A Not-So-Fast Renumberer for OSI BASIC

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Written in BASIC, this utility makes your listings neat and tidy.

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This article describes a routine that will renumber BASIC programs for the Ohio Scientific BASIC-in-ROM computers. The program itself is written in BASIC and was designed on and for my personal machine, a Challenger C2-4P. However, it has also been tested and found to work without modification on the Challenger C1-P and C2-8P machines. Hence, any OSI computer with BASIC-in-ROM can make use of this renumbering routine. I would like to thank Phil Thornton of Elkhart Computer for providing a Challenger C1-P on which to test the program.

I decided to design this program and write this article for three major reasons. First, I have been the proud owner of my C2-4P for a number of months now and, as a result, have written a sizable library of BASIC programs that I would like to tidy up and expand. Second, I hope to make a few bucks from publishing this article so I can buy more hardware to write more programs that will need to be renumbered. And finally, in a February 1979 letter to the editor (p. 20), E. Morris of Midland, Michigan, said he would not renew his subscription unless there was an article oreinted toward us Ohio Scientific users in the next eleven months. I'm always glad to keep a fellow OSI user happy.

After having used their machines for a reasonable period of time, most OSI users would agree that one significant feature absent from the OSI version of Microsoft BASIC-in-ROM is the ability to renumber an existing program. This is a shortcoming that, until recently, I had managed to circumvent manually by writing programs with large gaps in the statement numbers and renumbering manually from printed listings when the source got too shabby to share with fellow programmers. However, my professionalism (I program operating system software for an Amdahl 470/V5 to support my hobby and family) got to me recently, and I finally decided that if I can renumber by hand, then I should certainly be able to tell the 6502 how to do it by itself.

In the process of collecting ideas for an OSI renumber routine, I read a number of articles by others who have written renumber routines for other systems—some in machine code and others in BASIC, some for 6502 machines and some not. The common foundation for all of these routines is a knowledge of how the BASIC interpreter stores the user's program in memory for execution, and I knew this was the key to designing a renumber routine for OSI's version of BASIC.

OSI's BASIC-in-ROM stores a user's source program starting at decimal location 769 in RAM. Each statement is composed of a four-byte header, followed by the compressed statement and terminated with a single byte of zeros. The four-byte header contains two 2-byte data words. The first word is the address of the next sequential statement, or zeros if this is the last statement in the program. The second word contains the statement number in binary format.

Routine Design

My first attempt at writing a renumber program was designed to renumber only the statements themselves, with no consideration of renumbering GOTOs, GOSUBs, THENs or RUNs embedded in the text of the statements. This was a relatively simple task that involved chaining from one statement to the next and inserting the new binary statement number into the second data word in the header I mentioned before.

The crux of this simpleminded renumberer is contained in lines 32000–32010 of the final version (see the listing). This first attempt at renumbering proved quite useful, but it was still a nuisance to have to go back and manually renumber the GOTOs, etc.

The tricky part comes when you go back and attempt to renumber the internals of the statements. As others who have written renumber routines have found, there is an inconsistency in the way statement numbers are stored. The numbers on the statements themselves are in binary form, but the statement number references in GOTOs, etc., are in ASCII.

Fortunately, the OSI BASIC has the very useful STR$ and ASC functions to aid in the conversion process from binary to ASCII. Luckily, the conversion in the other direction—from ASCII to binary—is not too difficult to perform in BASIC without support functions.

The OSI BASIC, as do most others, uses "tokens" to allow the compression of the BASIC source into a smaller package in memory. The tokens are simply single-byte flags with values in the range of decimal 128–255, beyond the range of valid ASCII codes, which are used to take the place of the BASIC command verbs.

Whenever the BASIC scanner finds a string of characters it recognizes as a keyword, such as GOTO, it replaces that character string with the single-byte token that corresponds to that keyword. The renumber routine must thus scan for the tokens requiring renumbering and alter the statement numbers that follow them. In the OSI version of Microsoft BASIC, the tokens we need to look for are decimal 136 (GOTO), 137 (RUN), 140 (GOSUB) and 160 (THEN).

The renumber routine is organized into two parts. The first part is the "simpleminded" renumberer I described earlier, with one additional function. While it is inserting the new statement numbers, it also must save the old statement numbers in a chunk of RAM so the second pass will know how to renumber the internals of the statements. In OSI systems with video boards, one of the most convenient chunks of RAM is the video display memory, which begins at 53248 decimal. Each statement number saved uses two bytes, and two bytes are required for an end-of-table flag. Hence in the C1-P machines with 1024 bytes of video RAM, you can renumber a program with as many as 511 statements. In the C2-4P you can handle 1023 statements with its 2K of video RAM.

The second part of the renumberer goes back and looks at the text in the state-

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ments, looking for the four tokens noted earlier. When it finds one of them, it looks behind it to see if there is a statement number. If the routine finds a statement number 1, it converts it from ASCII to binary and then compares it against the statement numbers that the first pass saved in the video RAM.

At this point one of two things can happen to the renumber program. The first is that it finds the old statement number in the table. If this occurs all is OK, and we proceed normally. The alternative is that the routine can't find the old statement number, in which case there was an error in your original source program, such as a GOTO with a missing destination.

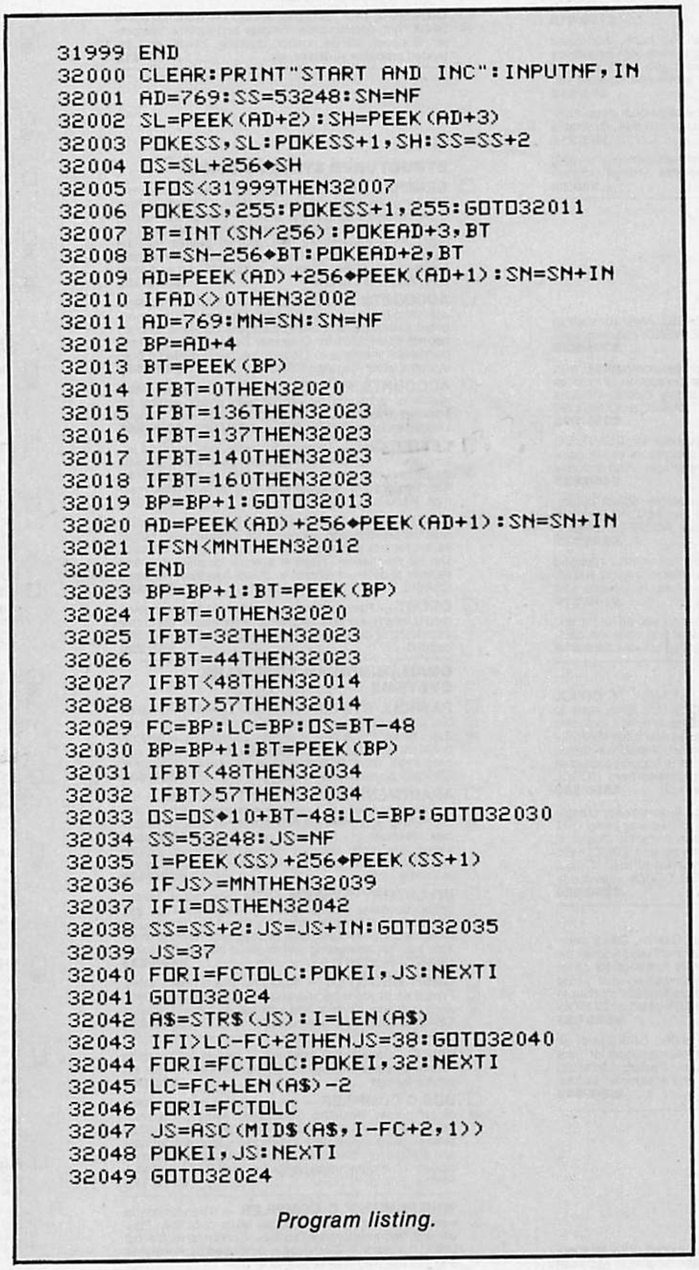
Improvisations

But at this point your old program is partially renumbered, and we can't just stop renumbering. So to recover, I chose to insert percent signs (%) where the missing statement number was, to indicate in the renumbered listing that something went wrong during renumbering. It would have been nice to print an error message at this point, but doing so would have disturbed the video RAM where the old statement numbers were stored. I discovered this the hard way after much head scratching!

If the program successfully found the old statement number in the video RAM, it must now insert the corresponding new statement number in the BASIC text in place of the old number. Here is where the STR$ and ASC functions of BASIC come in to play. One minor quirk that must be addressed here is that the STR$ function returns a leading blank in the character string, probably where a sign would go, and this blank should be skipped over when POKEing back the ASCII characters.

At this point we run into another possible error condition. What happens if the new statement number has more digits than the original statement number and, hence, won't fit over top of it? Again, I chose to overlay the old statement number with a special character, in this case the ampersand (&), to flag the error and distinguish this type of error from the "old statement not found" condition noted before.

A few other minor changes are required to make this renumbering technique work. Most important is to make sure that the program doing the renumbering does not try to renumber itself. Strange and undesirable things can happen if a program attempts to dynamically renumber itself. To prevent this from occurring, the renumber program checks for statement numbers greater than 31998 and leaves them alone. Since the renumberer starts at statement 31999, it will remain intact.



```
31999 END
32000 CLEAR:PRINT"START AND INC":INPUTNF,IN
32001 AD=769:SS=53248:SN=NF
32002 SL=PEEK(AD+2):SH=PEEK(AD+3)
32003 POKESS,SL:POKESS+1,SH:SS=SS+2
32004 OS=SL+256◆SH
32005 IFOS<31999THEN32007
32006 POKESS,255:POKESS+1,255:GOTO32011
32007 BT=INT(SN/256):POKEAD+3,BT
32008 BT=SN-256◆BT:POKEAD+2,BT
32009 AD=PEEK(AD)+256◆PEEK(AD+1):SN=SN+IN
32010 IFAD<>0THEN32002
32011 AD=769:MN=SN:SN=NF
32012 BP=AD+4
32013 BT=PEEK(BP)
32014 IFBT=0THEN32020
32015 IFBT=136THEN32023
32016 IFBT=137THEN32023
32017 IFBT=140THEN32023
32018 IFBT=160THEN32023
32019 BP=BP+1:GOTO32013
32020 AD=PEEK(AD)+256◆PEEK(AD+1):SN=SN+IN
32021 IFSN<MNTHEN32012
32022 END
32023 BP=BP+1:BT=PEEK(BP)
32024 IFBT=0THEN32020
32025 IFBT=32THEN32023
32026 IFBT=44THEN32023
32027 IFBT<48THEN32014
32028 IFBT>57THEN32014
32029 FC=BP:LC=BP:OS=BT-48
32030 BP=BP+1:BT=PEEK(BP)
32031 IFBT<48THEN32034
32032 IFBT>57THEN32034
32033 OS=OS◆10+BT-48:LC=BP:GOTO32030
32034 SS=53248:JS=NF
32035 I=PEEK(SS)+256◆PEEK(SS+1)
32036 IFJS>=MNTHEN32039
32037 IFI=OSTHEN32042
32038 SS=SS+2:JS=JS+IN:GOTO32035
32039 JS=37
32040 FORI=FCTOLC:POKEI,JS:NEXTI
32041 GOTO32024
32042 A$=STR$(JS):I=LEN(A$)
32043 IFI>LC-FC+2THENJS=38:GOTO32040
32044 FORI=FCTOLC:POKEI,32:NEXTI
32045 LC=FC+LEN(A$)-2
32046 FORI=FCTOLC
32047 JS=ASC(MID$(A$,I-FC+2,1))
32048 POKEI,JS:NEXTI
32049 GOTO32024
```

Program listing.

Operation

The procedure to use the renumber program is relatively simple. First, load in the renumber program, which starts at statement 31999. Actually, the first executable statement is at 32000; the END at 31999 is inserted to stop a user program that terminates by falling through to the end of the program without an explicit END statement. After loading in the renumbering program, load or key in the program you wish to renumber. It is assumed that this program will not have statement numbers greater than 31998.

After loading is complete, key in RUN 32000 to begin renumbering. You will be prompted for the desired beginning new statement number and increment value. After this, the only visible evidence that renumbering is in process is that some apparently meaningless characters will appear at the top portion of your video monitor during the first renumbering pass: These are the old statement numbers being saved in the video RAM. These may not be visible if you are renumbering a short program on a C1-P system, due to video overscan.

After this there will be a relatively long pause, possibly several minutes, depending on the size of the program being renumbered. Be patient; do not press control-C or BREAK during this period or the program being renumbered will be left only partially renumbered, since the video RAM will be disturbed. When renumbering is completed, BASIC will prompt you with an OK, and you can proceed to list and save your renumbered program. To save or list just your renumbered program and not the renumbering code, key in LIST 1-31998, and any statements in your program will be listed.

The renumberer can be a valuable tool during program development by allowing dynamic renumbering while you are in the process of coding and testing a new program. It gives the added benefit of checking for missing destinations on GOTOs and GOSUBs that might otherwise go undetected until an unusual condition arose in program execution.

The renumberer does not affect the execution of the user program while coexisting with it in the machine, other than by occupying memory that would otherwise be available for variables. The program statements for the renumberer occupy just under 1K bytes, and the requirement for variables during execution will bring the storage re quirement up somewhat beyon that. ■

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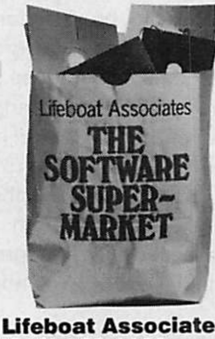

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