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Ethnologists and Programming

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INTRODUCTION

At the time of its establishment, the National Museum of Ethnology (NME) planned to make good use of computers in ethnological and related research. Of the many attempts made over several years, some have been useful, but various problems have also arisen.

These stem from the fact that ethnologists are not trained to use computers and know little or nothing about hardware and software. But many ethnologists ask why they must know computers. They believe that they have no more to do than just use the application programs that computer specialists have made.

In response to these doubts, it is important, first, to distinguish the programs that an ethnologist makes by himself and for his own use from those available from other sources. Also necessary in this discussion is an understanding of relationship between ethnologists and computers, which can be classified into five levels. The problems that arise when ethnologists program a computer need to be discussed, as do the advantages and disadvantages of programmable machines, including those other than computers. These considerations may lead, then, to a discussion of whether it is essential for ethnologists themselves to program computers.

FIVE LEVELS OF ETHNOLOGISTS' USAGE OF COMPUTERS

My observations of how ethnologists use the computer systems of the NME have led to the following five-level classification, based on intimacy with the computer:

- (1) Using data that another person has already processed by computer.
KWIC concordances and statistics fall under this category. An ethnologist can refer to such publications as papers, books, or reports. In the same way, scientists formerly looked up the table of trigonometric functions. The advantages in this case are that there is nothing special in the use of computer-processed data and that it can be used everywhere (for example, in the train or even in bed) without sitting at the computer terminal. Further, he need not have a computer at his disposal.
- (2) Requesting computer specialists to develop a program which carries out a desired processing.

An ethnologist interested in computers will be ideally situated if he finds such specialists to function as assistants or co-researchers. They could be one of the most intelligent man-machine interfaces.

- (3) Using application programs as a user only.

Word-processors and information retrieval systems are in this category. Generally, this is an ethnologist's first step toward operating a computer directly. Whether he feels familiar or not with computers depends on the man-machine interface.

In the categories (1) to (3) a user who is not satisfied with the results or the function of that system can do almost nothing to modify them.

- (4) Making a program by combining packaged subroutines supplied by others. At this level, it is not enough for an ethnologist to understand the function of a subroutine package. To some extent he must know the real computer system, for example, interacting with the operating system, a programming language, an editor, a compiler, and a linker.

- (5) Programming a computer by oneself with a programming language.

The ethnologist could do everything that computer specialists can do by computer. He is a full-fledged computer programmer.

WHY IS PROGRAMMING SO TEDIOUS A TASK?

Software has been in crisis for the past fifteen or so years. Even for a professional programmer, it is not easy to write a large-scale program that works correctly. An ethnologist trying to write a program experiences difficulties at a more primary level. First, he is faced with unfamiliar concepts, such as variable, loop, conditional branch, subroutine, and complicated data structures. Each step of a program means an abstract function and constitutes only a very small part of the whole program. What he wants to process must be reduced into a long sequence of program statements that the computer can understand. The work is tedious and must be done step-by-step, and there is always a gap between any step of a program and the final goal. The rules (or grammar) of programming language are very strict. If a single period is omitted, the program will not run as expected. With many other responsibilities beyond programming, an ethnologist cannot usually devote time to writing a program.

WHAT IS THE PROGRAMMING?

While the word *program* is derived from pro- (=before) and -gram (=something written) and means "writing something beforehand," in engineering the term *programmable* has a specialized meaning: "flexible," "variable," or even "post-settable" when it is used in such phrases as Programmable Read Only Memory. From these uses, *to program* can be defined as "to fix beforehand the flexible aspects or the variable portions." In other words, a specific value is given to each

parameter. In modern digital computers, a parameter corresponds to a machine instruction of one step, and programming corresponds to specifying previously what instruction must be executed at that point.

According to the definition of program given above, there have been many programmable machines other than digital computers, for example, an automatic washing machine, a music box, a street organ, an analog computer, and a music synthesizer. In a sense, even a record player is a programmable machine that plays various music by changing programs (*i.e.*, records).

The appearance of all those programmable machines brought about changes in their use and in our understanding of them. First, machines became multi-purpose or universal. By a change in its program, a single machine can perform various functions. Combining a programmable machine and a program produces a special-purpose machine. Moreover, we can add new functions to the machine or can remove useless ones, so that if we modify or develop a program, the machine is now fitted as closely as possible to the current requirement. Von Neumann's idea of the stored-program computer enables the functions of computerized machines to be modified more easily. Second, if we preserve the program that we have made or the value of parameters that we have adjusted with great effort, we can exactly restore the function of a programmable machine every time we need to. Third, a programmable machine is controlled by itself according to its program without human intervention. Once a program is written, even if it is very complex, the machine works very fast and precisely.

When a program is viewed in this manner, programming is not restricted to what can be written according to so-called programming languages, even in digital computers. Command procedures and scripts¹⁾ are a kind of program in a broad sense. In interactive program, many parameters are not fixed until their values are given by the user during run-time. If the fixation of these parameters are done by the values already stored somewhere in a computer's storage area, the set of these values will be regarded as a program higher by one level.

DO ETHNOLOGISTS NEED TO PROGRAM A COMPUTER?

To make good use of a computer in the central part of a research project, an ethnologist cannot do without programming. Because research is intended to discover new information to formulate new laws, ready-made software, designed for routine uses such as office work, cannot suffice. Ethnological research requires special ways of data processing and programs must be *customized* for these purposes. Such programs are essential for research, even though they may be used only once.

Reactions to this imperative way vary between older ethnologists and younger or future ones. Old ethnologists may consider it too expensive in time, money, and

1) Script is a file that contains a sequence of commands usually given to the interactive program by the user during run-time. If an interactive program is started with a script, it can run automatically obtaining commands from the script instead of from the user.

effort to learn the computer and programming. But they have been using other machines for their field work. They must have been trained to take a picture by camera and many can drive a car. A computer has the advantages over these other machines in that it is not a mere tool but a means of making many other tools. The ability of older ethnologists to understand a computer depends on their acceptance of it.

Another way for them to use a computer is to find a *human interface*, i.e., a person who bridges the gap between ethnologists and computers. For the old-fashioned ethnologist, this is the best situation, in that there is no need to learn anything about computers. In the near future artificial intelligence and knowledge base technology will convert the user interface into an almost *human interface*.

But I am optimistic about the relationship between new or future ethnologists. Current computer systems have essentially exhausted all aspects of programming, not only for ethnologists but also for engineers. Everyone wants to do without making programs, if possible. Nevertheless programming in a broad sense, as has been mentioned, is gradually being introduced in daily life. As a very natural concept, it is not hard to learn step-by-step. Even though *computer* means a computing machine, programming does not necessarily concern mathematics. In addition, the next generation will feel familiar with computers around them.

Many aspects of current computer systems must be improved in order to raise programming to the level presented here. How ethnologists are taught to understand programming is important. I propose that programming for ethnologists in a broad sense is experienced or taught top down. As a first step, an ethnologist enters commands interactively to the computer, and knows how to use the system. Then, a sequence of commands prepared beforehand is entered into the computer. This primary programming will teach what programming is and how useful it is. Similarly, combining software modules is a kind of programming. As the need to make more complicated programs gradually includes variables, conditional branches, loops, subroutines, and other subtleties, all concepts of programming will finally be learned with minimal effort. The fundamental problems that we must try to solve are what programming environment is to be supplied for ethnologists and what set of software modules are most suitable for their studies.