

1983

## EC83-877 Selecting a Computer System for the Farm Business

H. Doug Jose

Follow this and additional works at: <http://digitalcommons.unl.edu/extensionhist>

---

Jose, H. Doug, "EC83-877 Selecting a Computer System for the Farm Business" (1983). *Historical Materials from University of Nebraska-Lincoln Extension*. 4405.

<http://digitalcommons.unl.edu/extensionhist/4405>

This Article is brought to you for free and open access by the Extension at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Historical Materials from University of Nebraska-Lincoln Extension by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

AGR1

11/10/3

S  
85  
E7  
#83-877  
C. 1

EC 83-877 NEBRASKA COOPERATIVE EXTENSION SERVICE



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Leo E. Lucas, Director of Cooperative Extension Service, University of Nebraska, Institute of Agriculture and Natural Resources.



The Cooperative Extension Service provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.



# Selecting A Computer System FOR THE FARM BUSINESS

**H. Doug Jose**

**Extension Farm Management Specialist**

## **Introduction**

Computers are useful tools.<sup>1/</sup> They can help us do everything from performing banking transactions to keeping track of how much fertilizer was applied on the north quarter. They can perform detailed arithmetic and logical calculations in fractions of seconds. But, they can only perform those wondrous functions if they are told what to do. The necessary instructions are called software, or computer programs—the equipment which does the actual processing is called the hardware.

The problem to be solved must be defined before useful software can be developed. Once the problem is defined, the computer can help analyze data to show how things are and calculate a solution according to the operator's specifications. Before a computer can be effectively utilized, the manager must think through the business objectives and how the computer can help achieve those objectives. Software can then be obtained or developed.

In this publication, we will look at types of software, how to select and evaluate software, development of software packages, and the hardware aspects of computer applications.

## **Computer Applications**

Computers are good at storing and sorting numbers and doing many complicated calculations in a few seconds. Applications summarized here utilize these computer characteristics.

The overall objective for an on-farm computer is to create a management information system to help the decision-maker analyze alternative actions. There are many managerial tasks that can be performed, including accounting, budgeting, livestock and crop data base management, word processing, and communication with other computers and data bases. The conversion of raw data into managerial information is limited only by the manager's ability to specify what information is needed and how it can be obtained. The computer can then perform the drudgery of data searches and calculations.

On-farm computers can be used for:

<sup>1/</sup> The information given in this publication is supplied with the understanding that no discrimination is intended and no endorsement by Cooperative Extension is implied.

## **Accounting**

Computers are particularly good at doing repetitive tasks quickly and accurately. Remember, an accounting system still requires the manager to put the data into the computer completely and accurately. Financial accounting is a specific application of data base management.

## **Data Base Management**

A data base is a collection of data that can be used for different purposes and can be updated. Examples include livestock herd records, market prices for agricultural commodities, and field records for crops. A commitment to a data base is a commitment to collect the figures for a number of data items on a regular basis and to store them in the computer.

## **Budgeting and Electronic Spreadsheets**

Managers need efficient budgeting techniques for different situations. These include enterprise budgets, cash flow budgets and whole farm long-run planning.

Electronic worksheets allow a computer user to set up budgeting applications without the need to be familiar with computer programming. These worksheets are like a large tablet of paper with 250 rows down the page and 65 columns across—a total of 16,250 cells. The user can specify what label, number, or calculation goes in each cell. A specific application could be cash flow sheet, or a feeder hog budget, or a grain storage cost calculator, or an analysis of participation in the government farm programs. The user needs to know only the formulas used to make the calculations.

For most spreadsheets the user manipulates a cursor across a window of the worksheet. To enter a formula or data, the user moves the cursor to the desired cell location and types the information.

## **Communications**

Microcomputers (small but complete computer systems) can communicate with other computers to transfer messages, to access programs on other computers, and to access other data bases. There are commercial data bases which offer access to a wide range of information including various news services, stock exchange and commodity market prices, and lists of recommended restaurants in various cities.



## Word Processing

“Word processing” refers to the ability to type, file, edit and print letters and manuscripts. Word processing programs can also create mailing lists. Reports and correspondence can be produced and changed quickly and accurately.

Let's stop here a second! You think you can use a computer in your business and you have identified specific applications. Computers are like many other useful tools—there are many potential applications you probably haven't thought of yet. Let your mind go for a few minutes and think of all the possible uses you might make of a computer in your business. Think how the computer might fit into your total operation.

This will help determine software needs, hardware needs, and the best way to acquire the software. The computer system must be able to expand to fit the business system.

### Types of Software

Software is not something that is soft and cuddly. Software is a set of coded instructions that tells a computer what to do. A software package is an interrelated set of programs which performs a set of tasks. There are two basic types of software—operating, and application.

#### Operating software (OS)

The purpose of operating software is to start programs, stop them when they do not run properly, and deal with error situations. It allows utility operations on data and programs such as saving, copying, printing, editing, deleting, merging, or moving files from one storage device to another.

Operating software enables the computer to schedule work in the most efficient manner. The tasks performed by the operating software free the programmer to concentrate on the solution to a specific problem rather than on how the computer will carry out each task internally.

Operating software includes translators which convert programming language instructions into machine language instructions. These translators are called assemblers and compilers.

In most microcomputers, there is built in software which allows communication between the main parts of the system—the keyboard, the microprocessor, and the memory. This allows the operating software system to be started when the computer is turned on.

A specific form of operating system software is the disk operating system, or DOS. This software allows the computer to write and read data to and from disk storage according to a set of specific instructions.

Operating systems software are machine-specific and

application software programs are written to run with that operating system. This makes it difficult for a computer to read a program written on a machine with a different disk operating system. There is one operating system that has become a standard, at least for 8-bit byte machines, because it can operate different machines. This is called the CP/M operating system (Control Program Monitor) and was developed by Digital Research, Inc. Programs that were created, edited, debugged, assembled, and executed on one CP/M-based configuration should run on all other configurations using the same version of the CP/M operating system. One word of caution—there are also many versions of CP/M operating systems.

### Application Software

Application software programs perform the required calculations to get a specific answer.

Writing good programs requires knowledge of computer languages as well as thorough understanding of the problem to be solved. Some of the good agricultural programs were written by farmers who had a problem to solve and who learned enough programming to at least write the first version. Computer programming specialists can take such programs and revise them to make more efficient use of the computer's capabilities and memory.

Program instructions must follow the rules of programming language. Since each instruction is executed sequentially, it must provide the computer with either the exact information needed or the source of that information.

### Programming Languages

There are three types of programming language. The first is machine language which requires the programmer to construct programs according to the way the computer stores data internally. This includes designating storage locations for both instructions and data. Machine language programs are difficult to write but produce the most efficient programs as far as storage requirements and operating speeds are concerned. While few application programs are constructed in machine language, most operations software are written in machine language.

The second is assembly language. In assembly language, the address or location in memory is expressed in combinations of letters rather than the actual numeric address—eliminating the need for the programmer to remember all the numeric addresses. Since the computer only understands and executes machine language programs, assembly programs must be translated into machine language. The assembly process first determines if the structure of the program is correct, and then produces a listing in the assembly language and its machine language equivalent. The computer can then



execute the program.

Machine and assembly language programs are machine dependent—each computer having its own machine or assembly language.

The third type of language is “high-level” computer languages. These are called high level languages because they allow the programmer to express operations in a form close to the normal human language representation of the procedures. Examples are BASIC (Beginners All-purpose Symbolic Instruction Code), COBOL (COMmon Business Oriented Language), FORTRAN (FORmula TRANslator), Pascal and C. The computer must then take the “human” language and convert it to machine language before operations can be performed.

### Sources of Application Software

The source of software depends on how much you are willing to spend and how much programming you wish or are willing to do yourself. There is a growing number of *commercial software companies* who specialize in producing and marketing agricultural software. Some hardware vendors also sell this commercial software. There is a wide variation in the capabilities of this software and buyers should use the checklist at the end of this publication to make comparisons. Lists of commercial software and software vendors are available from the extension service. Most users should buy commercial software during the period they are learning to use the computer.

The second method of acquiring software is to have it written according to your specifications by a *professional programmer*. Software can be written to fit your needs and produce the output you are most comfortable with. The disadvantage is the cost. Programming can consume considerable time and skilled programmers will probably charge a minimum of \$20 per hour. It is also possible to acquire a commercial software package and have it customized to fit your needs.

Some universities are also making software available to farmers. Generally, the cost of these programs is minimal. The program models are based on research results and should be methodologically correct.

The last method of obtaining software is for users to *write their own programs*. This requires considerable time and is accompanied by considerable frustration. However, it can be a very rewarding experience when the final product, a useful farm program, is up and running. It requires logical thinking and the patience to spend a few hours to learn a computer language. The result may be a better program than commercially available because it is tailored to the specific needs of the programmer.

There is no “best” method for acquiring software. A program purchased off the shelf which is only partially satisfactory to the manager may be no better than no program at all. On the other hand, to do your own programming requires a significant commitment in time.

Successful programming requires very disciplined work and thinking.

### Developing an Applications Program

Regardless of the method used to obtain software, effective computer use will be aided by understanding the steps in developing a computer program. These steps are:

#### Problem Identification

Identify the problem or the job that needs to be done. This includes specifying the output desired or the answer needed.

#### Program Design

This phase includes planning data to be computed, the form and characteristics of the output and the calculations required to get that output. There are different ways to plan the output to get the form that is easiest to read and interpret. If the operator cannot understand the output or is uncomfortable with it, the program has little value. In designing the program, it is helpful to prepare a flowchart of the program. The flowchart shows the sequence of steps involved in solving the problem. It is like a roadmap showing the steps necessary to get to the desired destination.

#### Program Coding

Once the program design is established, the computer code can be written in whatever language is selected. In most cases, the language will be BASIC, particularly if farm operators are doing their own programming.

#### Program Verification

Once the program is written, it must be checked to see if it runs, tested to determine if the answers are correct, and “debugged” to eliminate programming as well as logic errors.

#### Program Documentation

This step is often overlooked. A detailed description of the program’s design and capabilities must be written so others can use the program. The documentation includes instructions on how to use the program, a description of the inputs required, an explanation of the options included in the program, and instructions on how to interpret the output.

#### Program Maintenance

Programs are often updated either to correct deficiencies, or to update with current information, or because



research has revealed more accurate functional relationships. A computer program must be kept current with the most recent information to be useful to decision makers.

### **Evaluating Software**

If some software will be purchased, selecting that software is the most important aspect of the computerization process. Having a computer without software is like having a tractor and no implements. Similarly, it is important that the implements purchased be consistent with the size of farm, field conditions, and crops to be grown. Software selected must also be consistent with the jobs to be done on the computer. Consider these points in evaluating software.

### **Test Programs**

Run the programs before you actually buy them. Do not have someone else demonstrate the program—run it yourself. You cannot get a feel for a program and how it runs unless you actually run it yourself. This will allow you to use data that fit your own operation. It is also a good idea to try erroneous data to see how the program reacts. For example, does the program check data input to insure it is within a feasible range? If erroneous data is used can the program work around it and correct the situation without leaving the user hung-up? It is frustrating and inefficient if you have to start back at the beginning of a program every time you accidentally input a wrong number. A “bullet proof” program will avoid this problem.

### **User-Friendly Software**

Look for programs that are menu-driven and user-friendly. You should be able to select particular parts of a program rather than going sequentially through a whole program. Sequential operation is frustrating for the user and inefficient use of time and computer capacity. Except for short simple programs, you will never go through a program in the same sequence every time. A menu allows you to select the specific part you are interested in and allows you to repeat a specific part of a program.

Help statements and prompting aids add to program friendliness. Once you are familiar with a program, however, this type of prompting and assistance may slow down processing time and become a disadvantage. The optimum is to have a program designed to provide help if you wish, or do the calculations without the help.

### **References**

Ask the vendor for names and addresses of people who are using the software. The experience of these

people will help in assessing software strengths and weaknesses. If a program is well accepted, the vendor should have no concern in supplying the users' names. A large number of users indicates wide acceptance of a program. It also should mean the “bugs” in the program have been discovered and corrected.

### **Documentation**

Look for a well-documented program. The minimum should be instructions on how to start the program and a description of the user inputs. Flowcharts would be useful to a programmer who may wish to make changes. This is important for two reasons. First, you may want to alter the program to make it fit more closely to your situation and second, you may want to change some coefficients to update them to current conditions or to fit your specific situation. Along with a flowchart, a description of the assumptions is helpful to determine if any changes in the functional coefficients are needed. Sample output would be helpful to understand what the program does and what the output should look like.

### **Vendor Support**

Vendor support after you buy a software package needs to be determined. Helpful services include: (1) Someone who will answer questions about the program use including interpretation of results; (2) providing program updates; and (3) help to modify the program to fit your needs. To avoid surprises, inquire about service costs. Some, such as answering questions, may be free. There will be additional charges for other services such as program modification. Also, ask about the vendor's plan to update the program. Get a specific phone number to call if you need help.

### **Summary of Software Considerations**

Computers can be useful tools. The first step is to determine your needs and objectives in owning a micro-computer. For those operators who do not already have computers:

1. Define some “what if” questions that relate to the management of your operation during the next year.
2. Think beyond these questions to other needs you might have for the computer in the next few years.
3. Select software packages which will fulfill these needs. Don't box yourself in by selecting programs which will have limited use or will not allow you to expand the “computerized” management of your business. Remember to give the programs a trial run before you buy them.
4. Select hardware that will operate the programs you have selected.
5. Learn to run the simple packages first and do some planning for the next year.



6. Analyze some longer-run decisions such as buying land.

7. When you are familiar with these "decision aid" programs consider starting to do your recordkeeping with your computer. You might also want to consider livestock and field records.

8. Make sure you are prepared to allocate the necessary time to this whole process before you go beyond the first step.

9. Don't become dependent on the computer until you are sure it is doing what you want it to do. If you use it to keep records, also keep a manual set of records for the first year. This will allow time to get to know your computer system, to find out if it is handling the data the way you think it is. It also gives you the chance to make a few mistakes without being left high and dry with no back-up set of records!

### How Computers Work

Now that you have figured out what you want to do with a computer, let's look at how it works.

Innovation and technological advancements are not new to farmers but the benefits of computer technology are more difficult to document than other technological advances. It is a distinct new technology on many farms rather than an evolutionary change. At the same time, the multitude of potential computer applications may be more important to farmers in the next decade than any other technological change.

### The Binary System

A digital computer, which can perform sequences of arithmetic and logical operations, recognizes only two situations. It distinguishes between the power source being "on" or "off." The computer uses the two numbers "1" and "0" internally to correspond to "on" and "off", respectively. The numbers 1 and 0 are referred to as binary digits or "bits" for short. The bit is a unit of information equaling one binary decision, or the designation of one of two possible and equally likely values or states.

Even though a computer is electronically designed to translate "1" and "0" as on and off states, designing a program using "1" and "0" would be tedious and time consuming. A code format was developed to convey letters, numbers and other characters in a sequence of 8 bits, or 1 byte. This was called the ASCII code which stands for American Standards Committee on Information Interchange (usually pronounced "ask-ee"). It relates 96 displayed characters (64 without lower case) and 32 nondisplayed control characters to a sequence of 8 binary digits. For example 00110001 represents the number "1" and 01000001 is a representation of the letter "A".

The earliest record of computer architecture dates back to the early 1600's, but notable breakthroughs did

not occur until the mid 1900's. The development of the microcomputer can be attributed to the evolution of transistors into integrated circuits. Microscopic electronic components are photoetched onto a tiny piece of semiconductor material, forming one or more circuits. It is a semiconductor because its conductivity is between that of a metal and an insulator. The main parts are made of semiconductor materials such as germanium and silicon. In contrast to metals, the electrical conductivity of a semiconductor increases as the temperature increases, making response time even faster.

### The Development of Chips

An integrated circuit manufacturer, Intel, Inc., developed a general purpose integrated circuit in 1971. This was the Intel 4004. It was a 4-bit circuit, equivalent to 2,300 transistors. This was followed in 1972 by the Intel 8008, an 8-bit circuit. This was the basis of the first general purpose microcomputer.

The next step in the technological evolution was a family of 16-bit microprocessors. Intel introduced the 8086 in 1978 which was the equivalent of 29,000 transistors. Others in the 16-bit family are the Motorola 68000 and Z8000.

While most microcomputers are 8-bit systems, a 32-bit chip has already been developed. This is the iZ-Px432 developed by Intel. The main advantages of 32-bit versus 16-bit versus 8-bit systems are computing power, speed of processing, and ability to address more memory. For many computer users, the additional speed may not be a significant advantage. An 8-bit machine is a lot faster than manual calculations and the additional fraction of a second saved by a 16-bit processor may not be sufficient reason to upgrade a working system. An 8-bit processor can address a maximum of only 64K memory while 16-bit processors can address 1000K or 1 megabyte.

Chips have different functions and different methods of handling routines and computations. We could compare them to household appliances. Each appliance, such as a food processor, has a specific function but different brands have different features.

### Components of a Computer System

When your objectives for owning a microcomputer have been determined and software selected, the next step is selecting the hardware to run the software. Hardware is a system of integrated components rather than just one unit. Each of the components are described in this section. A microcomputer can essentially be divided into three basic functions: the microprocessor or central processing unit (CPU), input/output (I/O) and memory.



## Central Processing Unit (CPU)

This is the heart of the computer and contains the microprocessor chip. All calculations and operations required to use the logic specified in a program are carried out in the CPU. This is where the "computing" takes place in a computer.

## Input/Output (I/O)

Every other device hooked into the computer can be referred to as a peripheral device. These input-output or I/O devices include the keyboard, the video display terminal, the storage disk, and printer. The sequencing of data between these peripheral devices and the CPU and between the peripherals themselves is determined by a control unit.

## Memory

The two basic types of memory are: Read only memories (ROM) and Random access memories (RAM).

"Read only" memory refers to memory that cannot be altered in normal computer use. It is usually a relatively small memory (10 to 12K) that contains often-used instructions such as microprograms or system software (the ability to list and run programs) and sometimes a programming language translator. You cannot change its functions or use it for other purposes. You can only read the factory specified instructions.

There are ROM's that can be changed with special equipment but not during normal computer use. These are referred to as programmable ROM's. Special equipment is required to program a ROM according to the user's specification. Most personal and small business microcomputers have a ROM that can never be changed. This is referred to as "masked" ROM. The content is set or "burned on" when the chip is made.

"Read only" memories are not forgotten when the power is turned off. The instructions are still available when power is restored.

The RAM or "random-access memory" provides immediate access to any storage location point in the memory. This portion of the memory is used to store data words. Each word is stored in RAM at a known location called an address. The information in RAM is lost every time the computer is turned off unless it has been stored on tape or disk.

Memory capacity is measured in kilobytes or K. A kilobyte is 1,024 bytes ( $2^{10}$ ) but is usually thought of as 1,000 bytes. Since the computer recognizes only two stages, a "0" or "1", all memory capabilities are measured to the base 2. In 1K of memory there are actually 1,024 memory cells. A computer with 64K RAM has 65,536, or memory for about 64,000 data words. This memory can be used to store the program being used, the data being used, and the answers generated until they are outputted or used in another section of the pro-

gram. Once the power is shut off, the information in the RAM is lost.

## Video Display

The display unit is a TV-like screen called a cathode ray tube or CRT. This displays data input, program instructions and the data processing results. Monitors specifically designed for microcomputers have clearer displays than standard TV sets. The number of characters that can be displayed on the screen is controlled by the circuits in the control processing unit. A display of 80 characters per line and 24 lines per screen is the most common. Some microcomputers have less than 80 characters per line.

## Mass Storage

These are peripheral devices into which large amounts of data can be deposited and recovered. These are sometimes referred to as "secondary" storage to differentiate from the process memory described above. Tape cassette is a possibility but is not recommended for small business applications due to inconvenience, problems with accuracy of retrieval and slow speed. Most businesses are going to utilize either a floppy disk or a hard disk system as the storage device.

**Floppy Disks.** Floppy disks, which resemble thin phonograph records, can be read from or written to at a high rate of speed. The disk is coated with iron oxide and magnetized to store data. They come in several sizes but the two most common are 5 1/4 inches and 8 inches in diameter. An important consideration is the storage capacity of a single disk, particularly if the computer is being used for data storage purposes such as farm record keeping. There are four characteristics which determine the capacity of a floppy disk:

1. Disk size. The current alternatives are 3 1/2, 5 1/4 and 8 inches in diameter.
2. Number of recording surfaces. Some systems use only one side of the disk and some use both sides. The use of both sides is referred to as double-sided.
3. Linear recording density. Recording density is referred to as either single density (2,600 to 3,200 bits per inch) or double density (5,200 to 6,400 bits per inch).
4. Track density. On the disk surface is a number of tracks. The usual configuration is 35 or 40 tracks on a 5 1/4-inch disk and 77 tracks on an 8-inch disk. The tracks are similar to grooves on a phonograph record except they do not connect. That is, they are concentric circles, one inside the other (Figure 1). Each track is subdivided into a number of sectors. The number of sectors per track depends on the computer brand and the disk operating system used.



Example unformatted disk capacities are given below:  
5 1/4" single sided single density (SSSD) 80,640 bytes.

5 1/4" double sided double density (DSDD) 322,560 bytes.

8" single sided single density 256,256 bytes.

8" double sided double density 1,024,024 bytes (1 megabyte).

These capacities are calculated as follows:

No of tracks per disk x no. of sectors per track x no. of bytes per sector = no. of bytes per disk.

If, for example, the sector capacity for a particular computer is 256 bytes per sector and each track has 16 sectors, the capacity for a SSSD disk is  $35 \times 16 \times 256 = 143,360$  bytes.

This system of tracks and sectors makes it easier and quicker for the computer to locate a particular byte. Once the track and sector are located the computer must then only search through the number of bytes in that sector.

Technology is advancing rapidly with disk storage capabilities just as it is with other components of computer systems. The current trend is a doubling of disk storage densities every two and half years.

**Hard Disks.** The second type of mass storage is the rigid or hard disk system, also referred to as Winchester drive disks. The word "Winchester" denotes a disk drive with specific functional characteristics. It is not a brand name and not all hard disks are Winchester disks. Winchester drives utilize a fast rotating, high-density disk and medium to high speed head positioners to achieve performance comparable to the most expensive hard disks. Winchester disks are extremely susceptible to dust, dirt, and smoke. Major advantage of the Winchester drive is the storage capacity. The data storage capacity of an 8-inch Winchester for example, ranges from 2 to 40 megabytes (a megabyte is 1,024,024 or about 1 million bytes). Winchester drives are also faster than the floppies. For a single user, this may not be a significant factor but does become more of a factor if there are a number of users on the same storage system.

There is one problem with the Winchester drive. Since the units are sealed, another device must be available to create a backup data file. Floppy disks are often used for this purpose, but that may require a large number of disks and the advantage of the hard disk may be lost. On the other hand, using the floppy as a backup provides an alternate storage system should the hard disk fail. A second alternative is to have another rigid disk system, probably a removable cartridge system. This is feasible but it makes the whole system relatively expensive. Another backup alternative is the "streaming tape" storage which is similar to a reel-to-reel tape. This system makes efficient use of the tape but is also expensive.

## Printers

Much variability exists in the speed, characters per line, type, print quality and noise level of printers. The type selected depends on the use. Letter quality printers are more expensive than the dot-matrix printers and are not required unless the computer system will be used frequently for correspondence or manuscripts. The dot-matrix printer forms characters by blackening a pattern of dots in a grid (usually 7 x 9 dots). Dot-matrix printers working at 80 to 200 characters per second (CPS) are available. A daisy wheel printer is slower, only 50 to 60 CPS, and more expensive than the dot matrix printer but produces "letter quality" printouts. They work by spinning a character "petal" into place like a single element or ball typewriter and then striking it from behind with a tiny hammer. The major advantages of the dot-matrix printers are their low cost, lower maintenance, and greater printing speed than the daisy wheel printers.

As is the case with input devices, the interface between the printer and the computer must match the signals of the computer to those the printer can execute. There are two possible interface modes. A "parallel" interface allows an entire 8-bit word to flow from the computer to the device at the same time. The 8 bits essentially flow simultaneously. The "serial" interface sends the 8 bits one at a time.

## Modems

Microcomputer systems equipped with the necessary devices can be used to communicate with other computer systems. Modems are used to convert audio signals which travel over telephone lines into electronic signals understandable by the computer and vice versa. The word modem comes from the words modulate and demodulate.

An ordinary telephone handset can be used with an acoustical coupler which is a set of earmuffs—the rubber sockets into which you place the handset of your telephone. This is a simple interface but noise or interference on the telephone line is a problem. Another method is to plug the modem directly into a telephone jack. These hard-wired modems can potentially transmit data much faster than with the acoustical coupler.

When you send data from your computer to another one, the modem converts your computer's signals into audio signals which are sent over the telephone lines to the other computer. Remember, the other computer must have a modem to convert the audio signals to signals that computers can understand.



## Computer Glossary

The following glossary was compiled by the North Central Computer Institute, a joint project of the land grant universities in 12 North Central States.

**Acoustic Coupler.** A type of modem that allows one computer to communicate with another computer or a terminal device via telephone. You place the handset of the telephone into this unit.

**Algorithm.** A step-by-step process for the solution of a problem in a finite number of steps. Usually developed in an outline or as a flow chart before coding begins.

**Alphanumeric.** Alphabetic, numeric, and punctuation characters.

**ALU.** (Arithmetic Logic Unit) The element in a computer which can perform the basic data manipulations in the central processor.

**Analog to Digital Converter.** A device for converting voltage levels (analog signals) to digital (computer) information.

**Applications Software.** Software programs that perform a specific useroriented task such as ration balancing or payroll. Applications software can be either purchased as a package, or custom designed by a programmer.

**ASCII.** (American Standard Code for Information Interchange) A common standard for representing numbers and characters inside a computer. It is a seven bit code widely used in computers and communications. Compare with EBCDIC.

**Assembler.** A computer program that converts (or translates) assembly language programs into a form (machine language) that the computer can understand. The assembler translates mnemonic instruction codes into binary numbers, replaces names with their binary equivalents, and assigns locations in memory to data and instructions.

**Backup.** Copying of one or more files onto a storage medium for safekeeping should the original get damaged or lost.

**BASIC.** (Beginner's All-purpose Symbolic Instruction Code) A relatively easy-to-use programming language that comes with many small computer systems.

**Batch Processing.** A traditional method of data processing in which transactions are collected and prepared for computer input to process a single unit.

**Baud.** A measurement of communication speeds between devices. Generally means bits transferred per second. Divide the number by 10 to get characters per second.

**Bidirectional.** (1) Ability to transfer data in either direction. (2) Ability of a print head to print from right to left and from left to right, which helps increase print speeds.

**Binary.** The basis for calculations in all computers, this two digit number system consists of digits 0 and 1 which are represented in the computer as the presence or absence of small electrical pulses.

**Bit.** The contraction of 'Binary Digit.' The smallest unit of information that the computer recognizes. A bit is equivalent to the presence or absence of an electrical pulse (0 or 1). Bits are usually grouped in nibbles (4), bytes (8), or larger units.

**Bit Map Graphics.** A technology that allows control of individual pixels on a display screen to produce graphic elements of superior resolution, permitting accurate reproduction of arcs, circles, sine waves, or other curved images that block addressing technology cannot accurately display.

**Byte.** A group of bits (usually 8). A byte can be used to represent one character (number or letter) of information, all or part of binary numbers, and machine language instructions.

**Catalog.** See Directory.

**Chip.** A thin semiconductor wafer on which electronic components are deposited in the form of integrated circuits.

**Compiler.** A translation program which converts high level instructions into a set of binary instructions (object code) for execution. Each high level language requires a compiler or an interpreter. A compiler translates the complete program which is then executed. Every change in the program requires a complete recompilation.

**Computer.** A general purpose electrical system designed for the manipulation of information, incorporating a central processing unit (CPU), memory, input/output (I/O) facilities, power supply and cabinet.

**CP/M.** An operating system for microcomputers, developed by Digital Research Corp., and used on many 8 bit microcomputers. CP/M stands for Control Program/Monitor.



**CPU.** (Central Processing Unit) The part of the computer that controls the execution of the machine language processing instructions.

**CRT.** (Cathode Ray Tube) The television tube used to display pictures or characters. Also the computer terminal made from a CRT. See VDT.

**Cursor.** An electronically generated symbol that appears on the display screen to tell the operator where the next character will appear.

**Custom Software.** Computer programs prepared for a specific tailor-made purpose. Contrast with packaged software, in which the programs are written in advance, usually for general purposes.

**Data.** Facts, numbers, letters, and symbols that when processed become usable information.

**Data Base.** (Database) A collection of interrelated data organized for ease of update and retrieval. For example, a livestock data base might include the health and breeding information for each animal in a herd.

**DBMS.** (Data Base Management System) Software that controls storage and retrieval of information in a database.

**Debug.** To find mistakes or problems with software or hardware and then eliminate them.

**Density.** A term used to describe the distance between magnetic information on tapes or floppy disks. Higher density increases information storage capability.

**Device.** In computers, a piece of hardware that performs some specific function. Input devices (e.g., keyboard) are used to get data into the CPU. Output devices (e.g., printer or display monitor) are used to take data out of a computer in some usable form. Input/output devices (e.g., terminal or disk drive) are able to perform both input and output of data.

**Digital to Analog Converter.** Device that transforms a computer's digital electrical pulses into a continuous analog signal in order to relay information to or power some non-digital device outside of the computer.

**Direct Connect Modem.** In contrast to an acoustic modem, a direct connect modem is hard wired directly to the data transmission line.

**Direct Memory Access.** See DMA.

**Directory.** An index to the files of data and programs on an external storage medium. Also referred to as a Catalog.

**Disk.** A circular plate with magnetic material on both sides. This plate rotates for the storage and retrieval of data by one or more 'heads' which transfer the information to and from the computer. The computer-readable information may be placed on a 'floppy' or a rigid (hard) disk, and may have information on one or both sides. Also known as diskette or disc.

**DMA.** (Direct Memory Access) An input/output method whereby an external device or controller directly transfers data between the memory and device without the processor's (CPU's) intervention.

**DOS.** (Disk Operating System) The program responsible for the housekeeping and communications between the disk storage device and the computer. The DOS is also usually responsible for communications between the computer and other peripheral units.

**Dot Matrix.** A printer type using a number of pins impacting a ribbon or specially treated paper to form characters.

**Downtime.** The period during which a computer is not operating.

**Driver.** A program that provides an input format to an external device or another program. A printer driver receives input from the computer in the form of printed lines or graphic characters, and it outputs these instructions to a printer or plotter.

**Duplex.** A method of operating a communications channel between two devices. 'Full Duplex' allows both units to send and receive simultaneously. 'Half Duplex' allows only one unit to send information at one time.

**EBCDIC.** An acronym for 'Extended Binary Coded Decimal Interchange Code.' Used extensively by IBM, this standard eight-bit code is used to represent letters, numbers and symbols. Compare with ASCII.

**Editor.** A program that manipulates text information and allows the user to make corrections, additions, deletions and other changes.

**Ergonomics.** The science of human engineering which combines the study of human body mechanics and physical limitations with industrial psychology.

**External Storage.** Used to store programs and information that would otherwise be lost if the computer were turned off; for example, tapes and disks. Also known as mass storage.



**Field.** A group of contiguous bytes of information that constitutes a single piece of data. A cow identification number may be one field, while milk production may be another.

**File.** A logical collection of information, designated by name, and considered as a unit by a user. A file is divided into smaller records, and the records into fields. Fields are stored on external storage.

**Function Keys.** Additional keys on a keyboard which are used to perform user or program definable operations.

**Graphics.** Presenting information pictorially rather than alphanumerically.

**Hardware.** The electronic circuits, memory and input/output components of a computer system. The 'tangible objects.'

**High Level Language.** A programming language in which the statements represent procedures rather than single machine instructions. FORTRAN, COBOL and BASIC are 3 common high level languages. A high level language requires a compiler or interpreter.

**Input.** (1) The data that is entered into programs. (2) The act of entering data into a computer. (3) Data used by programs and subroutines to produce output.

**Input Device.** Any machine that allows you to enter commands or information into the computer. An input device could be a keyboard, tape drive, disk drive, microphone, light pen, digitizer or electronic sensor.

**Intelligent Terminal.** (Smart Terminal) A terminal that has some data processing capability or local computing capacity.

**Interface.** The juncture at which two computer components (hardware and/or software) meet and interact with each other. Also applies to human-machine interaction.

**Interpreter.** A translation program used to execute statements expressed in a high level language. An interpreter translates each such statement and executes it immediately. Instructions can be freely added or modified in the user program, and execution may be resumed without delay; an interpreter is interactive. Compare with Compiler.

**K.** Computer shorthand for the quantity 1024. The term is usually used to measure computer storage capacity, and transfer rates.

**KSR.** (Keyboard Send Receive) Indicates that your printer has a keyboard on it.

**Language.** See Programming Language.

**Low Level Language.** A language which is easily understood by the computer. In a low level language programs are harder to write but faster to execute. They also take up less space than a program written in a high level language. Examples are machine or assembler language.

**LSI.** (Large Scale Integration) The combining of about 1,000 to 10,000 circuits on a single chip. Typical examples of LSI circuits are memory chips, microprocessors, calculator chips and watch chips.

**Machine Language.** Set of binary codes (0's and 1's), representing the instructions which can be directly executed by a processor.

**Main Frame.** The largest of computers. With an expansive internal memory and fast processing time, costs range into the millions of dollars.

**Mega.** (M) Prefix for a million; hence 1 megabyte equals a million bytes.

**Memory.** The section of the computer where instructions and data are stored. Each item in memory has a unique address that the CPU can use to retrieve information.

**Microcomputer.** A small but complete microprocessor-based computer system, including CPU, memory, input/output (I/O) interfaces and power supply.

**Microprocessor.** LSI implementation of a complete processor (ALU & control unit) on a single chip.

**Minicomputer.** A small computer, intermediate in size between a microcomputer and a main frame computer.

**Modem.** (Modulator-Demodulator) A device that transforms a computer's electrical pulses into audible tones for transmission over the phone line to another computer. A modem also receives incoming tones and transforms them into electrical signals that can be processed and stored by the computer. See Acoustic Coupler and Direct Connect Modem.

**Object Program.** (Object Code) The output from an assembler or compiler.

**Operating System.** A collection of programs for operating the computer. Operating systems perform house-keeping tasks such as input/output between the com-



puter and peripherals, and accepting and interpreting information from the keyboard.

**Output.** Any processed information coming out of a computer via any medium (print, CRT, etc.), or the act of transferring information to these media.

**Output Device.** A machine that transfers programs or information from the computer to some other medium. Examples of output devices include tape, disk, and bubble memory drives; computer printers, typewriters, and plotters; the computer picture screen (video display); robots; and sound synthesis devices that enable the computer to talk and/or play music.

**Packaged Software.** A program designed to be marketed for general use, unadapted to any particular installation.

**Parallel.** In communications, the method of sending an entire character or word at a time over a series of computer lines rather than breaking them up into their component elements. Parallel communication between the computer and printers is generally faster. Contrast with Serial.

**Parity.** A 1-bit code that makes the total number of bits in the word, including the parity bit, odd (odd parity) or even (even parity). Used for error detection during data transmission.

**Peripheral.** A device attached to a computer (for example, the CRT or printer).

**Pixels.** (Picture Elements) Definable locations on a display screen that are used to form images on the screen. For graphics displays, screens with more pixels generally provide higher resolution. See Bit Map Graphics.

**Program.** A sequence of instructions directing a computer to perform a particular function; a statement of an algorithm in a programming language.

**Programming Language.** A set of words and rules that constitutes a language understood by the computer and the programmer alike. See also High Level Language and Low Level Language.

**RAM.** (Random Access Memory) RAM serves as the computer's scratch pad. Information is usually transferred into RAM from permanent storage.

**Record.** A collection of data items stored on a diskette or other medium which may be recalled as one unit. Records may be of either fixed or variable length. One or more records usually make up a data file.

**Resolution.** The quality of the image on the CRT, as influenced by the number of pixels on the screen, described by rows and columns. The greater the number of pixels, the higher the resolution. Typical values range from 128x128 to 1024x1024.

**Response Time.** The time required for the system to respond to a user's request or to accept user's inputs.

**Reverse Video.** A feature on a display unit that produces the opposite combination of characters and background from that which is usually employed; i.e., black characters on a white screen, if having white characters on a black screen is normal.

**RO.** (Receive Only) Refers to a printer that cannot be used to send information.

**ROM.** (Read Only Memory) Memory containing fixed data or instructions that is permanently loaded during the manufacturing process. A computer can use the data in ROM, but cannot change it.

**RS-232.** A standard interface for the transmission of serial digital data.

**Sequential Access.** A storage method (such as on a magnetic tape) by which data can only be reached or retrieved by passing through all intermediate locations between the current one and the desired one.

**Serial.** The handling of data, one item after another. In communications, a serial transmission breaks each character into its component bits and sends these bits one at a time to a receiving device where they are reassembled.

**Software.** A general term for computer programs and documentation involved in the operation of the computer.

**Source Code.** The humanly readable computer commands written in a programming language. It requires an interpreter or compiler. It is sometimes referred to as a source program.

**Storage.** The general term for any device which is capable of holding data which will be retrieved later.

**Subroutine.** A program segment permitting a frequently required task to be called from any point of the main program. Execution is transferred to a subroutine when a subroutine call occurs. Subroutines save memory space at the expense of execution speed.

**Tape.** Inexpensive mass storage medium. Must be accessed sequentially.



**Teletext.** Textual information transmitted to people's homes via their TV. Information is usually maintained and updated on a computer.

**Terminal.** A keyboard plus a CRT and/or printer that can be connected to a computer.

**Terminal Emulation.** A communication method in which a terminal or a suitably programmed computer acts as a terminal of a particular design so that it can be used on various systems.

**Timesharing.** A method of sharing the resources of the computer between several users, so that several people can appear to be running different computer tasks simultaneously.

**Tractor Feed.** An attachment used to move paper through a printer. The roller that moves the paper has sprockets on each end that fit into the fanfold paper's matching pattern of holes.

**Utility Program.** A program used to assist in the operation of the computer; e.g., a sort routine, a printout program, a file conversion program, etc. Generally these programs perform housekeeping functions and have little relationship to the actual processing of the data.

**Video Display Terminal.** (VDT) A CRT plus keyboard.

**Word.** A unit of data or the set of characters which occupies one storage location. In microcomputing, a character, a word and a byte are interchangeable. In most minicomputers, a word is equal to two bytes.

**Word Processor.** A text editor system for electronically writing, formatting, and storing letters, reports, and books prior to printing.