A Northstar BASIC Cross-Reference Tool

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In the course of two years of micro computing, I cannot count the number of times friends and acquaintances have offered me copies of programs they have written, only to be disappointed because their BASIC and my BASIC were so vastly different. In many cases, when the offered programs were just too good to pass up, I have locked myself in the study for an evening and made the necessary conversions. It isn't a job that I relish. And while I haven't found an easy way to accomplish it, I have developed, over time, some tools to ease the burden.

This particular program accepts programs in BASIC on Northstar disks and compiles cross-reference lists for all variables, string variables, array variables, and line numbers. I have found this to be a valuable assist when converting programs from one BASIC to another and when compacting a program by placing multiple statements on a single line. Additionally, I have discovered that such lists, annotated with the purpose of each variable, are excellent pieces of documentation.

This program is written in 8080 assembly language and requires 13.4K of RAM to accommodate the program and the table space. The program itself requires 1.64K, and 12K is allocated for space in which to build the cross-reference tables. This latter space is more than sufficient for the largest programs I have. It could be reduced if necessary to save space by changing the allocation in line 5090 and changing the byte against which the high order byte of the address is compared at line 0945 to agree with the space allocated.

The program is designed to run at 2A00H and use the I/O and disk drivers currently in your Northstar DOS. References to these drivers are contained in the EQU vectors at the opening of the assembly language listing for ease in changing them if your drivers or your COS are not standard.
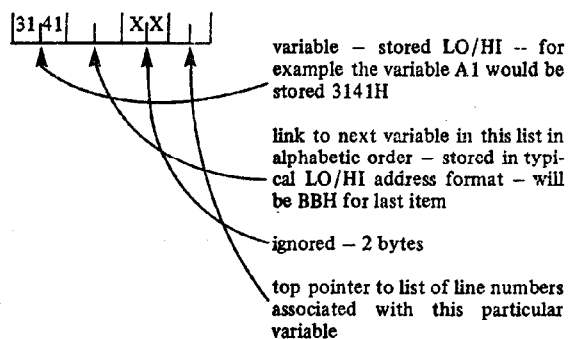
The program creates four separate lists:

1. Variables
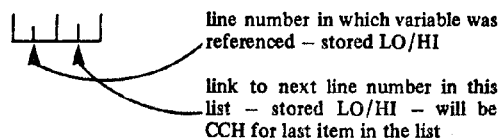2. String variables
3. Array variables
4. Line # references

Each of these are supported as linear linked lists in alphabetic soft order. The storage areas SYTOP, STTOP, ARTOP, and NMTOP are the top pointers for these four lists, and the marker BBH is used to mark the end of each of these lists.

SYTOP	STTOP	ARTOP	NMTOP
list of variables	list of string variables	list of array variables	list of line #references
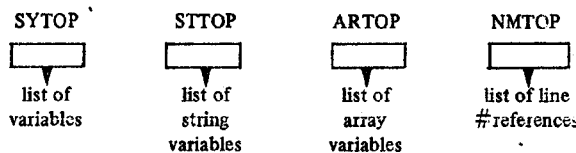
Each entry in each of the four lists has an accompanying top pointer for its associated list of line numbers. The mark CCH is used to mark the end of each line number list. A typical variable item looks like this:

|31|41| | |X|X| | |

variable — stored LO/HI -- for example the variable A1 would be stored 3141H

link to next variable in this list in alphabetic order — stored in typical LO/HI address format — will be BBH for last item

ignored — 2 bytes

top pointer to list of line numbers associated with this particular variable

The list of line numbers associated with each variable in each list is constructed in a similar, but simpler, fashion:

line number in which variable was referenced — stored LO/HI

link to next line number in this list — stored LO/HI — will be CCH for last item in the list

The entire program is read from the disk, one 256 byte block at a time, and scanned for the purpose of constructing these lists. When this is completed, the lists are followed in order from beginning to end and the stored variables and line numbers are formated and printed to produce the cross-reference lists. Each list is printed with its own header, i.e. STRING VARIABLES. And the entry NULL LIST is printed for any list that is empty.

The diagram below represents the multi-list structure in somewhat stylized fashion:
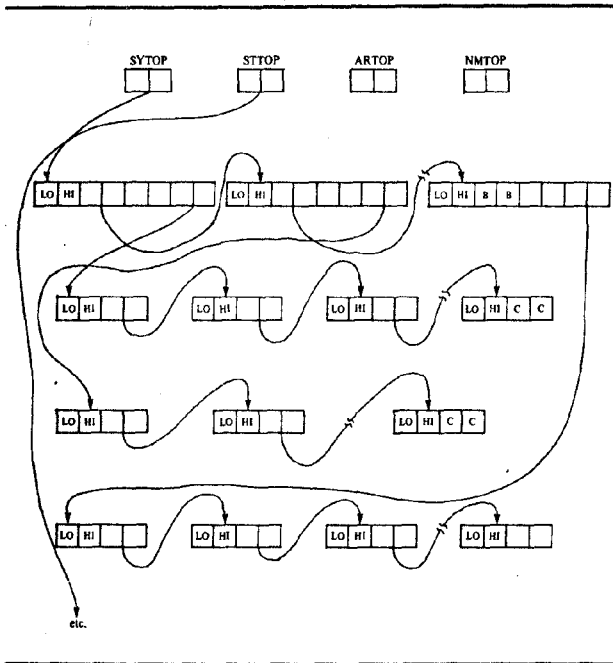
The variables which were found in the program are stored in ASCII in the appropriate list so their conversion for printing is straightforward. The line numbers that are placed in the lists, however, are stored as two byte LO/HI binary values. The algorithm used to convert these to ASCII for printing is fairly simple, if somewhat bulky. Taking the binary value as an ordered 16 bit field, the program uses a 5 byte work area to construct the resulting decimal number. A table is provided (BASE:) which represents, as 5 single digits, the decimal number associated with each bit position of the 16 bit binary value. If a bit in the binary value is "on," then the five digits associated with that bit position are added to the five byte work area along with any necessary "carry's" from byte to byte. If, on the other hand, a bit in the binary value is "off," then the pointer into the table (BASE:) is bumped down 5 to point to the next series of 5 values. When this process is complete, 30H is added to each byte of the 5 byte work area to yield the desired ASCII value.

This program has proven useful in its own right. But it is worth mentioning that a modification of this same idea, directed solely at line number references, would be the basis for a program which would "compact" BASIC programs by removing unnecessary line numbers. Similarly, this sort of cross-reference compilation would form the basis of "pass one" of more sophisticated software such as a compiler. A compiler! Now there's an idea.

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                    0005 ; THIS PROGRAM PROVIDES SOFTWARE SUPPORT FOR
                    0010 ; PROGRAMS WRITTEN IN NORTHSTAR BASIC. IT COMPILES
                    0015 ; AND PRINTS FOUR LISTS: 1)A LIST OF VARIABLE NAMES
                    0020 ; USED AND LINES IN WHICH EACH OF THEM OCCURS, 2)A
                    0025 ; LIST OF STRING VARIABLE NAMES USED AND LINES IN
                    0030 ; WHICH EACH OCCURS, 3)A LIST OF ARRAY VARIABLE
                    0035 ; NAMES AND LINES IN WHICH EACH OCCURS, AND 4)A
                    0040 ; LIST OF LINE NUMBERS REFERENCED IN GOTO AND GOSUB
                    0045 ; STATEMENTS AND LINE NUMBERS IN WHICH THEY ARE
                    0050 ; REFERENCED.
                    0055 ;
2A00                0060          ORG    2A00H
2A00 214233         0065          LXI    H,STACK+49
2A03 F9             0070          SPHL
2010 =              0075 CIN:     EQU    2010H
200D =              0080 COUT:    EQU    200DH
201C =              0085 DIRCK:   EQU    201CH
2022 =              0090 RDDSK:   EQU    2022H
2028 =              0095 EXIT:    EQU    2028H
                    0100 ;
                    0105 ; PRINT HEADER
                    0110 ;
2A04 0E1F           0115 START:   MVI    C,31
2A06 218730         0120          LXI    H,HDR1
2A09 CD5E30         0125          CALL   PRINT
2A0C CD6830         0130          CALL   CRLF
                    0135 ;
                    0140 ; PRINT FILE NAME PROMPT
                    0145 ;
2A0F 0E11           0150 ASKFL:   MVI    C,17
2A11 21A630         0155          LXI    H,HDR2
2A14 CD5E30         0160          CALL   PRINT
2A17 0E0A           0165          MVI    C,10
2A19 218731         0170          LXI    H,PNAME
                    0175 ;
                    0180 ; BLANK PROGRAM NAME AREA
                    0185 ;
2A1C 3620           0190 BLNAM:   MVI    M,20H
2A1E 23             0195          INX    H
2A1F 0D             0200          DCR    C
2A20 C21C2A         0205          JNZ    BLNAM
2A23 0E09           0210          MVI    C,9
2A25 218731         0215          LXI    H,PNAME
                    0220 ;
                    0225 ; ACCEPTS FILE NAME. USES REG C AS COUNTER AND
                    0230 ; ACCEPTS UP TO 8 CHARACTERS. TAKES CARE OF
                    0235 ; BLANKING CHAR IN RESPONSE TO BACKSPACE (5FH),
                    0240 ; ROUTINE TERMINATES WHEN CR (0DH) IS ENCOUNTERED.
                    0245 ;
2A28 CD1020         0250 INFIL:   CALL   CIN
2A2B 32B232         0255          STA    HOLDT
2A2E FE0D           0260          CPI    0DH
2A30 CA6F2A         0265          JZ     INUNT
2A33 FE5F           0270          CPI    5FH
2A35 C2542A         0275          JNZ    STORE
2A38 3E09           0280          MVI    A,9
2A3A B9             0285          CMP    C
2A3B CA282A         0290          JZ     INFIL
2A3E 3AB232         0295          LDA    HOLDT
2A41 2B             0300          DCX    H
2A42 0C             0305          INR    C
2A43 47             0310          MOV    B,A
2A44 CD0D20         0315          CALL   COUT
2A47 0620           0320          MVI    B,20H
2A49 CD0D20         0325          CALL   COUT
2A4C 065F           0330          MVI    B,5FH
2A4E CD0D20         0335          CALL   COUT
2A51 C3282A         0340          JMP    INFIL
                    0345 ;
                    0350 ; PLACES CHARACTERS FROM INFIL: SEQUENTIALLY
                    0355 ; INTO AREA CALLED 'PNAME' TO BUILD INPUT
                    0360 ; FILE NAME. PRINTS 'NAME TOO LONG' ERROR
                    0365 ; IF 8 CHARACTERS ARE EXCEEDED.
                    0370 ;
2A54 77             0375 STORE:   MOV    M,A
2A55 47             0380          MOV    B,A
2A56 CD0D20         0385          CALL   COUT
2A59 23             0390          INX    H
2A5A 0D             0395          DCR    C
2A5B C2282A         0400          JNZ    INFIL
2A5E CD6830         0405          CALL   CRLF
2A61 0E10           0410          MVI    C,16
2A63 211031         0415          LXI    H,HDR7
2A66 CD5E30         0420          CALL   PRINT
2A69 CD6830         0425          CALL   CRLF
2A6C C30F2A         0430          JMP    ASKFL
                    0435 ;
                    0440 ; ACCEPTS DISK UNIT NUMBER. CHECKS TO MAKE
                    0445 ; SURE INPUT IS ASCII 1, 2, OR 3.
                    0450 ;
2A6F 0E0C           0455 INUNT:   MVI    C,12
2A71 21B730         0460          LXI    H,HDR3
2A74 CD6830         0465          CALL   CRLF
2A77 CD5E30         0470          CALL   PRINT
2A7A 219131         0475          LXI    H,DRIVE
2A7D CD1020         0480          CALL   CIN
2A80 47             0485          MOV    B,A
2A81 CD0D20         0490          CALL   COUT
2A84 FE31           0495          CPI    31H
2A86 CAA42A         0500          JZ     GETCR
2A89 FE32           0505          CPI    32H
2A8B CAA42A         0510          JZ     GETCR
2A8E FE33           0515          CPI    33H
2A90 CAA42A         0520          JZ     GETCR
                    0525 ;
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                    0530 ; PRINTS 'INVALID UNIT' ERROR IF INPUT
                    0535 ; IS NOT EQUAL TO ASCII 1, 2, OR 3.
                    0540 ;
2A93 CD6830         0545 ERUNT: CALL  CRLF
2A96 0E0C           0550        MVI   C,12
2A98 212031         0555        LXI   H,HDR6
2A9B CD5E30         0560        CALL  PRINT
2A9E CD6830         0565        CALL  CRLF
2AA1 C36F2A         0570        JMP   INUNT
                    0575 ;
                    0580 ; TRIMS ASCII INPUT UNIT # TO BINARY VALUE
                    0585 ; AND STORES IT IN AREA CALLED 'DRIVE'. ACCEPTS
                    0590 ; CR TO CONTINUE. ANY OTHER INPUT CAUSES
                    0595 ; 'INVALID UNIT' ERROR. PUTS ADDRESS OF PROGRAM
                    0600 ; NAME IN REG H/L AND VALUE OF DRIVE # IN REG
                    0605 ; A. CALLS DOS DIRECTORY LOOKUP ROUTINE
                    0610 ; AT 201CH. IF CARRY BIT IS SET ON RETURN
                    0615 ; 'NO PROGRAM' ERROR IS PRINTED.
                    0620 ;
2AA4 E60F           0625 GETCR: ANI   0FH
2AA6 77             0630        MOV   M,A
2AA7 CD1020         0635        CALL  CIN
2AAA 47             0640        MOV   B,A
2AAB CD0D20         0645        CALL  COUT
2AAE FE0D           0650        CPI   0DH
2AB0 C2932A         0655        JNZ   ERUNT
2AB3 060A           0660        MVI   B,0AH
2AB5 CD0D20         0665        CALL  COUT
2AB8 3A9131         0670        LDA   DRIVE
2ABB 218731         0675        LXI   H,PNAME
2ABE 37             0680        STC
2ABF 3F             0685        CMC
2AC0 CD1C20         0690        CALL  DIRCK
2AC3 D2D42A         0695        JNC   CKTYP
2AC6 0E19           0700        MVI   C,25
2AC8 210330         0705        LXI   H,HDR4
2ACB CD5E30         0710        CALL  PRINT
2ACE CD6830         0715        CALL  CRLF
2AD1 C30F2A         0720        JMP   ASKFL
                    0725 ;
                    0730 ; CHECKS FILE TYPE TO INSURE IT IS TYPE 2.
                    0735 ;
2AD4 0600           0740 CKTYP: MVI   B,0
2AD6 0E04           0745        MVI   C,4
2AD8 09             0750        DAD   B
2AD9 3E02           0755        MVI   A,2
2ADB BE             0760        CMP   M
2ADC CAED2A         0765        JZ    STADD
2ADF 0E12           0770        MVI   C,18
2AE1 21DC30         0775        LXI   H,HDR5
2AE4 CD5E30         0780        CALL  PRINT
2AE7 CD6830         0785        CALL  CRLF
2AEA C30F2A         0790        JMP   ASKFL
                    0795 ;
                    0800 ; STORES DATA FROM DISK DIRECTORY FOR THE FILE
                    0805 ; IN AREA CALLED 'DIR'.
                    0810 ;
2AED 2B             0815 STADD: DCX   H
2AEE 2B             0820        DCX   H
2AEF 2B             0825        DCX   H
2AF0 2B             0830        DCX   H
2AF1 0E08           0835        MVI   C,8
2AF3 110933         0840        LXI   D,DIR
2AF6 7E             0845 STADI: MOV   A,M
2AF7 12             0850        STAX  D
2AF8 23             0855        INX   H
2AF9 13             0860        INX   D
2AFA 0D             0865        DCR   C
2AFB C2F62A         0870        JNZ   STADI
                    0875 ;
                    0880 ; SETS LINKS IN AREA CALLED 'TABLE'. INITIALIZES
                    0885 ; THE TOP POINTERS FOR THE FOUR LISTS 'SYTOP',
                    0890 ; 'STTOP', 'ARTOP' AND 'NMTOP'. INITIALIZES THE
                    0895 ; AVAILABILITY POINTER 'AVAIL'.
                    0900 ;
2AFE 2600           0905        MVI   H,0
2B00 2E00           0910        MVI   L,0
2B02 224333         0915        SHLD  ADDR
2B05 0600           0920        MVI   B,0
2B07 0E04           0925        MVI   C,4
2B09 118F33         0930        LXI   D,TABLE+2
2B0C 2A4333         0935 SLINK: LHLD  ADDR
2B0F 23             0940        INX   H
2B10 3E0C           0945        MVI   A,0CH
2B12 BC             0950        CMP   H
2B13 CA232B         0955        JZ    STOPS
2B16 224333         0960        SHLD  ADDR
2B19 62             0965        MOV   H,D
2B1A 6B             0970        MOV   L,E
2B1B 09             0975        DAD   B
2B1C EB             0980        XCHG
2B1D 73             0985        MOV   M,E
2B1E 23             0990        INX   H
2B1F 72             0995        MOV   M,D
2B20 C30C2B         1000        JMP   SLINK
2B23 3EFF           1005 STOPS: MVI   A,0FFH
2B25 23             1010        INX   H
2B26 77             1015        MOV   M,A
2B27 26BB           1020        MVI   H,0BBH
2B29 2EBB           1025        MVI   L,0BBH
2B2B 22A632         1030        SHLD  SYTOP
2B2E 22A832         1035        SHLD  STTOP
2B31 22AA32         1040        SHLD  ARTOP
2B34 22AC32         1045        SHLD  NMTOP
2B37 218F33         1050        LXI   H,TABLE+2
2B3A 22AE32         1055        SHLD  AVAIL
2B3D CD2F30         1060        CALL  RLBLK
                    1065 ;
                    1070 ; BEGINS PROCESSING FOR A LINE OF BASIC CODE.
                    1075 ; STORES LINE NUMBER AND LINE LENGTH.
                    1080 ;

2B40 AF             1085 NEWLN: XRA   A
2B41 329732         1090        STA   MARK
2B44 3C             1095        INR   A
2B45 EB             1100        XCHG
2B46 BE             1105        CMP   M
2B47 CABC2D         1110        JZ    PRTRN
2B4A EB             1115        XCHG
2B4B CD7330         1120        CALL  NXTCR
2B4E 1A             1125        LDAX  D
2B4F 32A232         1130        STA   LOLIN
2B52 CD7330         1135        CALL  NXTCR
2B55 1A             1140        LDAX  D
2B56 32A332         1145        STA   HILIN
2B59 AF             1150        XRA   A
2B5A 32A132         1155        STA   LNTAB
2B5D CD7330         1160        CALL  NXTCR
2B60 62             1165 NEWL1: MOV   H,D
2B61 6B             1170        MOV   L,E
2B62 3E20           1175        MVI   A,20H
2B64 BE             1180        CMP   M
2B65 CAB62B         1185        JZ    NEWL6
2B68 3E8F           1190        MVI   A,8FH
2B6A BE             1195        CMP   M
2B6B C2732B         1200        JNZ   NEWL2
2B6E 3E01           1205        MVI   A,1
2B70 329732         1210        STA   MARK
2B73 3E22           1215 NEWL2: MVI   A,22H
2B75 BE             1220        CMP   M
2B76 C2902B         1225        JNZ   NEWL4
2B79 3A9732         1230        LDA   MARK
2B7C FE02           1235        CPI   02H
2B7E C2882B         1240        JNZ   NEWL3
2B81 AF             1245        XRA   A
2B82 329732         1250        STA   MARK
2B85 C3B62B         1255        JMP   NEWL6
2B88 3E02           1260 NEWL3: MVI   A,2
2B8A 329732         1265        STA   MARK
2B8D C3B62B         1270        JMP   NEWL6
2B90 3A9732         1275 NEWL4: LDA   MARK
2B93 FE00           1280        CPI   0H
2B95 C2E62B         1285        JNZ   NEWL6
2B98 3E9A           1290        MVI   A,9AH
2B9A BE             1295        CMP   M
2B9B C2E42B         1300        JNZ   NEWL5
2B9E CDC82B         1305        CALL  STNUM
2BA1 C3B62B         1310        JMP   NEWL6
2BA4 3E40           1315 NEWL5: MVI   A,40H
2BA6 BE             1320        CMP   M
2BA7 D2B62B         1325        JNC   NEWL6
2BAA 3E5A           1330        MVI   A,5AH
2BAC BE             1335        CMP   M
2BAD C3B62B         1340        JC    NEWL6
2BB0 CDEA2B         1345        CALL  GETSY
2BB3 C3B92B         1350        JMP   NEWL7
2BB6 CD7330         1355 NEWL6: CALL  NXTCR
2BB9 3E0D           1360 NEWL7: MVI   A,0DH
2BBB 21A132         1365        LXI   H,LNTAB
2BBE BE             1370        CMP   M
2BBF C2602B         1375        JNZ   NEWL1
2BC2 CD7330         1380        CALL  NXTCR
2BC5 C34025         1385        JMP   NEWLN
                    1390 ;
                    1395 ; EXTRACTS A LINE NUMBER REFERENCE
                    1400 ; AND PLACES IT IN 'VALHI' AND 'VALLO'
                    1405 ; THEN CALLS THE SEARCH AND INSERT
                    1410 ; NODE ROUTINES
                    1415 ;
2BC8 CD7330         1420 STNUM: CALL  NXTCR
2BCB 1A             1425        LDAX  D
2BCC 32A532         1430        STA   VALLO
2BCF CD7330         1435        CALL  NXTCR
2BD2 1A             1440        LDAX  D
2BD3 32A432         1445        STA   VALHI
2BD6 AF             1450        XRA   A
2BD7 32A132         1455        STA   LNTAB
2BDA 2AAC32         1460        LHLD  NMTOP
2BDD 22B032         1465        SHLD  TOP
2BE0 CD7A2C         1470        CALL  SERCH
2BE3 2ABE32         1475        LHLD  TOP
2BE6 22AC32         1480        SHLD  NMTOP
2BE9 C9             1485        RET
                    1490 ;
                    1495 ; EXTRACT A SYMBOL AND DETERMINE WHICH
                    1500 ; LIST IT BELONGS IN.  CALLS THE
                    1505 ; SEARCH AND INSERT NODE ROUTINES.
                    1510 ;
2BEA 3E20           1515 GETSY: MVI   A,20H
2BEC 32A532         1520        STA   VALLO
2BEF 32A432         1525        STA   VALHI
2BF2 1A             1530        LDAX  D
2BF3 32A432         1535        STA   VALHI
2BF6 CD7330         1540        CALL  NXTCR
2BF9 3E0D           1545        MVI   A,0DH
2BFB 21A132         1550        LXI   H,LNTAB
2BFE BE             1555        CMP   M
2BFF C2082C         1560        JNZ   GETS1
2C02 CD4A2C         1565        CALL  STRSY
2C05 C3492C         1570        JMP   GETS5
2C08 62             1575 GETS1: MOV   H,D
2C09 6B             1580        MOV   L,E
2C0A 3E2F           1585        MVI   A,2FH
2C0C BE             1590        CMP   M
2C0D D2202C         1595        JNC   GETS2
2C10 3E39           1600        MVI   A,39H
2C12 BE             1605        CMP   M
2C13 DA2C2C         1610        JC    GETS2
2C16 1A             1615        LDAX  D
2C17 32A532         1620        STA   VALLO
2C1A CD7330         1625        CALL  NXTCR
2C1D 3E0D           1630        MVI   A,0DH
2C1F 21A132         1635        LXI   H,LNTAB
2C22 BE             1640        CMP   M
2C23 C22C2C         1645        JNZ   GETS2
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2C26 CD4A2C  1650      CALL  STRSY
2C29 C3492C  1655      JMP   GETS5
2C2C 62      1660 GETS2: MOV  H,D
2C2D 6E      1665      MOV   L,E
2C2E 3E24    1670      MVI   A,24H
2C30 BE      1675      CMP   M
2C31 C23A2C  1680      JNZ   GETS3
2C34 CD5A2C  1685      CALL  STRST
2C37 C3492C  1690      JMP   GETS5
2C3A 3EE0    1695 GETS3: MVI  A,0E0H
2C3C BE      1700      CMP   M
2C3D C2462C  1705      JNZ   GETS4
2C40 CD6A2C  1710      CALL  STRAR
2C43 C3492C  1715      JMP   GETS5
2C46 CD4A2C  1720 GETS4: CALL STRSY
2C49 C9      1725 GETS5: RET
             1730 ;
             1735 ; SETS SYMBOL LIST TOP POINTER AND CALLS
             1740 ; SEARCH AND INSERT NODE ROUTINES.
             1745 ;
2C4A 2AA632  1750 STRSY: LHLD SYTOP
2C4D 22B032  1755      SHLD  TOP
2C50 CD7A2C  1760      CALL  SERCH
2C53 2AB032  1765      LHLD  TOP
2C56 22A632  1770      SHLD  SYTOP
2C59 C9      1775      RET
             1780 ;
             1785 ; SETS TOP POINTER TO STRING LIST TOP AND
             1790 ; CALLS SEARCH AND INSERT NODE ROUTINES.
             1795 ;
2C5A 2AA832  1800 STRST: LHLD STTOP
2C5D 22B032  1805      SHLD  TOP
2C60 CD7A2C  1810      CALL  SERCH
2C63 2AB032  1815      LHLD  TOP
2C66 22A832  1820      SHLD  STTOP
2C69 C9      1825      RET
             1830 ;
             1835 ; SETS TOP POINTER TO ARRAY LIST TOP AND
             1840 ; CALLS SEARCH AND INSERT NODE ROUTINES.
             1845 ;
2C6A 2AAA32  1850 STRAR: LHLD ARTOP
2C6D 22B032  1855      SHLD  TOP
2C70 CD7A2C  1860      CALL  SERCH
2C73 2AB032  1865      LHLD  TOP
2C76 22AA32  1870      SHLD  ARTOP
2C79 C9      1875      RET
             1880 ;
             1885 ; SEARCH AND STORE ROUTINE
             1890 ;
2C7A 229C32  1895 SERCH: SHLD NEXT
2C7D EB      1900      XCHG
2C7E 229E32  1905      SHLD  POINT
2C81 3EBB    1910      MVI   A,0BBH
2C83 329832  1915      STA   LAST
2C86 329932  1920      STA   LAST+1
2C89 2AAE32  1925      LHLD  AVAIL
2C8C 229A32  1930      SHLD  PRSNT
2C8F 2B      1935      DCX   H
2C90 3AA432  1940      LDA   VALHI
2C93 77      1945      MOV   M,A
2C94 2B      1950      DCX   H
2C95 3AA532  1955      LDA   VALLO
2C98 77      1960      MOV   M,A
2C99 23      1965      INX   H
2C9A 23      1970      INX   H
2C9B 3EBB    1975      MVI   A,0BBH
2C9D 77      1980      MOV   M,A
2C9E 23      1985      INX   H
2C9F 77      1990      MOV   M,A
2CA0 23      1995      INX   H
2CA1 23      2000      INX   H
2CA2 23      2005      INX   H
2CA3 7E      2010      MOV   A,M
2CA4 32AE32  2015      STA   AVAIL
2CA7 3ECC    2020      MVI   A,0CCH
2CA9 77      2025      MOV   M,A
2CAA 23      2030      INX   H
2CAB 7E      2035      MOV   A,M
2CAC 32AF32  2040      STA   AVAIL+1
2CAF 3ECC    2045      MVI   A,0CCH
2CB1 77      2050      MOV   M,A
2CB2 2A9C32  2055      LHLD  NEXT
2CB5 3EBB    2060      MVI   A,0BBH
2CB7 BC      2065      CMP   H
2CB8 C2C92C  2070      JNZ   SERC2
2CBB BD      2075      CMP   L
2CBC C2C92C  2080      JNZ   SERC2
2CBF 2A9A32  2085 SERC1: LHLD PRSNT
2CC2 22B032  2090      SHLD  TOP
2CC5 CD752D  2095      CALL  LNNUM
2CC8 C9      2100      RET
2CC9 2B      2105 SERC2: DCX  H
2CCA 56      2110      MOV   D,M
2CCB 3AA432  2115      LDA   VALHI
2CCE BA      2120      CMP   D
2CCF CA322D  2125      JZ    DEQUA
2CD2 D2FB2C  2130      JNC   DLESA
             2135 ;
             2140 ; SETS THE LINKS IN THE APPROPRIATE LIST
             2145 ; TO REFLECT THE PROPER SEQUENCE FOR THE
             2150 ; CURRENT ITEM.
             2155 ;
2CD5 2A9A32  2160 DGRTA: LHLD PRSNT
2CD8 3A9C32  2165      LDA   NEXT
2CDB 77      2170      MOV   M,A
2CDC 23      2175      INX   H
2CDD 3A9D32  2180      LDA   NEXT+1
2CE0 77      2185      MOV   M,A
2CE1 2A9832  2190      LHLD  LAST
2CE4 3EBB    2195      MVI   A,0BBH
2CE6 BC      2200      CMP   H
2CE7 C2EE2C  2205      JNZ   DGRT1
2CEA BD      2210      CMP   L

2CEB CABF2C  2215      JZ    SERC1
2CEE 3A9A32  2220 DGRT1: LDA PRSNT
2CF1 77      2225      MOV   M,A
2CF2 23      2230      INX   H
2CF3 3A9B32  2235      LDA   PRSNT+1
2CF6 77      2240      MOV   M,A
2CF7 CD752D  2245      CALL  LNNUM
2CFA C9      2250      RET
             2255 ;
             2260 ; CONTINUES TO SEARCH THE APPROPRIATE
             2265 ; LIST FOR THE PROPER PLACE IN WHICH
             2270 ; TO INSERT THE CURRENT ITEM.
             2275 ;
2CFB 3EBB    2280 DLESA: MVI A,0BBH
2CFD 2A9C32  2285      LHLD  NEXT
2D00 BC      2290      CMP   H
2D01 C2182D  2295      JNZ   DLES2
2D04 BD      2300      CMP   L
2D05 C2182D  2305      JNZ   DLES2
2D08 2A9832  2310 DLES1: LHLD LAST
2D0B 3A9A32  2315      LDA   PRSNT
2D0E 77      2320      MOV   M,A
2D0F 23      2325      INX   H
2D10 3A9B32  2330      LDA   PRSNT+1
2D13 77      2335      MOV   M,A
2D14 CD752D  2340      CALL  LNNUM
2D17 C9      2345      RET
2D18 2A9C32  2350 DLES2: LHLD NEXT
2D1B 229832  2355      SHLD  LAST
2D1E 5E      2360      MOV   E,M
2D1F 23      2365      INX   H
2D20 56      2370      MOV   D,M
2D21 EB      2375      XCHG
2D22 229C32  2380      SHLD  NEXT
2D25 3EBB    2385      MVI   A,0BBH
2D27 BC      2390      CMP   H
2D28 C2C92C  2395      JNZ   SERC2
2D2B BD      2400      CMP   L
2D2C C2C92C  2405      JNZ   SERC2
2D2F C3082D  2410      JMP   DLES1
             2415 ;
             2420 ; CHECKS TO SEE IF THE CURRENT ITEM IS
             2425 ; IS ALREADY IN THE APPROPRIATE LIST.
             2430 ;
2D32 2B      2435 DEQUA: DCX  H
2D33 56      2440      MOV   D,M
2D34 3AA532  2445      LDA   VALLO
2D37 BE      2450      CMP   M
2D38 CA412D  2455      JZ    DEQUI
2D3B D2FB2C  2460      JNC   DLESA
2D3E C3D52C  2465      JMP   DGRTA
2D41 2AAE32  2470 DEQUI: LHLD AVAIL
2D44 2B      2475      DCX   H
2D45 2B      2480      DCX   H
2D46 2B      2485      DCX   H
2D47 3AAF32  2490      LDA   AVAIL+1
2D4A 77      2495      MOV   M,A
2D4B 2B      2500      DCX   H
2D4C 3AAE32  2505      LDA   AVAIL
2D4F 77      2510      MOV   M,A
2D50 2B      2515      DCX   H
2D51 2B      2520      DCX   H
2D52 2B      2525      DCX   H
2D53 EB      2530      XCHG
2D54 2AAE32  2535      LHLD  AVAIL
2D57 2B      2540      DCX   H
2D58 2B      2545      DCX   H
2D59 2B      2550      DCX   H
2D5A 2B      2555      DCX   H
2D5B 22AE32  2560      SHLD  AVAIL
2D5E EB      2565      XCHG
2D5F 3AAF32  2570      LDA   AVAIL+1
2D62 77      2575      MOV   M,A
2D63 2B      2580      DCX   H
2D64 3AAE32  2585      LDA   AVAIL
2D67 77      2590      MOV   M,A
2D68 22AE32  2595      SHLD  AVAIL
2D6B 2A9C32  2600      LHLD  NEXT
2D6E 229A32  2605      SHLD  PRSNT
2D71 CD752D  2610      CALL  LNNUM
2D74 C9      2615      RET
             2620 ;
             2625 ; INSERTS THE LINE NUMBER FOR THE
             2630 ; CURRENT ITEM IN THE LINE NUMBER
             2635 ; LIST FOR THAT ITEM.  THE NEW
             2640 ; LINE NUMBER IS ADDED AT THE END
             2645 ; OF THE LIST SINCE THEY ARE ENCOUNTERED
             2650 ; IN ORDER.
             2655 ;
2D75 2A9A32  2660 LNNUM: LHLD PRSNT
2D78 23      2665      INX   H
2D79 23      2670      INX   H
2D7A 23      2675      INX   H
2D7B 23      2680      INX   H
2D7C 3ECC    2685 LNNU1: MVI A,0CCH
2D7E BE      2690      CMP   M
2D7F C2B52D  2695      JNZ   LNNU3
2D82 23      2700      INX   H
2D83 BE      2705      CMP   M
2D84 C2B42D  2710      JNZ   LNNU2
2D87 2B      2715      DCX   H
2D88 3AAE32  2720      LDA   AVAIL
2D8B 77      2725      MOV   M,A
2D8C 23      2730      INX   H
2D8D 3AAF32  2735      LDA   AVAIL+1
2D90 77      2740      MOV   M,A
2D91 2AAE32  2745      LHLD  AVAIL
2D94 2B      2750      DCX   H
2D95 2B      2755      DCX   H
2D96 3AA232  2760      LDA   LOLIN
2D99 77      2765      MOV   M,A
2D9A 23      2770      INX   H
2D9B 3AA332  2775      LDA   HILIN
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2D9E 77       2780        MOV   M,A
2D9F 23       2785        INX   H
2DA0 7E       2790        MOV   A,M
2DA1 32AE32   2795        STA   AVAIL
2DA4 3ECC     2800        MVI   A,0CCH
2DA6 77       2805        MOV   M,A
2DA7 23       2810        INX   H
2DA8 7E       2815        MOV   A,M
2DA9 32AF32   2820        STA   AVAIL+1
2DAC 3ECC     2825        MVI   A,0CCH
2DAE 77       2830        MOV   M,A
2DAF 2A9E32   2835        LHLD  POINT
2DB2 EB       2840        XCHG
2DB3 C9       2845        RET
2DB4 2B       2850 LNNU2: DCX   H
2DB5 5E       2855 LNNU3: MOV   E,M
2DB6 23       2860        INX   H
2DB7 56       2865        MOV   D,M
2DB8 EB       2870        XCHG
2DB9 C37C2D   2875        JMP   LNNU1
              2880 ;
              2885 ; PRINTS THE NECESSARY HEADERS AND
              2890 ; LOADS THE APPROPRIATE LIST TOP POINTERS
              2895 ; FOR USE BY THE SEARCH AND PRINT ROUTINES.
              2900 ;
2DBC 0E12     2905 PRTRN: MVI   C,18
2DBE 214131   2910        LXI   H,HDR11
2DC1 CD6830   2915        CALL  CRLF
2DC4 CD5E30   2920        CALL  PRINT
2DC7 CD6830   2925        CALL  CRLF
2DCA 2AA632   2930        LHLD  SYTOP
2DCD 22B030   2935        SHLD  TOP
2DD0 3E01     2940        MVI   A,1
2DD2 329732   2945        STA   MARK
2DD5 CD2F2E   2950        CALL  FNDSY
2DD8 CD6830   2955        CALL  CRLF
2DDB 0E10     2960        MVI   C,16
2DDD 215331   2965        LXI   H,HDR12
2DE0 CD5E30   2970        CALL  PRINT
2DE3 CD6830   2975        CALL  CRLF
2DE6 2AA832   2980        LHLD  STTOP
2DE9 22B030   2985        SHLD  TOP
2DEC 3E02     2990        MVI   A,2
2DEE 329732   2995        STA   MARK
2DF1 CD2F2E   3000        CALL  FNDSY
2DF4 CD6830   3005        CALL  CRLF
2DF7 0E0F     3010        MVI   C,15
2DF9 216331   3015        LXI   H,HDR13
2DFC CD5E30   3020        CALL  PRINT
2DFF CD6830   3025        CALL  CRLF
2E02 2AAA32   3030        LHLD  ARTOP
2E05 22B030   3035        SHLD  TOP
2E08 3E03     3040        MVI   A,3
2E0A 329732   3045        STA   MARK
2E0D CD2F2E   3050        CALL  FNDSY
2E10 CD6830   3055        CALL  CRLF
2E13 0E0C     3060        MVI   C,12
2E15 217231   3065        LXI   H,HDR14
2E18 CD5E30   3070        CALL  PRINT
2E1B CD6830   3075        CALL  CRLF
2E1E 2AAC32   3080        LHLD  NMTOP
2E21 22B030   3085        SHLD  TOP
2E24 3E04     3090        MVI   A,4
2E26 329732   3095        STA   MARK
2E29 CD2F2E   3100        CALL  FNDSY
2E2C C32820   3105        JMP   EXIT
              3110 ;
              3115 ; THIS SECTION USES THE CONTENTS OF 'TOP'
              3120 ; AND FOLLOWS THE LINKS FOR THE APPROPRIATE
              3125 ; LIST. AT EACH ELEMENT IT LOADS 'HOLDT'
              3130 ; WITH THE LINE FOR THE LINE NUMBER
              3135 ; REFERENCES AND FOLLOWS THAT LIST, PRINTING
              3140 ; THE NUMBERS AS IT GOES.
              3145 ;
2E2F 2AB032   3150 FNDSY: LHLD  TOP
2E32 3EBB     3155        MVI   A,0BBH
2E34 BC       3160        CMP   H
2E35 C24B2E   3165        JNZ   FNDS1
2E38 BD       3170        CMP   L
2E39 C24B2E   3175        JNZ   FNDS1
2E3C 0E09     3180        MVI   C,9
2E3E 217E31   3185        LXI   H,HDR15
2E41 CD6830   3190        CALL  CRLF
2E44 CD5E30   3195        CALL  PRINT
2E47 CD6830   3200        CALL  CRLF
2E4A C9       3205        RET
2E4B CD2130   3210 FNDS1: CALL  BLKLN
2E4E 2AB032   3215        LHLD  TOP
2E51 5E       3220        MOV   E,M
2E52 23       3225        INX   H
2E53 56       3230        MOV   D,M
2E54 2B       3235        DCX   H
2E55 EB       3240        XCHG
2E56 22C032   3245        SHLD  NEXT
2E59 3A9732   3250        LDA   MARK
2E5C FE04     3255        CPI   4
2E5E C28B2E   3260        JNZ   FNDS3
2E61 1B       3265        DCX   D
2E62 1A       3270        LDAX  D
2E63 32A432   3275        STA   VALHI
2E66 1B       3280        DCX   D
2E67 1A       3285        LDAX  D
2E68 32A532   3290        STA   VALLO
2E6B CD642F   3295        CALL  CONVR
2E6E 214533   3300        LXI   H,PLINE
2E71 EB       3305        XCHG
2E72 21B432   3310        LXI   H,NUMBR
2E75 0E05     3315        MVI   C,5
2E77 7E       3320 FNDS2: MOV   A,M
2E78 12       3325        STAX  D
2E79 23       3330        INX   H
2E7A 13       3335        INX   D
2E7B 0D       3340        DCR   C
2E7C C2772E   3345        JNZ   FNDS2
2E7F 2AB032   3350        LHLD  TOP
2E82 EB       3355        XCHG
2E83 1B       3360        DCX   D
2E84 1B       3365        DCX   D
2E85 CDDB2E   3370        CALL  LSTNM
2E88 C3C12E   3375        JMP   FNDS7
2E8B 214533   3380 FNDS3: LXI   H,PLINE
2E8E 1B       3385        DCX   D
2E8F 1A       3390        LDAX  D
2E90 77       3395        MOV   M,A
2E91 23       3400        INX   H
2E92 1B       3405        DCX   D
2E93 1A       3410        LDAX  D
2E94 FE20     3415        CPI   20H
2E96 CA9B2E   3420        JZ    FNDS4
2E99 77       3425        MOV   M,A
2E9A 23       3430        INX   H
2E9B 3A9732   3435 FNDS4: LDA   MARK
2E9E FE02     3440        CPI   2
2EA0 C2AC2E   3445        JNZ   FNDS5
2EA3 3E24     3450        MVI   A,24H
2EA5 77       3455        MOV   M,A
2EA6 CDDB2E   3460        CALL  LSTNM
2EA9 C3C12E   3465        JMP   FNDS7
2EAC FE03     3470 FNDS5: CPI   3
2EAE C2BE2E   3475        JNZ   FNDS6
2EB1 3E28     3480        MVI   A,28H
2EB3 77       3485        MOV   M,A
2EB4 23       3490        INX   H
2EB5 3E29     3495        MVI   A,29H
2EB7 77       3500        MOV   M,A
2EB8 CDDB2E   3505        CALL  LSTNM
2EBB C3C12E   3510        JMP   FNDS7
2EBE CDDB2E   3515 FNDS6: CALL  LSTNM
2EC1 2A9C32   3520 FNDS7: LHLD  NEXT
2EC4 3EBB     3525        MVI   A,0BBH
2EC6 BC       3530        CMP   H
2EC7 C2CF2E   3535        JNZ   FNDS8
2ECA BD       3540        CMP   L
2ECB C2CF2E   3545        JNZ   FNDS8
2ECE C9       3550        RET
2ECF CD6830   3555 FNDS8: CALL  CRLF
2ED2 2A9C32   3560        LHLD  NEXT
2ED5 22B032   3565        SHLD  TOP
2ED8 C34B2E   3570        JMP   FNDS1
              3575 ;
              3580 ; FOLLOWS EACH LINE NUMBER LIST AND PRINTS
              3585 ; THE FORMATED NUMBERS.
              3590 ;
2EDB 13       3595 LSTNM: INX   D
2EDC 13       3600        INX   D
2EDD 13       3605        INX   D
2EDE 13       3610        INX   D
2EDF 13       3615        INX   D
2EE0 13       3620        INX   D
2EE1 13       3625        INX   D
2EE2 13       3630        INX   D
2EE3 13       3635        INX   D
2EE4 13       3640        INX   D
2EE5 AF       3645 LSTN1: XRA   A
2EE6 329432   3650        STA   TAB
2EE9 3E08     3655        MVI   A,8
2EEB 329232   3660        STA   LINCT
2EEE 3E0C     3665        MVI   A,12
2EF0 329332   3670        STA   CHRCT
2EF3 215133   3675        LXI   H,PLINE+12
2EF6 22B232   3680        SHLD  HOLDT
2EF9 1B       3690 LSTN2: DCX   D
2EFA 1A       3695        LDAX  D
2EFB 32A432   3700        STA   VALHI
2EFE 1B       3705        DCX   D
2EFF 1A       3710        LDAX  D
2F00 32A532   3715        STA   VALLO
2F03 13       3720        INX   D
2F04 13       3725        INX   D
2F05 1A       3730        LDAX  D
2F06 329832   3735        STA   LAST
2F09 13       3740        INX   D
2F0A 1A       3745        LDAX  D
2F0B 329932   3750        STA   LAST+1
2F0E CD842F   3755        CALL  CONVR
2F11 2AB232   3760        LHLD  HOLDT
2F14 EB       3765        XCHG
2F15 21B432   3770        LXI   H,NUMBR
2F18 0E05     3775        MVI   C,5
2F1A 7E       3780 LSTN3: MOV   A,M
2F1B 12       3785        STAX  D
2F1C 23       3790        INX   H
2F1D 13       3795        INX   D
2F1E 0D       3800        DCR   C
2F1F C21A2F   3805        JNZ   LSTN3
2F22 13       3810        INX   D
2F23 13       3815        INX   D
2F24 EB       3820        XCHG
2F25 22B232   3825        SHLD  HOLDT
2F28 219332   3830        LXI   H,CHRCT
2F2B 3E07     3835        MVI   A,7
2F2D 86       3840        ADD   M
2F2E 329332   3845        STA   CHRCT
2F31 3A9232   3850        LDA   LINCT
2F34 3D       3855        DCR   A
2F35 CA4E2F   3860        JZ    LSTN4
2F38 329232   3865        STA   LINCT
2F3B 2A9832   3870        LHLD  LAST
2F3E EB       3875        XCHG
2F3F 3ECC     3880        MVI   A,0CCH
2F41 BA       3885        CMP   D
2F42 C2F92E   3890        JNZ   LSTN2
2F45 BB       3895        CMP   E
2F46 C2F92E   3900        JNZ   LSTN2
2F49 3E01     3905        MVI   A,1
2F4B 329432   3910        STA   TAB
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2F4E 3A9332   3915 LSTN4: LDA   CHRCT
2F51 4F       3920       MOV   C,A
2F52 214533   3925       LXI   H,PLINE
2F55 CD5E30   3930       CALL  PRINT
2F58 CD6830   3935       CALL  CRLF
2F5B 3A9432   3940       LDA   TAB
2F5E FE01     3945       CPI   1
2F60 C26A2F   3950       JNZ   LSTN6
2F63 2A9C32   3955 LSTN5: LHLD  NEXT
2F66 22B032   3960       SHLD  TOP
2F69 C9       3965       RET
2F6A 2A9832   3970 LSTN6: LHLD  LAST
2F6D 3ECC     3975       MVI   A,0CCH
2F6F BC       3980       CMP   H
2F70 C27A2F   3985       JNZ   LSTN7
2F73 BD       3990       CMP   L
2F74 C27A2F   3995       JNZ   LSTN7
2F77 C3632F   4000       JMP   LSTN5
2F7A CD2130   4005 LSTN7: CALL  BLKLN
2F7D 2A9832   4010       LHLD  LAST
2F80 EB       4015       XCHG
2F81 C3E52E   4020       JMP   LSTN1
              4025 ;
              4030 ; CONVERTS EACH NUMBER IN THE LINE NUMBER
              4035 ; LISTS FROM HEX TO DECIMAL (ASCII).  THIS IS
              4040 ; DONE BY INSPECTING EACH BIT OF THE STORED
              4045 ; LINE NUMBER BEGINNING WITH THE HIGH ORDER
              4050 ; BIT.  IF THE BIT IS ON, THE APPROPRIATE VALUE
              4055 ; (5 DIGITS) FROM THE DATA CALLED 'BASE:' ARE
              4060 ; ADDED DECIMALLY, ONE DIGIT AT A TIME, INTO
              4065 ; AN ACCUMULATOR AREA CALLED 'NUMBR:'.
              4070 ;
2F84 0E05     4075 CONVR: MVI   C,5
2F86 AF       4080       XRA   A
2F87 21B432   4085       LXI   H,NUMBER
2F8A 77       4090 CONV1: MOV   M,A
2F8B 23       4095       INX   H
2F8C 0D       4100       DCR   C
2F8D C28A2F   4105       JNZ   CONV1
2F90 AF       4110       XRA   A
2F91 329432   4115       STA   TAB
2F94 210833   4120       LXI   H,BASE+79
2F97 EB       4125       XCHG
2F98 3AA432   4130       LDA   VALHI
2F9B 47       4135 CONV2: MOV   B,A
2F9C 0E08     4140       MVI   C,8
2F9E 78       4145 CONV3: MOV   A,B
2F9F E680     4150       ANI   80H
2FA1 C2AC2F   4155       JNZ   CONV4
2FA4 1B       4160       DCX   D
2FA5 1B       4165       DCX   D
2FA6 1B       4170       DCX   D
2FA7 1B       4175       DCX   D
2FA8 1B       4180       DCX   D
2FA9 C3DD2F   4185       JMP   CONV8
2FAC 21B832   4190 CONV4: LXI   H,NUMBR+4
2FAF AF       4195       XRA   A
2FB0 329532   4200       STA   CARRY
2FB3 3E05     4205       MVI   A,5
2FB5 329632   4210 CONV5: STA   COUNT
2FB8 1A       4215       LDAX  D
2FB9 86       4220       ADD   M
2FBA 77       4225       MOV   M,A
2FBB 3A9532   4230       LDA   CARRY
2FBE 86       4235       ADD   M
2FBF FE0A     4240       CPI   0AH
2FC1 CACC2F   4245       JZ    CONV6
2FC4 D2CC2F   4250       JNC   CONV6
2FC7 77       4255       MOV   M,A
2FC8 AF       4260       XRA   A
2FC9 C3D12F   4265       JMP   CONV7
2FCC D60A     4270 CONV6: SUI   0AH
2FCE 77       4275       MOV   M,A
2FCF 3E01     4280       MVI   A,1
2FD1 329532   4285 CONV7: STA   CARRY
2FD4 2B       4290       DCX   H
2FD5 1B       4295       DCX   D
2FD6 3A9632   4300       LDA   COUNT
2FD9 3D       4305       DCR   A
2FDA C2B52F   4310       JNZ   CONV5
2FDD 0D       4315 CONV8: DCR   C
2FDE CAE72F   4320       JZ    CONV9
2FE1 78       4325       MOV   A,B
2FE2 07       4330       RLC
2FE3 47       4335       MOV   B,A
2FE4 C39E2F   4340       JMP   CONV3
2FE7 3A9432   4345 CONV9: LDA   TAB
2FEA FE01     4350       CPI   1
2FEC CAFA2F   4355       JZ    CON10
2FEF 3E01     4360       MVI   A,1
2FF1 329432   4365       STA   TAB
2FF4 3AA532   4370       LDA   VALLO
2FF7 C39B2F   4375       JMP   CONV2
2FFA 0E05     4380 CON10: MVI   C,5
2FFC 21B432   4385       LXI   H,NUMBR
2FFF 7E       4390 CON11: MOV   A,M
3000 C630     4395       ADI   30H
3002 77       4400       MOV   M,A
3003 3A9432   4405       LDA   TAB
3006 FE01     4410       CPI   1
3008 C21B30   4415       JNZ   CON13
300B 3E30     4420       MVI   A,30H
300D BE       4425       CMP   M
300E C21730   4430       JNZ   CON12
3011 3E20     4435       MVI   A,20H
3013 77       4440       MOV   M,A
3014 C31B30   4445       JMP   CON13
3017 AF       4450 CON12: XRA   A
3018 329432   4455       STA   TAB
301B 23       4460 CON13: INX   H
301C 0D       4465       DCR   C
301D C2FF2F   4470       JNZ   CON11
3020 C9       4475       RET

              4480 ;
              4485 ; FILLS THE PRINT LINE WITH SPACES (20H).
              4490 ;
3021 0E48     4495 BLKLN: MVI   C,72
3023 214533   4500       LXI   H,PLINE
3026 3E20     4505       MVI   A,20H
3028 77       4510 BLKL1: MOV   M,A
3029 23       4515       INX   H
302A 0D       4520       DCR   C
302B C22830   4525       JNZ   BLKL1
302E C9       4530       RET
              4535 ;
              4540 ; THIS ROUTINE READS ONE 256 BYTE BLOCK
              4545 ; OF DATA FROM THE DISK INTO THE AREA
              4550 ; CALLED 'DATA'.
              4555 ;
302F 3E01     4560 RDBLK: MVI   A,1
3031 0601     4565       MVI   B,1
3033 219131   4570       LXI   H,DRIVE
3036 4E       4575       MOV   C,M
3037 119231   4580       LXI   D,DATA
303A 2A0933   4585       LHLD  DIR
303D 23       4590       INX   H
303E 220933   4595       SHLD  DIR
3041 2B       4600       DCX   H
3042 CD2220   4605       CALL  RDDSK
3045 D25630   4610       JNC   RDBL1
3048 0E0E     4615       MVI   C,14
304A 213331   4620       LXI   H,HDR10
304D CD5E30   4625       CALL  PRINT
3050 CD6830   4630       CALL  CRLF
3053 C32820   4635       JMP   EXIT
3056 AF       4640 RDBL1: XRA   A
3057 32A032   4645       STA   BLKPT
305A 119231   4650       LXI   D,DATA
305D C9       4655       RET
              4660 ;
              4665 ; PRINT STRING AT ADDRESS IN REG H/L FOR
              4670 ; NUMBER OF CHARACTERS IN REG C.
              4675 ;
305E 46       4680 PRINT: MOV   B,M
305F CD0D20   4685       CALL  COUT
3062 23       4690       INX   H
3063 0D       4695       DCR   C
3064 C25E30   4700       JNZ   PRINT
3067 C9       4705       RET
              4710 ;
              4715 ; INSERT CR AND LF
              4720 ;
3068 060D     4725 CRLF:  MVI   B,0DH
306A CD0D20   4730       CALL  COUT
306D 060A     4735       MVI   B,0AH
306F CD0D20   4740       CALL  COUT
3072 C9       4745       RET
              4750 ;
              4755 ; CHECK BLOCK ROUTINE
              4760 ;
3073 13       4765 NXTCR: INX   D
3074 21A032   4770       LXI   H,BLKPT
3077 34       4775       INR   M
3078 CC2F30   4780       CZ    RDBLK
307B 62       4785       MOV   H,D
307C 6B       4790       MOV   L,E
307D 3E0D     4795       MVI   A,0DH
307F BE       4800       CMP   M
3080 C28630   4805       JNZ   NXTC1
3083 32A132   4810       STA   LNTAB
3086 C9       4815 NXTC1: RET
              4820 ;
              4825 ; HEADERS
              4830 ;
3087 4E4F5254484835 HDR1:  DB 'NORTHSTAR BASIC PROGRAM SUPPORT'
30A6 4E614D45224840 HDR2:  DB 'NAME OF PROGRAM: '
30B7 4F4E2044524845 HDR3:  DB 'ON DRIVE #: '
30C3 4E4F2050524850 HDR4:  DB 'NO PROGRAM WITH THAT NAME'
30DC 46494C45204855 HDR5:  DB 'FILE IS NOT TYPE 2'
30EE 5441424C454860 HDR6:  DB 'TABLE FULL - PARTIAL LIST SUPPLIED'
3110 4E414D45204865 HDR7:  DB 'NAME IS TOO LONG'
3120 494E564I4C4870 HDR8:  DB 'INVALID UNIT'
312C 4E4F2052 F4875 HDR9:  DB 'NO ROOM'
3133 415247554D4880 HDR10: DB 'ARGUMENT ERROR'
3141 53594D424F4885 HDR11: DB 'SYMBOLIC VARIABLES'
3153 535452494E4890 HDR12: DB 'STRING VARIABLES'
3163 A1525241594895 HDR13: DB 'ARRAY VARIABLES'
3172 4C494E45204900 HDR14: DB 'LINE NUMBERS'
317E 4E554C4C204905 HDR15: DB 'NULL LIST'
3187         4910 PNAME: DS  10
3191         4915 DRIVE: DS  1
3192         4920 DATA:  DS  256
3292         4925 LINCT: DS  1
3293         4930 CHRCT: DS  1
3294         4935 TAB:   DS  1
3295         4940 CARRY: DS  1
3296         4945 COUNT: DS  1
3297         4950 MARK:  DS  1
3298         4955 LAST:  DS  2
329A         4960 PRSNT: DS  2
329C         4965 NEXT:  DS  2
329E         4970 POINT: DS  2
32A0         4975 BLKPT: DS  1
32A1         4980 LNTAB: DS  1
32A2         4985 LOLIN: DS  1
32A3         4990 HILIN: DS  1
32A4         4995 VALHI: DS  1
32A5         5000 VALLO: DS  1
32A6         5005 SYTOP: DS  2
32A8         5010 STTOP: DS  2
32AA         5015 ARTOP: DS  2
32AC         5020 NMTOP: DS  2
32AE         5025 AVAIL: DS  2
32B0         5030 TOP:   DS  2
32B2         5035 HOLDT: DS  2
32B4         5040 NUMBR: DS  5
```

```
*32B9 0000000015045 BASE: DB    0,0,0,0,1,0,0,0,0,2,0,0,0,0,4,0,0,0,0
 32CC 0000000015050       DB    8,0,0,0,1,6,0,0,0,3,2,0,0,0,6,4,0,0,1
 32DF 0280000025055       DB    2,8,0,0,2,5,6,0,0,5,1,2,0,1,0,2,4,0,2
 32F2 0004080004506D      DB    0,4,8,0,4,0,9,6,0,8,1,9,2,1,6,3,8,4,3
 3305 02070608   5065     DB    2,7,6,8
 3309          5070 DIR:  DS    8
 3311          5075 STACK: DS   50
 3343          5080 ADDR: DS    2
 3345          5085 PLINE: DS   72
 336D          5090 TABLE: DS   12288
 638D          5095       END   2A00H


DH 2A00)33FF
    ?
>DH 2A00-33FF?
>DH 2A00-33FF
```

```
2A00  21 42 33 F9   0E 1F 21 87   30 CD 5E 30   CD 68 30 0E
2A10  11 21 A6 30   CD 5E 30 0E   0A 21 87 31   36 20 23 0D
2A20  C2 1C 2A 0E   09 21 87 31   CD 10 20 32   B2 32 FE 0D
2A30  CA 6F 2A FE   5F C2 54 2A   3E 09 B9 CA   28 2A 3A B2
2A40  32 2B 0C 47   CD 0D 20 06   20 CD 0D 20   06 5F CD 0D
2A50  20 C3 28 2A   77 47 CD 0D   20 23 0D C2   28 2A CD 68
2A60  30 0E 10 21   10 31 CD 5E   30 CD 68 30   C3 0F 2A 0E
2A70  0C 21 B7 30   CD 68 30 CD   5E 30 21 91   31 CD 10 20
2A80  47 CD 0D 20   FE 31 CA A4   2A FE 32 CA   A4 2A FE 33
2A90  CA A4 2A CD   68 30 0E 0C   21 20 31 CD   5E 30 CD 68
2AA0  30 C3 6F 2A   E6 0F 77 CD   10 20 47 CD   0D 20 FE 0D
2AB0  C2 93 2A 06   0A CD 0D 20   3A 91 31 21   87 31 37 3F
2AC0  CD 1C 20 D2   D4 2A 0E 19   21 C3 30 CD   5E 30 CD 68
2AD0  30 C3 0F 2A   06 00 0E 04   09 3E 02 BE   CA ED 2A 0E
2AE0  12 21 DC 30   CD 5E 30 CD   68 30 C3 0F   2A 2B 2B 2B
2AF0  2B 0E 08 11   09 33 7E 12   23 13 0D C2   F6 2A 26 00
2B00  2E 00 22 43   33 06 00 0E   04 11 8F 33   2A 43 33 23
2B10  3E 0C BC CA   23 2B 22 43   EB 73 23 72
2B20  C3 0C 2B 3E   FF 23 77 26   BB 2E BB 22   A6 32 22 A8
2B30  32 22 AA 32   22 AC 32 21   8F 33 22 AE   32 CD 2F 30
2B40  AF 32 97 32   3C EB BE CA   BC 2D EB CD   73 30 1A 32
2B50  A2 32 CD 73   30 1A 32 A3   32 AF 32 A1   32 CD 73 30
2B60  62 6B 3E 20   BE CA B6 2B   3E 8F BE C2   73 2B 3E 01
2B70  32 97 32 3E   22 BE C2 90   2B 3A 97 32   FE 02 C2 88
2B80  2B AF 32 97   32 C3 B6 2B   3E 02 32 97   32 C3 B6 2B
2B90  3A 97 32 FE   00 C2 B6 2B   3E 9A BE C2   A4 2B CD C8
2BA0  2B C3 B6 2B   3E 40 BE D2   B6 2B 3E 5A   BE DA B6 2B
2BB0  CD EA 2B C3   B9 2B CD 73   30 3E 0D 21   A1 32 BE C2
2BC0  6B 2B CD 73   30 C3 40 2B   CD 73 30 1A   32 A5 32 CD
2BD0  73 30 1A 32   A4 32 AF 32   A1 32 2A AC   32 22 B0 32
2BE0  CD 7A 2C 2A   B0 32 22 AC   32 C9 3E 20   32 A5 32 32
2BF0  A4 32 1A 32   A4 32 CD 73   30 3E 0D 21   A1 32 BE C2
2C00  08 2C CD 4A   2C C3 49 2C   62 6B 3E 2F   BE D2 2C 2C
2C10  3E 39 BE DA   2C 2C 1A 32   A5 32 CD 73   30 3E 0D 21
2C20  A1 32 BE C2   2C 2C CD 4A   2C C3 49 2C   62 6B 3E 24
2C30  BE C2 3A 2C   CD 5A 2C C3   49 2C 3E E0   BE C2 46 2C
2C40  CD 6A 2C C3   49 2C CD 4A   2C C9 2A A6   32 22 B0 32
2C50  CD 7A 2C 2A   B0 32 22 A6   32 C9 2A A8   32 22 B0 32
2C60  CD 7A 2C 2A   B0 32 22 A8   32 C9 22 9C   32 EB 22 9E
2C70  CD 7A 2C 2A   B0 32 22 AA   32 C9 22 9C   32 EB 22 9E
2C80  32 3E BB 32   98 32 32 99   32 2A AE 32   22 9A 32 2B
2C90  3A A4 32 77   2B 3A A5 32   77 23 23 3E   BB 77 23 77
2CA0  23 23 23 7E   32 AE 32 3E   CC 77 23 7E   32 AF 32 3E
2CB0  CC 77 2A 9C   32 3E BB BC   C2 C9 2C BD   C2 C9 2C 2A
2CC0  9A 32 22 B0   32 CD 75 2D   C9 2B 56 3A   A5 32 BE CA
2CD0  32 2D D2 FB   2C 2A 9A 32   3A 9C 32 77   23 3A 9D 32
2CE0  77 2A 98 32   3E BB BC C2   EE 2C BD CA   BF 2C 3A 9A
2CF0  32 77 23 3A   9B 32 77 CD   75 2D C9 3E   BB 2A 9C 32
2D00  BC C2 18 2D   BD C2 18 2D   2A 98 32 3A   9A 32 77 23
2D10  3A 9B 32 77   CD 75 2D C9   2A 9C 32 3E   BB 32 5E 23
2D20  56 EB 22 9C   32 3E BB BC   C2 C9 2C BD   C2 C9 2C C3
2D30  08 2D 2B 56   3A A5 32 BE   CA 41 2D D2   FB 2C C3 D5
2D40  2C 2A AE 32   2B 2B 2B 3A   AF 32 77 2B   3A AE 32 77
2D50  2B 2B 2B EB   2A AE 32 2B   2A AE 32 2B   9C 32 22 9A
2D60  AF 32 77 2B   3A AE 32 77   22 AE 32 2A   9C 32 22 9A
2D70  32 CD 75 2D   C9 2A 9A 32   3A 23 23 23   23 3A AF 32
2D80  B5 2D 23 BE   C2 B4 2D 2B   3A AE 32 77   23 3A AF 32
2D90  77 2A AE 32   2B 2B 3A A2   32 77 23 3A   A3 32 77 23
2DA0  7E 32 AE 32   3E CC 77 23   7E 32 AF 32   3E CC 77 2A
2DB0  9E 32 EB C9   2B 5E 23 56   0E 12 21 41
2DC0  31 CD 68 30   CD 5E 30 CD   68 30 2A A6   32 22 B0 32
2DD0  3E 01 32 97   32 CD 2F 2E   CD 68 30 0E   10 21 53 31
2DE0  CD 5E 30 CD   68 30 2A A8   32 22 B0 32   3E 02 32 97
2DF0  32 CD 2F 2E   CD 68 30 CD   0F 21 63 31   32 CD 2F 2E
2E00  68 30 2A AA   32 22 B0 32   3E 03 32 97   32 CD 2F 2E
2E10  CD 68 30 0E   0C 21 72 31   CD 5E 30 CD   68 30 2A AC
2E20  32 22 B0 32   3E 04 32 97   32 CD 2F 2E   32 28 20 2A
2E30  B0 32 3E BB   BC C2 4B 2E   BD C2 4B 2E   0E 09 21 7E
2E40  31 CD 68 30   CD 5E 30 CD   68 30 C9 CD   21 30 2A B0
2E50  32 5E 23 56   2B EB 22 9C   3A A9 32 77   32 A5 32 CD
2E60  2E 1B 1A 32   A4 32 1B 1A   12 23 13 0D   84 2F 21 45
2E70  33 EB 21 B4   33 05 05 7E   C3 C1 2E 21   87 31 2E 2A
2E80  B0 32 EB 1B   1B CD DB 2E   45 33 1B 1A   2E 77 23 3A
2E90  77 23 1B 1A   FE 20 CA 9B   97 32 FE 02   C2 AC 2E 3E
2EA0  C2 AC 2E 3E   24 77 CD DB   FE 03 C2 B6   2E 3E 28 77
2EB0  2E 3E 28 77   23 3E 29 77   CD DB 2E C3   C1 2E CD DB
2EC0  2E 2A 9C 32   3E BB BC C2   CF 2E BD C2   CF 2E C9 CD
2ED0  68 30 2A 9C   32 22 B0 32   C3 4B 2E 13   13 13 13 13
```
```
2EE0  13 13 13 13   13 AF 32 94   32 3E 08 32   92 32 3E 0C
2EF0  32 93 32 21   51 33 22 B2   32 1B 1A 32   A4 32 1B 1A
2F00  32 A5 32 13   13 1A 32 98   32 13 1A 32   99 32 CD 84
2F10  2F 2A B2 32   EB 21 B4 32   0E 05 7E 12   23 13 0D C2
2F20  1A 2F 13 13   EB 22 B2 32   21 93 32 3E   07 86 32 93
2F30  32 3A 92 32   3D CA 4E 2F   32 92 32 2A   98 32 EB 3E
2F40  CC BA C2 F9   2E BB C2 F9   2E 3E 01 32   94 32 3A 93
2F50  32 4F 21 45   33 CD 5E 30   CD 68 30 3A   94 32 FE 01
2F60  C2 6A 2F 2A   9C 32 22 B0   32 C9 2A 98   32 3E CC BC
2F70  C2 7A 2F BD   C2 7A 2F C3   63 2F CD 21   30 2A 98 32
2F80  EB C3 E5 2E   0E 05 AF 21   B4 32 77 23   0D C2 8A 2F
2F90  AF 32 94 32   21 08 33 EB   3A A4 32 47   0E 08 78 E6
2FA0  80 C2 AC 2F   1B 1B 1B 1B   1B C3 DD 2F   21 B8 32 AF
2FB0  32 95 32 3E   05 32 96 32   1A 86 77 3A   95 32 86 FE
2FC0  0A CA CC 2F   D2 CC 2F 77   AF C3 D1 2F   D6 0A 77 3E
2FD0  01 32 95 32   2B 1B 3A 96   32 3D C2 B5   2F 0D CA E7
2FE0  2F 78 07 47   C3 9E 2F 3A   94 32 FE 01   CA FA 2F 3E
2FF0  01 32 94 32   3A A5 32 C3   9B 2F 0E 05   21 B4 32 7E
3000  C6 30 77 3A   94 32 FE 01   C2 1B 30 3E   30 BE C2 17
3010  30 3E 20 77   C3 1B 30 3A   32 94 32 23   0D C2 FF 2F
3020  C9 0E 48 21   45 33 3E 20   77 23 0D C2   28 30 C9 3E
3030  01 06 01 21   91 31 4E 23   92 31 2A 09   33 23 22 09
3040  33 2B CD 22   20 D2 56 30   0E 0E 21 33   31 CD 5E 30
3050  CD 68 30 C3   28 20 AF 32   A0 32 11 92   31 C9 46 CD
3060  0D 20 23 0D   C2 5E 30 C9   06 0D CD 0D   20 06 0A CD
3070  0D 20 C9 13   21 A0 32 34   CC 2F 30 62   6B 3E 0D BE
3080  C2 86 30 32   A1 32 C9 4E   4F 52 54 49   52 4F 4F 52
3090  20 42 41 53   49 43 20 50   4D 45 20 4F   52 20 50 52
30A0  55 50 50 4F   52 54 4E 41   4D 45 20 4F   52 20 50 52
30B0  4F 4E 42 41   49 31 31 30   32 20 32 0F   0A 31 38 30
30C0  23 3A 20 4E   4F 20 50 52   4F 20 50 52   4F 4D 20 57
30D0  54 44 20 54   48 41 31 54   20 2D 20 50   41 52 54 49
30E0  42 4C 45 20   46 55 4C 4C   54 52 20 49   20 32 54 41
30F0  42 4C 45 20   46 55 4C 4C   20 49 53 20   54 4F 4F 20
3100  49 4E 41 4D   45 20 49 53   20 49 53 20   54 4F 4F 20
3110  4E 41 4D 45   20 49 53 20   54 4F 4F 20   4C 4F 4E 47
3120  49 4E 56 41   4C 49 44 20   55 4E 49 54   4E 4F 20 52
3130  4F 46 4F 4D   42 4F 4C 49   43 20 56 41   52 49 41 42
3140  52 53 59 4D   42 4F 4C 49   47 20 56 41   52 49 41 42
3150  4C 45 53 53   54 52 49 4E   20 56 41 52   49 41 42 4C
3160  4C 45 53 53   52 52 41 59   20 49 42 45   52 53 59 4E
3170  45 53 53 49   4E 45 20 4C   55 4D 42 45   52 53 4E 55
3180  4C 4C 20 4C   49 53 54 20   2B 20 2D 0A   4C 48 2D 44
3190  31 37 32 30   20 53 4C 49   43 20 56 41   52 49 41 42
31A0  20 20 41 44   44 52 0D 0A   31 37 33 30   20 20 20 20
31B0  20 20 20 20   49 4E 50 20   20 20 20 20   20 41 31 33
31C0  32 20 20 20   20 20 20 20   20 4D 56 49   20 20 20 20
31D0  2C 30 43 48   0D 0A 31 37   33 34 20 20   20 20 20 20
31E0  20 20 20 43   48 4D 20 20   20 20 20 4A   5A 0D 0A 31
31F0  20 20 20 20   20 20 20 20   20 20 20 4A   5A 20 53 54
3200  50 53 0D 0A   31 37 33 37   20 20 20 20   20 20 20 20
3210  53 48 4C 44   20 20 20 20   20 20 41 44   31 37 33 38
3220  20 20 20 20   20 20 20 20   4D 4F 56 20   20 20 48 2C
3230  44 0D 0A 31   20 20 4C 2C   20 4C 0D 0A   31 37 37 20
3240  4F 56 20 20   20 20 4C 2C   45 0D 0A 31   35 30 20 20
3250  20 20 20 20   20 20 44 41   44 20 20 20   42 0D 0A 31
3260  37 36 30 20   20 20 20 20   20 20 20 58   43 48 47 0D
3270  0A 31 37 36   32 20 20 20   20 20 20 20   20 4D 4F 56
3280  20 20 20 20   4D 2C 45 0D   0A 31 37 36   34 20 20 20
3290  20 20 20 20   49 4E 58 20   20 20 20 48   0A 31 37 36
32A0  36 20 20 20   20 20 20 20   20 4D 4F 56   20 20 20 4D
32B0  2C 44 0D 0A   31 37 36 38   00 00 00 00   00 01 00 00
32C0  00 00 02 00   00 00 00 04   00 00 00 00   08 00 00 00
32D0  01 06 00 00   00 03 02 00   00 00 06 04   00 00 01 02
32E0  08 00 00 02   05 06 00 00   00 00 01 02   00 00 02 04
32F0  00 02 00 04   08 00 04 00   09 06 00 08   01 09 02 01
3300  06 03 08 04   03 02 07 06   08 4F 56 20   20 20 4D 2C
3310  41 0D 0A 31   37 39 30 20   20 20 20 20   42 42 48 0D
3320  56 49 20 20   20 20 48 2C   30 42 42 48   0A 31 38 30
3330  30 20 20 20   20 20 20 20   20 4D 56 49   20 20 20 20
3340  2C 30 42 42   48 0D 0A 31   38 31 30 20   20 20 20 20
3350  20 20 20 53   48 4C 44 20   20 53 59 54   4F 50 0D 0A
3360  31 38 32 30   21 30 2A 98   20 53 48 44   53 48 4C 44
3370  20 20 20 53   54 4F 50 0D   0A 31 38 33   30 20 20 20
3380  20 20 20 20   20 53 48 4C   44 20 20 20   52 54 4F 50
3390  0D 0A 31 38   34 30 20 20   20 20 53 48   20 20 53 48
33A0  4C 44 20 20   20 20 4E 4D   54 4F 50 0D   0A 31 38 33
33B0  20 20 20 20   20 20 20 4C   58 49 20 20   20 48 2C 54
33C0  41 42 4C 45   2B 32 0D 0A   20 20 41 56   41 49 4C 0D
33D0  20 20 20 20   20 53 48 4C   44 20 20 41   41 49 4C 0D
33E0  0A 31 39 30   30 20 20 20   20 20 20 20   20 43 41 4C
33F0  4C 20 20 52   44 42 2C 4C   0D 0A 31 39   31 30 20 3B
```

SYMBOLIC VARIABLES

A	310	340	370	560	705			
B	330	340	360	560	705			
C	350	360	370	560	705			
D	480	480	530	532	560			
E	480	480	480	480	480	530	534	560
F	480	480	480	532	534	560		
I	285	286	565	580	600	630		
J	286	286	570	580	600	620		
P	470	520	590	590	610	610	640	650
	660	680						
T	400	410	690	750				
X	286	430	440	445	480	480	705	710

STRING VARIABLES

A$	50	80	820	830

ARRAY VARIABLES

Z()	305	560	560	560	560	560	560	580
	580							

LINE NUMBERS

285	80	
290	830	
330	340	
350	360	370
410	460	550
450	440	
470	445	
540	530	532	534
560	538	
620	580	600
680	650	
690	670	
750	520	640
820	740	