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June 30, 1960

The Elegant Assembly SYstem for the 205 ("EASY")

This assembly program is a "quick-and-dirty" routine for the Datatron 205 which still provides a convenient assembly language. It was thrown together in a hurry in order to enable the user to throw his programs together in a hurry. The rules for its use are as follows:

1. There are eleven fields on the input cards.
   a. Program point location (column 5)
   b. Symbolic location (cols. 7-11)
   c. Numeric word (cols. 13-23)
      (1) sign (column 13)
      (2) control digits (cols. 14-17)
      (3) numeric operation (cols. 18-19)
      (4) numeric address (cols. 20-23)
   d. Symbolic operation (cols. 25-29)
   e. Symbolic address (cols. 31-35)
   f. Program point address (cols. 37-38)
   g. High-speed-loop tag (column 40)
   h. Remarks (cols. 42-56).

Column 1 must contain a "1"; all other columns are ignored on input.

2. If the symbolic operation field is blank, the numeric operation field becomes the assembled operation code. If the symbolic operation field is a 205-mnemonic operation, this number supercedes the numeric operation field. If the symbolic op is START or END, special assembly operation occurs, as described later.

3. If the symbolic address field is non-blank, this symbol must occur exactly once in the symbolic location field somewhere in the input program; and the symbol then represents the location of that line.

The program point address field is relevant if it is non-blank and if the symbolic address is blank. This field can have the forms:

   a. n+ n=0,1,...,9; meaning current location plus n.
   b. n- n=0,1,...,9; meaning current location minus n.
   c. nF n=1,2,...,9; meaning the next location of the program which has n in the program point location field.
   d. nB n=1,2,...,9; meaning the previous location of the program which has n in the program point location field.

The addresses of forward program points and "forward" symbols (i.e. those symbols which occur later in the location field) are eventually assembled as their corresponding equivalents; the addresses of backward program points, of n+ and n- addresses, and of "backward" symbols (i.e. symbols which have occurred previously in the location field) are assembled as their corresponding equivalents plus the numeric address field (mod 10000), allowing the use of so-called "regional addresses."

Restriction: On all forward symbols and program points the high-order control digit (column 14) must be zero. This is necessary to the loading routine which adjusts the assembled instructions wherever forward references were made and which finds the high-speed-loop tag there.

4. If the high-speed-loop tag is non-zero this digit is inserted into the high-order digit of the assembled address. This is used for programs that have been blocked to a loop and the loop address is sought.

5. A symbolic location is specified by punching the symbol in the appropriate field. The location will be one greater than the previous location if the previous card was not a START card, and will be the location specified by the START card otherwise.
A program point location is specified by punching the number into column 5.
6. START and END are pseudo-operations which do not result in an assembled instruction. On both of these operations an address is specified in the numeric address field and/or symbolic or program point field. (Only non-forward symbols and program points are meaningful here.)

a. START sets the location counter to this address. (Examples:
1000 START causes the next line to have location 1000.
START 2+ causes the assembled coding to skip two lines.

b. END is used exactly once in every assembled program, as the last card. This causes a loading routine to be punched starting at the address you specify on the END card. The loading routine uses (33 plus the number of locations which were used for forward references) memory cells.
7. For best results do not assemble any instructions into location 0000. This simple-minded assembler gets very confused with this location!
8. The output of EASY is immediately reloadable as a one-per-card deck, provided you set the Cardatron control panel to take the format band from column 2. The output is also reloadable for another assembly if the Cardatron control panel is set to take the format band from column 1.
9. Operating instructions: Load EASY deck followed by your input cards into input unit one. Put blank cards into output punch unit one. Let the program take off. There are three programmed stops:

08 8421, improper symbolic operation code. Hit Continuous to read in and process the next card. (rA=erroneous op)
08 9669, symbol occurs in location address twice. (rA=symbol) Hit Continuous to read in and process the next card.
08 1111, end of assembly. Unrestartable.

10. Operation Codes: The symbolic operation codes chosen were designed for a man who wants to use both the 205 and the 220 and not be confused. These codes can, however, be easily modified if desired.

00 PTR	10 DAD	20 BUN	31 CUBR	44 CRD	60 MUL	72 LDB	82 FMU
01 CIRA	11 BA	21 CUR	32 IB	45 CRI	61 DIV	73 OSD	83 FDV
02 STC	12 STA	22 DBB	33 CLR	48 CRF	63 EXT	74 ADD	
03 PTW	13 SRT	23 RND	34-7 BT4-7	50 MOW	64 CAD	75 SUB	
04 CNZ	14 SLT	24-7 BF4-7	38 CCB	52 MRW	65 CSU	76 ADA	
06 UA	15 NOR	28 BOF	39 CCBR	54 CWR	66 CAA	77 SUA	
07 PTWF	16 ASC	29 CCR	40 MRD	55 CWI	67 CSA	80 FAD	
08 HLT	17 SSC	30 CUB	42 MTS	58 CWF	70 MRO	81 FSU	

11. Listing of EASY program. This listing is an illustration of most of the rules given here and it also is the final authority on EASY operation. The listing is not as it would come out of an assembly, but as an edited listing showing all the forward references as they would appear after the loading routine went to work.

(1)

```
                    1000 START                 EASY ASSEMBLER.                           1000
PROC         10     6005 CRD                   READ INPUT CARD      1000   0 0010 44 6005
                    1600 BF6                   MAKE TWO COPIES      1001   0 0000 26 1600
                    6012 CAD                   IS THE OP CODE       1002   0 0000 64 6012
                         CNZ   OP                 SYMBOLIC.         1003   0 0000 04 1024
ADDR                6011 CAD                   IS THE ADDRESS       1004   0 0000 64 6011
                         CNZ   SYMBL              SYMBOLIC.         1005   0 0000 04 1048
                    6009 CAD                   IS THE ADDRESS       1006   0 0000 64 6009
                         CNZ   NUMAD           N+ N- NF OR NB.      1007   0 0000 04 5006
FLAG                     SRT                                        1008   0 0000 13 0000
LOCAT               6017 CAD                   IS THE LOCATION      1009   0 0000 64 6017
                         CNZ   SLOC               SYMBOLIC.         1010   0 0000 04 1056
                    6018 CAD                   IS THE LOCATION      1011   0 0000 64 6018
                         CNZ   NLOC            A PROGRAM POINT      1012   0 0000 04 1070
FINIS               1613 CAA                                        1013   0 0000 66 1613
                       4 SRT                   SYNTHESIZE           1014   0 0000 13 0004
                    1608 CAD                   INSTRUCTION.         1015   0 0000 64 1608
                         CNZ          1F       CHECK HSL TAG        1016   0 0000 04 1020
2                   1614 CAD                   TACK ON              1017   0 0000 64 1614
                       2 SRT                   OPERATION CODE.      1018   0 0000 13 0002
                         BUN   HSLF                                 1019   0 0000 20 7010
1                      1 SLT                   INSERT               1020   0 0000 14 0001
                    6008 CAD                   HSL TAG DIGIT        1021   0 0000 64 6008
                       1 SRT                                        1022   0 0000 13 0001
                         BUN          2B                            1023   0 0000 20 1017
OP                       ADD   SEVEN           LOOK UP              1024   0 0000 74 5008
                         CUR   TABLE           SYMBOLIC OPCODE      1025   0 0000 21 4000
                    8421 HLT                   HALT IF              1026   0 0000 08 8421
                         BUN   PROC            UNDEFINED.           1027   0 0000 20 1000
                    1614 STA                   BUT IF DEFINED       1028   0 0000 12 1614
                       2 SRT                   CHECK FOR            1029   0 0000 13 0002
                    1614 CNZ                   PSUDO OPERATION      1030   0 0000 04 1614
                         BUN   ADDR                                 1031   0 0000 20 1004
END                      CAD          3F       SET UP               1032   0 0000 64 1046
                         STA   PROC            TO FINISH OFF.       1033   0 0000 12 1000
START                    CAD          2F       CALCULATE            1034   0 0000 64 1047
                         STC   FLAG            ADDRESS              1035   0 0000 02 1008
                         BUN   ADDR            EQUIVALENT.          1036   0 0000 20 1004
5                        CAD          1F                            1037   0 0000 64 1045
                         STA   FLAG                                 1038   0 0000 12 1008
```

```
                  1613 CAD               CHANGE LOCATION  1039  0 0000 64 1613
                  6002 STA               COUNTER          1040  0 0000 12 6002
                  6003 ADD               AND INSERT       1041  0 0000 74 6003
                  6000 STA               TRANSFER         1042  0 0000 12 6000
                  6004 CAD               INSTRUCTION.     1043  0 0000 64 6004
                       BUN   PUNCH                        1044  0 0000 20 7017
1                      SRT                                1045  0 0000 13 0000
3                      CUB   PLOAD                        1046  0 0000 30 1708
2                      BUN         5B                     1047  0 0000 20 1037
 SYMBL                 CUR   TABLE       LOOK SYMBOL UP.  1048  0 0000 21 4000
       1          1900 STC               IF UNDEFINED.    1049  1 0000 02 1900
                       BUN   LOOP7       DEFINE IT.       1050  0 0000 20 7000
                       OSD         7+    IF DEFINED AND   1051  0 0000 73 1058
                       BOF   LOOP7       FORWARD GO TO    1052  0 0000 28 7000
 EQ               6013 ADD               SPECIAL ROUTINE  1053  0 0000 74 6013
                  1613 STA               OTHERWISE SET    1054  0 0000 12 1613
                       BUN   FLAG        EQUIVALENT.      1055  0 0000 20 1008
 SLOC                  CUR   TABLE       LOOK FOR SYMBOL  1056  0 0000 21 4000
       1          1900 STC                                1057  1 0000 02 1900
                       BUN   A3          UNDEFINED LOC.   1058  0 0000 20 1064
                       OSD         7-                     1059  0 0000 73 1052
                       BOF   A3          DEFINED LOC.     1060  0 0000 28 1064
                  6017 CAD               HALT IF SYMBL    1061  0 0000 64 6017
                  9669 HLT               OCCURS TWICE     1062  0 0000 08 9669
                       BUN   PROC        IN LOCATION      1063  0 0000 20 1000
 A3                    STA   TEMP                         1064  0 0000 12 4019
                  6002 CAD               IF FORWARD       1065  0 0000 64 6002
       1          2900 STA               REFERENCE WAS    1066  1 0000 12 2900
 A2                    CAD   TEMP        MADE.  MAKE      1067  0 0000 64 4019
                       CNZ   A1          NEW TABLE ENTRY  1068  0 0000 04 5011
                       BUN   FINIS                        1069  0 0000 20 1013
 NLOC             6018 LDB               PROGRAM POINT    1070  0 0000 72 6018
       1          3950 CAD               LOCATION.        1071  1 0000 64 3950
                       STA   TEMP        UNDEFINE         1072  0 0000 12 4019
                  6002 CAD               FORWARD P.P.     1073  0 0000 64 6002
       1          3900 STC               DEFINE BACKWARD  1074  1 0000 02 3900
       1          3950 STA                                1075  1 0000 12 3950
                       BUN   A2                           1076  0 0000 20 1067
 HALT                  CAD   TRANS       PUNCH FINAL      1077  0 0000 64 1723
                  7006 STA               CARD AND         1078  0 0000 12 7006
            210   7000 CWR               STOP             1079  0 0210 54 7000
                  1111 HLT               UNCONDITIONALLY  1080  0 0000 08 1111
                       BUN         1-                     1081  0 0000 20 1080
                  1810 START                                              1810
                  6002 CAD               N+               1810  0 0000 64 6002
                  6010 ADD                                1811  0 0000 74 6010
```

```
                      BUN   EQ                          1812  0 0000 20 1053
                 1820 START                                              1820
                 6002 CAD                N-             1820  0 0000 64 6002   (3)
                 6010 SUB                               1821  0 0000 75 6010
                      BUN   EQ                          1822  0 0000 20 1053
                 1842 START                                              1842
                 6010 LDB                NB             1842  0 0000 72 6010
          1      3900 CAD                               1843  1 0000 64 3900
                      BUN   EQ                          1844  0 0000 20 1053
                 1846 START                                              1846
                 6010 CAD                NF             1846  0 0000 64 6010
                      ADD   FUDGE        PROCESS        1847  0 0000 74 5019
                      STA   TEMP         LIKE           1848  0 0000 12 4019
                      LDB   TEMP         SYMBOL         1849  0 0000 72 4019
          1      2900 CAD                               1850  1 0000 64 2900
                      BUN   LOOP7                       1851  0 0000 20 7000
                 1708 START                                              1708
 PLOAD      1    6002 CAD                PUNCH LOADING  1708  0 0001 64 6002
                 7000 ADD                ROUTINE.       1709  0 0000 74 7000
                 7000 STA                FIRST CARD     1710  0 0000 12 7000
                 7002 EXT                LOADS B BOX    1711  0 0000 63 7002
                 7002 STA                               1712  0 0000 12 7002
                 7006 CSU                               1713  0 0000 65 7006
                 7001 STA                               1714  0 0000 12 7001
           21    7000 CWR                               1715  0 0210 54 7000
                      CAD         3F 7                  1716  0 0000 64 7724
                      ADD   PLACE                       1717  0 0000 74 5014
                    4 SRT                               1718  0 0000 13 0004
                      BUN         1F                    1719  0 0000 20 1728
                      LDB                               1720  0 0000 72 0000
          4000        LDB                               1721  0 4000 72 0000
 SIGN6    1111201111                     SN CHGED TO 6  1722  0 1111 20 1111
 TRANS             15 BUN                               1723  0 0000 20 0015
3                  23                                   1724  0 0000 00 0023
                                                        1725  0 0000 00 0000
            1         CRD                               1726  0 0010 44 0000
          7667000005                                    1727  0 7667 00 0005
1                     CAD   TOFIX                       1728  0 0000 64 1776
                    4 SLT                               1729  0 0000 14 0004
                      STA   TOFIX                       1730  0 0000 12 1776
                 1740 BT4                               1731  0 0000 34 1740
                 6004 CAD                               1732  0 0000 64 6004
                      BUN         4F 4                  1733  0 0000 00 0000
                 1740 START                                              1740
3                  10 SRT                LOOP TO        1740  0 0000 13 0010
                 7007 LDB                PUNCH THE      1741  0 0000 72 7007
```

(4)

```
                  CAD            1F 4 LOADING ROUTINE   1742  0 0000 64 4745
             6004 SUB                                   1743  0 0000 75 6004
                  STA            1F 4                   1744  0 0000 12 4745
        1    1755 CAD                                   1745  1 0000 64 1755
        1    7000 STA                                   1746  1 0000 12 7000
                  DBB            1B 4                   1747  0 0000 22 4745
             7005 CAD                                   1748  0 0000 64 7005
                  CNZ            2+ 4                   1749  0 0000 04 4751
                  BUN     HALT                          1750  0 0000 20 1077
             7006 CAD                                   1751  0 0000 64 7006
             6004 ADD                                   1752  0 0000 74 6004
             7006 STA                                   1753  0 0000 12 7006
          21 7000 CWR                                   1754  0 0210 54 7000
               10 SLT                 AFTER FIRST       1755  0 0000 14 0010
4                 SUB     ONE         SIX CARDS,        1756  0 0000 75 5005
                  CNZ            3B 4 DUMP FORWARD      1757  0 0000 04 4740
                  CAD            8F   REFERENCE TABLE   1758  0 0000 64 1760
                  STA            1B 4                   1759  0 0000 12 4746
8       1         CAD                                   1760  1 0000 64 0000
                                                                        1761
             1761 START
        1    0001 CAD                 LOADING ROUTINE   1761  1 0000 64 0001
        2      30 STA                 CLEANS UP         1762  2 0000 12 0030
        2      29 EXT                 FORWARD           1763  2 0000 63 0029
        2      31 SUB                 REFERENCES.       1764  2 0000 75 0031
                9 SRT                                   1765  0 0000 13 0009
        2      21 CNZ                                   1766  2 0000 04 0021
                1 SRT                                   1767  0 0000 13 0001
        2      30 CAD                                   1768  2 0000 64 0030
               10 SLT                                   1769  0 0000 14 0010
        1       1 STC                                   1770  1 0000 02 0001
        2      30 LDB                                   1771  2 0000 72 0030
        2         DBB                                   1772  2 0000 22 0000
        2      15 CAD                                   1773  2 0000 64 0015
        2      28 SUB                                   1774  2 0000 75 0028
        2      15 STA                                   1775  2 0000 12 0015
  TOFIX 2      64                                       1776  2 0000 00 0064
        2      30 STA                                   1777  2 0000 12 0030
                4 SRT                                   1778  0 0000 13 0004
        2      31 STA                                   1779  2 0000 12 0031
        2      10 CNZ                                   1780  2 0000 04 0010
             1221 HLT                                   1781  0 0000 08 1221
        2      32 STC                                   1782  2 0000 02 0032
                6 SLT                                   1783  0 0000 14 0006
        2      27 EXT                                   1784  2 0000 63 0027
        2      32 ADD                                   1785  2 0000 74 0032
                7 SRT                                   1786  0 0000 13 0007
```

```
        2          7 BUN
         1111111110
                    1
         1111110000
                 4000 START
  TABLE                STC    HOLD          SYMBOL TABLE
                       CAD           4F     SEARCH ROUTINE.
                     4 SLT
                       STA    EXIT          STORE EXIT.
                       CAD    HOLD          GENERATE
                       MUL    10101         STARTING
                       STC    TEMP          PLACE, AND
                     3 SLT                  SEARCH FOR
                       STA    TEMP          EMPTY OR
                       LDB    TEMP          UNUSED PLACE
1       1         1900 CAD
                       CNZ           2F
                       CAD    HOLD          NOT IN TABLE
  EXIT
  10101  1001001001
3                      CAD    EXIT          IF SYMBOL IN
                       ADD    TWO           TABLE, ADD 2
                       STA    TEMP          TO EXIT LINE
        1         2900 CAD                  AND DISPLAY
  TEMP                                       EQUIVALENT
                 5000 START
2                      SUB    HOLD
                       NOR           3B
                       DBB           1B
                       LDB    999           CYCLE MOD
                       BUN           1B     1000.
  ONE                     1
  NUMAD             6009 LDB
          1         1800 BUN
  SEVEN                   7
  TWO                     2
  HOLD
  A1                      4 SRT              PREPARE
                    6002 CSU                 FORWARD
                       4 SLT                 REFERENCE
  PLACE                9 STA                 TABLE
                       CAD    PLACE         ENTRY
                       ADD    ONE
                       STC    PLACE
                       BUN    FINIS
  FUDGE             1050
```

```
1787  2 0000 20 0007
1788  0 1111 11 1110
1789  0 0000 00 0001
1790  0 1111 11 0000
                4000
4000  0 0000 02 5010
4001  0 0000 64 7012
4002  0 0000 14 0004
4003  0 0000 12 4013
4004  0 0000 64 5010
4005  0 0000 60 4014
4006  0 0000 02 4019
4007  0 0000 14 0003
4008  0 0000 12 4019
4009  0 0000 72 4019
4010  1 0000 64 1900
4011  0 0000 04 5000
4012  0 0000 64 5010
4013  0 0000 00 0000
4014  0 1001 00 1001
4015  0 0000 64 4013
4016  0 0000 74 5009
4017  0 0000 12 4019
4018  1 0000 64 2900
4019  0 0000 00 0000
                5000
5000  0 0000 75 5010
5001  0 0000 15 4015
5002  0 0000 22 4010
5003  0 0000 72 6019
5004  0 0000 20 4010
5005  0 0000 00 0001
5006  0 0000 72 6009
5007  1 0000 20 1800
5008  0 0000 00 0007
5009  0 0000 00 0002
5010  0 0000 00 0000
5011  0 0000 13 0004
5012  0 0000 65 6002
5013  0 0000 14 0004
5014  0 0000 02 0009
5015  0 0000 64 5014
5016  0 0000 74 5005
5017  0 0000 02 5014
5018  0 0000 20 1013
5019  0 0000 00 1050
```

```
                       6003 START                                                     6003
          81           0000 CRD               CONSTANTS FOR      6003  0 0810 44 0000
                          6                   PUNCHOUT           6004  0 0000 00 0006
                       6019 START                                                     6019
999       16           0999                                      6019  0 1600 00 0999
                       7000 START                                                     7000
LOOP7                  1613 STA               SET UP CHAINING    7000  0 0000 12 1613
                       6002 CSU               PROCEDURE          7001  0 0000 65 6002
         1             2900 STC               FOR FORWARD        7002  1 0000 02 2900
                       6015 CAD               REFERENCES         7003  0 0000 64 6015
                          3 SRT                                  7004  0 0000 13 0003
                       6008 CAD                                  7005  0 0000 64 6008
                          3 SLT                                  7006  0 0000 14 0003
                       1615 STC                                  7007  0 0000 02 1615
                       1608 STA                                  7008  0 0000 12 1608
                            BUN    LOCAT                         7009  0 0000 20 1009
HSLF                   1615 CAD               TACK ON CON-       7010  0 0000 64 1615
                          6 SLT               TROL DIGITS        7011  0 0000 14 0006
                       6020 STA                                  7012  0 0000 12 6020
                       6002 CAD               INCREMENT          7013  0 0000 64 6002
                            ADD    ONE        LOCATION           7014  0 0000 74 5005
                       6002 STC               COUNTER            7015  0 0000 02 6002
                       6016 CAD                                  7016  0 0000 64 6016
PUNCH                  6001 STC               SET SIGN           7017  0 0000 02 6001
            1          6000 CWR               PUNCH AND          7018  0 0010 54 6000
                            BUN    PROC       RECYCLE            7019  0 0000 20 1000
                                                                       0 0000 00 0000
```

The format bands
and symbolic op
table are not
shown here.