarter Short Courses

Registration 625-1300

● Registration Begins December 20, 1989

Registration ► Registration is handled by the Microcomputer and Workstation Networks Center. Registration for Winter Quarter 1990 begins Wednesday, December 20th. You can register in person at the Microcomputer Center in room 132 Shepherd Labs, Monday-Friday, 8-noon and 1-4 pm or by mail. Classes are filled in the order registration is received. Fees must accompany your registration. You can pay fees by cash, check, or Journal Voucher. The deadline for registration is 4:00 pm on the working day before the class begins. For additional registration information, call the Microcomputer Center at 625-1300.

Cancellations ► If you cannot attend a class, call the Microcomputer Center at 625-1300 to arrange a refund. We need to hear from you so that we can contact people on our waiting lists.

Refunds ► No refunds will be made if you cancel your registration *within 48 working hours of the beginning of a class*. However, if we must cancel a class, we will refund your registration fee in full.

Other Training Resources ► The Microcomputer Center owns training packages for many popular software programs. These training packages are available to University of Minnesota departments and current employees and students. There is no fee for using these packages, and you may check them out for 48 hours. However, before you can check them out, you must sign a *Usage Agreement* and leave your University of Minnesota ID with us. We will return your ID when you return the training materials. To use these materials you must supply your own equipment, such as a computer and cassette player. To reserve or check out materials, phone 625-1300 or stop in room 132 Shepherd Labs. New training materials are listed on page 26 of this newsletter.

General Course Descriptions

● Overview; No Hands-on. Limited Enrollment.

Strategies for Networking Microcomputers and Workstations: This 2.5-hour overview is a discussion of local area network products for microcomputers and workstations. The overview includes examples of how to interconnect Macintosh, IBM-type personal computers, SUN, and Apollo workstations.

IBM Course Descriptions

● Overview; No Hands-on. Limited Enrollment.

Orientation for IBM Campus Network Users: This 1-hour overview is for the novice network user who wants to learn how to use the campus network. We will cover some of the basics of accessing the campus network, such as using network programs for terminal emulation (Telnet) and file transfer (FTP). Attendees are welcome to bring a disk to get a free copy of NCSA Telnet. This class does not include information on using modems.

● Hands-on. Class Enrollment Limited to 10.

Introduction to Microcomputers — DOS: This is a 6-hour course for new users of PC/MS-DOS versions 3 or above. The course includes background information on microcomputer hardware and a hands-on introduction to DOS operating system commands.

☞ **Mastery of *Introduction to Microcomputers* or equivalent is required for the classes listed below.**

● Overview; No Hands-on. Limited Enrollment.

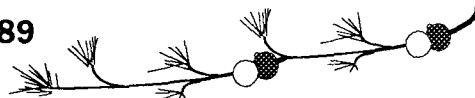
New ► **Introduction to OS/2 Operating System:** This 2.5-hour class is an overview of the IBM OS/2 Operating System. In it you will learn about the features offered by OS/2, including the presentation manager, multitasking, virtual memory management, LAN Manager, Database Server, and the Communications Manager. DOS Compatibility and issues concerning migration from DOS to OS/2 will also be discussed.

New ► **Introduction to Using the Novell Network:** This 2-hour presentation provides an overview of the Novell Netware networking system. We will discuss some of the basics of installation and organization of the network.

● Hands-on. Class Enrollment Limited to 10.

Changed ► **Hard Disk Commands:** In this 4-hour course we use the DOS 4.0 commands involved in organizing a hard disk. Some concepts covered are creating sub-directories, transferring data between subdirectories, backing up a hard disk, and an introduction to writing batch files.

New ► **Writing DOS Batch Files:** In this 1.5-hour course you will learn how to organize and write Batch files. This course also offers examples of Batch files to automate your computer startup procedure.



Mac Course Descriptions

● Overview; No Hands-on. Limited Enrollment.

Changed ► Introduction to Paradox: This 7.5-hour course covers the basic concepts of database management. The course covers only interactive commands. You will create several databases and learn how to enter data, modify it, and retrieve it.

Changed ► Introduction to dBASE IV: This 6-hour course will cover basic concepts of database management. The course covers only interactive commands. You will create several databases and learn how to enter data, retrieve it, and modify it.

Changed ► Programming in dBASE IV: (*Working knowledge of dBASE IV is a prerequisite for this class.*) In this 5-hour course you will write and run simple dBASE IV programs while learning some basic programming concepts.

Changed ► Beginning Lotus 1-2-3 version 2.2: This 5-hour course will familiarize users with basic Lotus spreadsheet concepts. You will be introduced to beginning commands by entering a sample spreadsheet. You will set-up your own spreadsheet, enter data and formulas, use commands, functions, formats, print, and create several charts.

Changed ► Beginning Word 5.0 for IBM: This 5-hour course is for new Word users. You will learn basic editing and formatting functions, such as: insert, delete, cut and paste, character formatting, line spacing, setting tabs, and using the menu and keyboard commands. Other topics include: page numbering, margins, running heads, glossary entries, summary sheets, adding boxes around text, search and replace, print and font options, and using the mouse.

Introduction to WordPerfect 5.0: This 5-hour course is for new WordPerfect users. You will learn to: create and edit files; use simple formatting commands, such as set margins, tabs, and page numbering; enhance text by using center, bold, and underline commands; manipulate blocks of text; and use search and replace and the spell checker.

► **Workbook Notice:** The fee for this class includes the cost of a workbook; the workbook is required for this class. You can pick up the workbook when you register or on the first day of class.

New ► Intermediate WordPerfect 5.0: (*Mastery of skills covered in Introduction to WordPerfect 5.0 is essential for this class.*) This 2.5-hour class will include working with merge documents and mailing labels; creating headers and footers; setting up multiple columns; and using fonts.



Changed ► Orientation for Macintosh Campus Network Users: This 1-hour class is for the novice network user who wants to learn how to use the campus network. We will cover some of the basics of accessing the campus network, such as using network programs for terminal emulation (Telnet) and file transfer (FTP). Attendees are welcome to bring a disk to get a free copy of NCSA Telnet. Please note: this class does not include information on using modems.

● Mac Hands-on. Class Enrollment Limited to 10.

Macintosh Fundamentals: In this 2-hour class you will learn how to use the mouse, keyboard, window environment, pull-down menus, cut/copy/paste commands, clipboard, 🍏 scrapbook, and how to manipulate files.



Mastery of Macintosh Fundamentals or equivalent is required for the classes listed below.

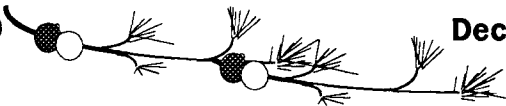
Introduction to Word 4.0: This 5-hour class is for new Macintosh Word users. You will use character and paragraph formatting and move blocks of text. In addition, you will learn how to: move quickly through your documents; manipulate multiple windows; set margins, tabs, indents, page numbers, headers and footers; insert footnotes; use the spelling checker; and preview your work.

Intermediate Word 4.0: (*Mastery of skills covered in Introduction to Word is essential for this class.*) In this 5-hour class you will learn to set tabs and tab leader characters; manipulate graphics and borders; create tables; set up multiple headers and footers, multiple columns, a glossary, and a merge document; transfer a list to a table; sort data; and customize your menus.

Changed ► Introduction to Excel 2.2: In this 5-hour course you will set up several spreadsheets and use Excel's format and paste functions as well as absolute and relative addressing. You will move data between Excel and MacWrite and create charts.

Changed ► Intermediate Excel 2.2: (*Mastery of skills covered in Introduction to Excel is essential for this class.*) In this 5-hour course you will create your own format and function macros and use the Macro recorder function to set up command macros. You will link spreadsheets and extract data from an Excel database.

Using HyperCard: This 5-hour class covers effective use of Apple's simple yet powerful information management



system. We start out learning how to retrieve and modify information and how to navigate within and between stacks. Next you will copy and create your own buttons that will enable you to link cards to other cards or to stacks. Finally you will learn how to author your own stacks and look at HyperCard's English-like scripting language.

Introduction to Desktop Publishing with PageMaker: In this 5-hour class you will put together a newsletter. You will create a master template, override that template, manipulate blocks of text, place graphics, create boxes, and wrap text around graphics.

New ► Introduction to FileMaker: This 4-hour class will cover basic concepts of database management. You will create a database and learn how to enter data; find, change, and sort information; and design simple reports.

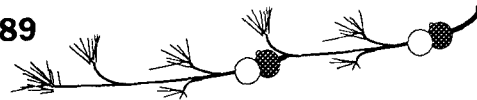
Introduction to Programming the Mac Using Pascal: *Prerequisites: Fluency in Pascal and some familiarity with HyperCard.* This 6-hour course covers using Pascal to program the Macintosh. We will use HyperCard to handle most of the Macintosh User Interface problems. If you can write a standard [non-Macintosh] Pascal program, this course lets you embed your Pascal code in HyperCard and

Winter Short Course Schedule. Fees differ for the following three groups:

	①	②	③	Section	Date(s)	Weekday(s)	Time
● General							
Strategies for Networking							
Microcomputers and Workstations	free	free	na	Sec. 1	March. 1	Th	1:30-4:00 pm
● IBM							
Introduction to Microcomputers -							
PC/MS-DOS	\$40	50	80	Sec. 1	Jan. 8,10,12	M,W,F	2:00-4:00 pm
				Sec. 2	Feb. 6,7,8	T,W,Th	2:00-4:00 pm
				Sec. 3	Feb/Mar. 27,28,1	T,W,Th	10:00-noon
Orientation for IBM							
Campus Network Users	free	free	na	Sec. 1	Jan. 19	F	9:00-10:00 am
				Sec. 2	Feb. 19	M	11:00-noon
<i>Mastery of "Introduction to Microcomputers - DOS" or equivalent is required for the IBM classes listed below.</i>							
Hard Disk Commands	\$40	50	80	Sec. 1	Jan. 24,25	W,Th	2:00-4:00 pm
Writing DOS Batch Files	\$20	30	50	Sec. 1	Mar. 7	W	2:00-3:30 pm
Introduction to OS/2 Operating Sys	free	free	na	Sec. 1	Mar. 2	F	1:30-4:00 pm
Introduction to dBase IV	\$40	50	80	Sec. 1	Jan/Feb. 29,31,2	M,W,F	10:00-noon
Programming in dBase IV ★	\$40	50	80	Sec. 1	Feb. 15,16	Th,F	9:30-noon
Introduction to Paradox	\$40	50	80	Sec. 1	Jan. 24,25,26	W,Th,F	9:30-noon
Beginning Lotus 1-2-3	\$40	50	80	Sec. 1	Jan. 17,18	W,Th	1:30-4:00 pm
				Sec. 2	Feb. 26,28	M,W	1:30-4:00 pm
Introduction to Microsoft Word 5.0	\$40	50	80	Sec. 1	Jan/Feb 30,1	T,Th	1:30-4:00 pm
Introduction to WordPerfect 5.0	\$51+	61+	101+	Sec. 1	Jan. 9,11	T,Th	9:30-noon
				Sec. 2	Feb. 13,14	T,W	9:30-noon
				Sec. 3	Mar. 13,14	T,W	9:30-noon
Intermediate WordPerfect 5.0 ★	\$25	35	60	Sec. 1	Feb. 21	W	1:30-4:00 pm
Introduction to Using Novell Network	free	free	na	Sec. 1	Mar. 15	Th	1:30-4:00 pm

+ **Note:** The fee for this class includes the cost of a workbook. You can pick up the workbook when you register for this class.

+ These classes have additional prerequisites. See *Course Descriptions* for more information.



run it on the Macintosh. HyperCard will handle graphics, menus, dialogs, buttons, text editing, scrollable-text, fonts, sound, etc.

discuss organizing data and bibliographies, placing graphs and illustrations in your documents, and using Apple LaserWriter printers.


● **Overview; No Hands-on. Limited Enrollment.**

Preparing a Dissertation on the Mac: In this 2.5-hour overview we will demonstrate and discuss the advantages and disadvantages of several word-processing and graphics programs currently available for the Macintosh. We will

Developing Applications for the Mac Using MacApp: *Prerequisites: Introduction to Programming the Macintosh Using Pascal or equivalent.* This 2.5-hour overview is an introduction to MacApp, Apple's Expandable Macintosh Application. We will cover the features of Object Pascal and the components of MacApp.

① **University students,** ② **University faculty and staff,** and ③ **others.**

Fee, Registration, and Cancellation information is on page 28.

	①	Fees	②	③	Section	Date(s)	Weekday(s)	Time
● Mac								
Macintosh Fundamentals	\$10	10	10	Sec. 1	Jan. 16	T	2:00-4:00 pm	
				Sec. 2	Jan. 29	M	2:00-4:00 pm	
				Sec. 3	Feb. 9	F	10:00-noon	
				Sec. 4	Feb. 20	T	2:00-4:00 pm	
				Sec. 5	Mar. 13	T	2:00-4:00 pm	
Orientation for Macintosh								
Campus Network Users	free	free	na	Sec. 1	Feb. 8	Th	10-11:00 am	
				Sec. 2	Feb. 27	T	3:00-4:00 pm	
 <i>Mastery of "Macintosh Fundamentals" or equivalent is required for the Mac classes listed below.</i>								
Introduction to Word	\$35	45	85	Sec. 1	Jan. 9,11	T,Th	1:30-4:00 pm	
				Sec. 2	Feb. 6,7	T,W	9:30-noon	
				Sec. 3	Mar. 8,9	Th,F	1:30-4:00 pm	
Intermediate Word ★	\$35	45	85	Sec. 1	Jan/Feb. 30,1	T,Th	9:30-noon	
				Sec. 2	Feb. 21,22	W,Th	9:30-noon	
Introduction to Excel 2.2	\$35	45	85	Sec. 1	Jan. 17,18	W,Th	9:30-noon	
				Sec. 2	Mar. 5,6	M,T	1:30-4:00 pm	
Intermediate Excel 2.2 ★	\$35	45	85	Sec. 1	Mar. 7,8	W,Th	9:30-noon	
Using HyperCard	\$35	45	85	Sec. 1	Jan. 10,12	W,F	9:30-noon	
				Sec. 2	Jan/Feb. 31,2	W,F	1:30-4:00 pm	
Introduction to Desktop Publishing with PageMaker	\$35	45	85	Sec. 1	Jan. 22,23	M,T	1:30-4:00 pm	
				Sec. 2	Feb. 22,23	Th,F	1:30-4:00 pm	
Introduction to FileMaker	\$35	45	85	Sec. 1	Mar. 15,16	Th,F	10:00-noon	
Introduction to Programming the Macintosh Using Pascal ★	\$35	45	85	Sec. 1	Feb. 12,13,14	M,T,W	2:00-4:00 pm	
Developing Applications for the Macintosh Using MacApp ★	\$25	35	50	Sec. 1	Mar. 14	W	1:30-4:00 pm	
Preparing a Dissertation on the Mac	\$15	25	NA	Sec. 1	Mar. 9	F	9:30-noon	

★ These classes have additional prerequisites. See *Course Descriptions* for more information

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Monday
Tuesday
Friday

9 am through 4 pm
Wednesday
Thursday

→ Newsletter Staff

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Microcomputer Newsletter

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