Z80:READ ONLY SECRETS

A good way to further your knowledge of machine code programming (which to many of us means learning the first principles) is to examine the instructions in a computer's read only memory or ROM. Geoff Lohrere, a specialist on the Z80 processor has written a disassembler for the Z80 based TRS-80/System 80 micro which, with a bit of perseverence can be used to lay bare the secrets of other Z80 based micros.

The program accompanying this article is a Z80 disassembler written for the TRS-80/System 80 micro. It should be easy to convert to most other Z80 based micros. The main purpose of a disassembler program is to convert machine code (possibly back) to assembler instructions. Machine code is a set of numeric instructions that the processor (Z80) can directly execute as a program. These numeric instructions usually take the form of a list of bytes in computer memory and can be very difficult to program without making numerous mistakes. To overcome this problem it is usual to use a substitute code known as the assembler language of the processor. This assembler language is far more meaningful from a programmer's point of view. For example, the hexadecimal (HEX) form of the machine code to load the Z80 C register with the value 24 (HEX) would be in two bytes OE 24. This is represented in assembler language as LD C,24H (LD for LOAD) which is far more meaningful to us.

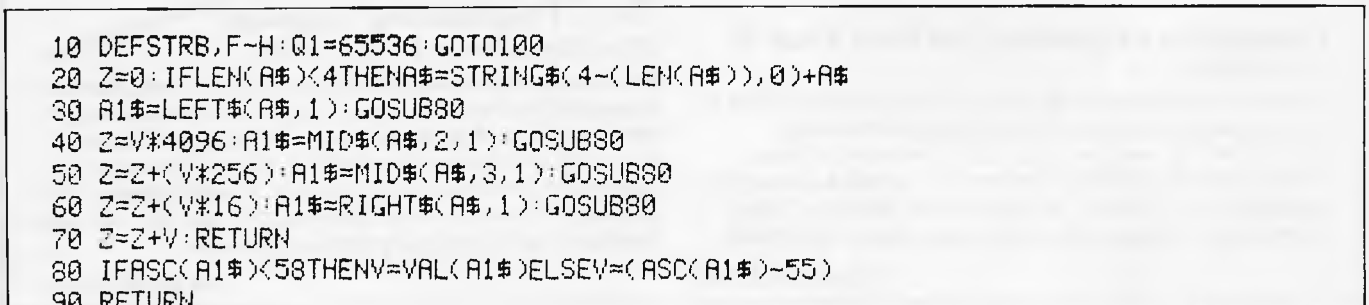
To convert the assembler language instructions to machine code we would use an assembler program. If however we have machine code instructions available such as in the ROM of the computer, we can convert these to assembler language instructions by using a disassembler program and discover what the code does.

The assembler language of the Z80 processor consists of a set of instructions that can be split into three parts: the mnemonic; the first field operation code or 'opcode'; and the second field 'operand'.

In the above example LD is the mnemonic, C is the first field and 24H is the second field or OE is the opcode indicating to the Z80 a value has to be loaded into the C register, and 24H is the operand the value to be loaded. Some instructions only have the mnemonic, for instance RLA (Rotate Left Accumulator), and some only have the mnemonic and the first field, for instance INC H (increment the H register). The missing fields can be thought of as being empty. The disassembler works by forming these three fields and putting them together. The number of bytes of machine code needed to completely form the instruction varies for different instructions as for another example, LD A, (4000H), (Load the A register with the contents of memory location 4000H). The brackets around the Hex value 4000H, mean 'the contents of'. LD is the mnemonic, A is the first field, and (4000H) is the second field. The machine code bytes for this instruction are 3A, 00,40. 3A is the opcode, and 4000H is the operand. The least significant and most significant bytes of an address or 16 bit value are stored in memory in the order of least significant followed by most significant. With a bit more perseverence, the average person can quite easily learn the deep dark secrets of Z80 machine code. Happy disassembling!

Using the program

Utilizing this program is very straight forward. When RUN, the program will simply ask for a start and end address. These should be input as a one to four digit Hex address. On entering the end address the program will display each address in decimal and hex, followed by the hex and ASCII contents of that address, and then the opcode and operand. The byte or bytes of the operand if present will be displayed on the next line or lines with their decimal address. At the end of each displayed page you will be prompted for 'Spacebar' to continue, or 'Newline or Enter' to start a fresh disassembly.



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10 DEFSTRB,F-H:Q1=65536:GOTO100
20 Z=0:IFLEN(A$)<4THENA$=STRING$(4-(LEN(A$)),0)+A$
30 A1$=LEFT$(A$,1):GOSUB80
40 Z=V*4096:A1$=MID$(A$,2,1):GOSUB80
50 Z=Z+(V*256):A1$=MID$(A$,3,1):GOSUB80
60 Z=Z+(V*16):A1$=RIGHT$(A$,1):GOSUB80
70 Z=Z+V:RETURN
80 IFASC(A1$)<58THENV=VAL(A1$)ELSEV=(ASC(A1$)-55)
90 RETURN
100 CLS:PRINT"* * *  Z80 DISASSEMBLER  * * *":PRINT:INPUT"Start Address (SSSS)";
A$:GOSUB20
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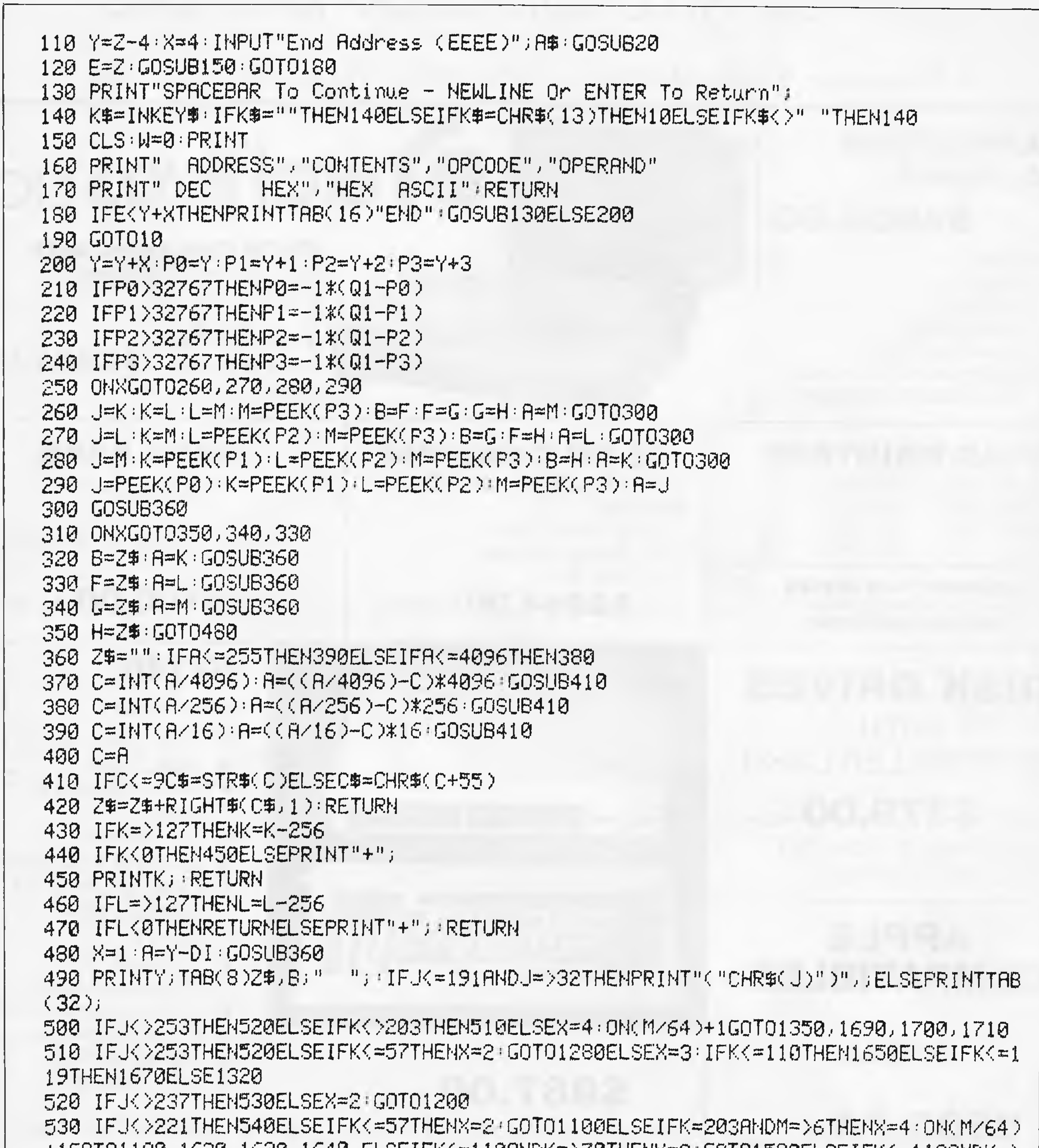

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110 Y=Z-4:X=4:INPUT"End Address (EEEE)";A$:GOSUB20
120 E=Z:GOSUB150:GOTO180
130 PRINT"SPACEBAR To Continue - NEWLINE Or ENTER To Return";
140 K$=INKEY$:IFK$=""THEN140ELSEIFK$=CHR$(13)THEN10ELSEIFK$<>" "THEN140
150 CLS:W=0:PRINT
160 PRINT"  ADDRESS","CONTENTS","OPCODE","OPERAND"
170 PRINT" DEC    HEX","HEX  ASCII":RETURN
180 IFE<Y+XTHENPRINTTAB(16)"END":GOSUB130ELSE200
190 GOTO10
200 Y=Y+X:P0=Y:P1=Y+1:P2=Y+2:P3=Y+3
210 IFP0>32767THENP0=-1*(Q1-P0)
220 IFP1>32767THENP1=-1*(Q1-P1)
230 IFP2>32767THENP2=-1*(Q1-P2)
240 IFP3>32767THENP3=-1*(Q1-P3)
250 ONXGOTO260,270,280,290
260 J=K:K=L:L=M:M=PEEK(P3):B=F:F=G:G=H:A=M:GOTO300
270 J=L:K=M:L=PEEK(P2):M=PEEK(P3):B=G:F=H:A=L:GOTO300
280 J=M:K=PEEK(P1):L=PEEK(P2):M=PEEK(P3):B=H:A=K:GOTO300
290 J=PEEK(P0):K=PEEK(P1):L=PEEK(P2):M=PEEK(P3):A=J
300 GOSUB360
310 ONXGOTO350,340,330
320 B=Z$:A=K:GOSUB360
330 F=Z$:A=L:GOSUB360
340 G=Z$:A=M:GOSUB360
350 H=Z$:GOTO480
360 Z$="":IFA<=255THEN390ELSEIFA<=4096THEN380
370 C=INT(A/4096):A=((A/4096)-C)*4096:GOSUB410
380 C=INT(A/256):A=((A/256)-C)*256:GOSUB410
390 C=INT(A/16):A=((A/16)-C)*16:GOSUB410
400 C=A
410 IFC<=9C$=STR$(C)ELSEC$=CHR$(C+55)
420 Z$=Z$+RIGHT$(C$,1):RETURN
430 IFK=>127THENK=K-256
440 IFK<0THEN450ELSEPRINT"+";
450 PRINTK;:RETURN
460 IFL=>127THENL=L-256
470 IFL<0THENRETURNELSEPRINT"+";:RETURN
480 X=1:A=Y-DI:GOSUB360
490 PRINTY;TAB(8)Z$,B;"  ";:IFJ<=191ANDJ=>32THENPRINT"("CHR$(J)")",;ELSEPRINTTAB
(32);
500 IFJ<>253THEN520ELSEIFK<>203THEN510ELSEX=4:ON(M/64)+1GOTO1350,1690,1700,1710
510 IFJ<>253THEN520ELSEIFK<=57THENX=2:GOTO1280ELSEX=3:IFK<=110THEN1650ELSEIFK<=1
19THEN1670ELSE1320
520 IFJ<>237THEN530ELSEX=2:GOTO1200
530 IFJ<>221THEN540ELSEIFK<=57THENX=2:GOTO1100ELSEIFK=203ANDM=>6THENX=4:ON(M/64)
+1GOTO1180,1620,1630,1640,ELSEIFK<=110ANDK=>70THENX=3:GOTO1580ELSEIFK<=119ANDK=>
112THENX=3:GOTO1600ELSEIFK<=249ANDK=>126THENX=3:GOTO1140
540 IFJ<>203THEN550ELSEX=2:IFK<=63THENON((K/8)+1)GOTO1480,1490,1500,1510,1520,15
30,1720,1540ELSEON((K-63.9)/64)+1GOTO1550,1560,1570
550 IFJ<=63THEN840ELSEIFJ<=127THEN1370ELSEIFJ=>192THEN990ELSEON((J-120)/8)GOTO14
00,1410,1420,1430,1440,1450,1460,1470
560 GOTO1720
570 ONNGOTO590,600,610,620,630,640,650,660
580 ONNGOTO670,680,690,700,710,720,730,740
590 PRINT"B,";:RETURN
600 PRINT"C,";:RETURN
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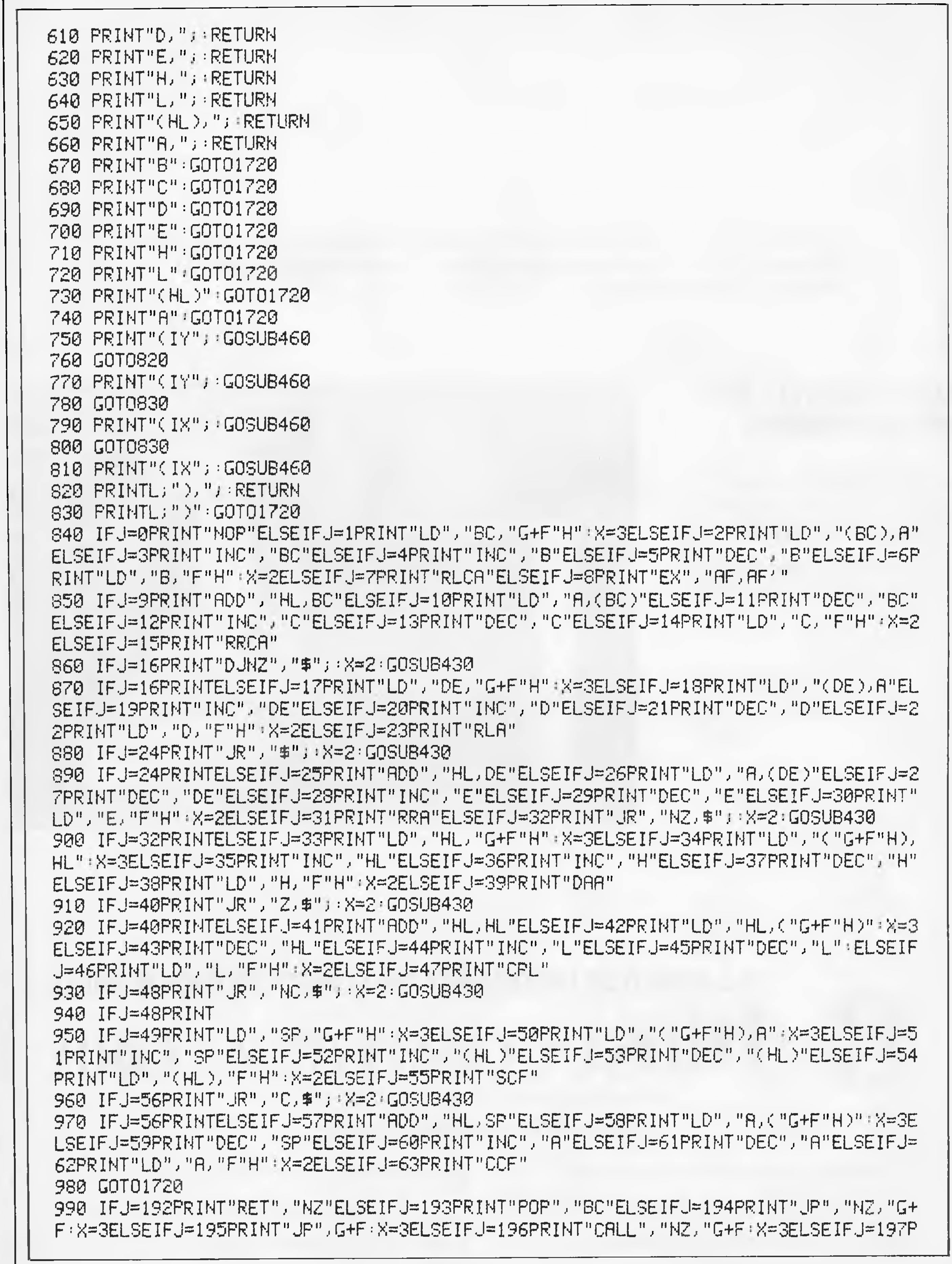

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610 PRINT"D,";:RETURN
620 PRINT"E,";:RETURN
630 PRINT"H,";:RETURN
640 PRINT"L,";:RETURN
650 PRINT"(HL),";:RETURN
660 PRINT"A,";:RETURN
670 PRINT"B":GOTO1720
680 PRINT"C":GOTO1720
690 PRINT"D":GOTO1720
700 PRINT"E":GOTO1720
710 PRINT"H":GOTO1720
720 PRINT"L":GOTO1720
730 PRINT"(HL)":GOTO1720
740 PRINT"A":GOTO1720
750 PRINT"(IY";:GOSUB460
760 GOTO820
770 PRINT"(IY";:GOSUB460
780 GOTO830
790 PRINT"(IX";:GOSUB460
800 GOTO830
810 PRINT"(IX";:GOSUB460
820 PRINTL;"),";:RETURN
830 PRINTL;")":GOTO1720
840 IFJ=0PRINT"NOP"ELSEIFJ=1PRINT"LD","BC,"G+F"H":X=3ELSEIFJ=2PRINT"LD","(BC),A"
ELSEIFJ=3PRINT"INC","BC"ELSEIFJ=4PRINT"INC","B"ELSEIFJ=5PRINT"DEC","B"ELSEIFJ=6P
RINT"LD","B,"F"H":X=2ELSEIFJ=7PRINT"RLCA"ELSEIFJ=8PRINT"EX","AF,AF'"
850 IFJ=9PRINT"ADD","HL,BC"ELSEIFJ=10PRINT"LD","A,(BC)"ELSEIFJ=11PRINT"DEC","BC"
ELSEIFJ=12PRINT"INC","C"ELSEIFJ=13PRINT"DEC","C"ELSEIFJ=14PRINT"LD","C,"F"H":X=2
ELSEIFJ=15PRINT"RRCA"
860 IFJ=16PRINT"DJNZ","$";:X=2:GOSUB430
870 IFJ=16PRINTELSEIFJ=17PRINT"LD","DE,"G+F"H":X=3ELSEIFJ=18PRINT"LD","(DE),A"EL
SEIFJ=19PRINT"INC","DE"ELSEIFJ=20PRINT"INC","D"ELSEIFJ=21PRINT"DEC","D"ELSEIFJ=2
2PRINT"LD","D,"F"H":X=2ELSEIFJ=23PRINT"RLA"
880 IFJ=24PRINT"JR","$";:X=2:GOSUB430
890 IFJ=24PRINTELSEIFJ=25PRINT"ADD","HL,DE"ELSEIFJ=26PRINT"LD","A,(DE)"ELSEIFJ=2
7PRINT"DEC","DE"ELSEIFJ=28PRINT"INC","E"ELSEIFJ=29PRINT"DEC","E"ELSEIFJ=30PRINT"
LD","E,"F"H":X=2ELSEIFJ=31PRINT"RRA"ELSEIFJ=32PRINT"JR","NZ,$";:X=2:GOSUB430
900 IFJ=32PRINTELSEIFJ=33PRINT"LD","HL,"G+F"H":X=3ELSEIFJ=34PRINT"LD","("G+F"H),
HL":X=3ELSEIFJ=35PRINT"INC","HL"ELSEIFJ=36PRINT"INC","H"ELSEIFJ=37PRINT"DEC","H"
ELSEIFJ=38PRINT"LD","H,"F"H":X=2ELSEIFJ=39PRINT"DAA"
910 IFJ=40PRINT"JR","Z,$";:X=2:GOSUB430
920 IFJ=40PRINTELSEIFJ=41PRINT"ADD","HL,HL"ELSEIFJ=42PRINT"LD","HL,("G+F"H)":X=3
ELSEIFJ=43PRINT"DEC","HL"ELSEIFJ=44PRINT"INC","L"ELSEIFJ=45PRINT"DEC","L":ELSEIF
J=46PRINT"LD","L,"F"H":X=2ELSEIFJ=47PRINT"CPL"
930 IFJ=48PRINT"JR","NC,$";:X=2:GOSUB430
940 IFJ=48PRINT
950 IFJ=49PRINT"LD","SP,"G+F"H":X=3ELSEIFJ=50PRINT"LD","("G+F"H),A":X=3ELSEIFJ=5
1PRINT"INC","SP"ELSEIFJ=52PRINT"INC","(HL)"ELSEIFJ=53PRINT"DEC","(HL)"ELSEIFJ=54
PRINT"LD","(HL),"F"H":X=2ELSEIFJ=55PRINT"SCF"
960 IFJ=56PRINT"JR","C,$";:X=2:GOSUB430
970 IFJ=56PRINTELSEIFJ=57PRINT"ADD","HL,SP"ELSEIFJ=58PRINT"LD","A,("G+F"H)":X=3E
LSEIFJ=59PRINT"DEC","SP"ELSEIFJ=60PRINT"INC","A"ELSEIFJ=61PRINT"DEC","A"ELSEIFJ=
62PRINT"LD","A,"F"H":X=2ELSEIFJ=63PRINT"CCF"
980 GOTO1720
990 IFJ=192PRINT"RET","NZ"ELSEIFJ=193PRINT"POP","BC"ELSEIFJ=194PRINT"JP","NZ,"G+
F:X=3ELSEIFJ=195PRINT"JP",G+F:X=3ELSEIFJ=196PRINT"CALL","NZ,"G+F:X=3ELSEIFJ=197P
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RINT"PUSH","BC"ELSEIFJ=198PRINT"ADD","A,"F"H":X=2
1000 IFJ=199PRINT"RST","0H"ELSEIFJ=200PRINT"RET","Z"ELSEIFJ=201PRINT"RET"ELSEIFJ
=202PRINT"JP","Z,"G+F:X=3ELSEIFJ=204PRINT"CALL","Z,"G+F:X=3ELSEIFJ=205PRINT"CALL
",G+F:X=3ELSEIFJ=206PRINT"ADC","A,"F"H":X=2ELSEIFJ=207PRINT"RST","8H"
1010 IFJ=208PRINT"RET","NC"
1020 IFJ=209PRINT"POP","DE"ELSEIFJ=210PRINT"JP","NC,"G+F:X=3ELSEIFJ=211PRINT"OUT
","("F"H,A":X=2ELSEIFJ=212PRINT"CALL","NC,"G+F:X=3ELSEIFJ=213PRINT"PUSH","DE"ELSE
IFJ=214PRINT"SUB",""F"H":X=2ELSEIFJ=215PRINT"RST","10H"ELSEIFJ=216PRINT"RET","C"
1030 IFJ=217PRINT"EXX"ELSEIFJ=218PRINT"JP","C,"G+F:X=3ELSEIFJ=219PRINT"IN","A,("F
"H":X=2ELSEIFJ=220PRINT"CALL","C,"G+F:X=3ELSEIFJ=222PRINT"SBC","A,"F"H":X=2ELSEI
FJ=223PRINT"RST","18H"ELSEIFJ=224PRINT"RET","PO"ELSEIFJ=225PRINT"POP","HL"
1040 IFJ=226PRINT"JP","PO,"G+F:X=3
1050 IFJ=227PRINT"EX","(SP),HL"ELSEIFJ=228PRINT"CALL","PO,"G+F:X=3ELSEIFJ=229PRI
NT"PUSH","HL"ELSEIFJ=230PRINT"AND",""F"H":X=2ELSEIFJ=231PRINT"RST","20H"ELSEIFJ=
232PRINT"RET","PE"ELSEIFJ=233PRINT"JP","(HL)"ELSEIFJ=234PRINT"JP","PE,"G+F:X=3
1060 IFJ=235PRINT"EX","DE,HL"ELSEIFJ=236PRINT"CALL","PE,"G+F:X=3ELSEIFJ=238PRINT
"XOR",""F"H":X=2ELSEIFJ=239PRINT"RST","28H"ELSEIFJ=240PRINT"RET","P"ELSEIFJ=241P
RINT"POP","AF"ELSEIFJ=242PRINT"JP","P,"G+F:X=3ELSEIFJ=243PRINT"DI"
1070 IFJ=244PRINT"CALL","P,"G+F:X=3ELSEIFJ=245PRINT"PUSH","AF"ELSEIFJ=246PRINT"O
R",""F"H":X=2ELSEIFJ=247PRINT"RST","30H"ELSEIFJ=248PRINT"RET","M"ELSEIFJ=249PRIN
T"LD","SP,HL"ELSEIFJ=250PRINT"JP","M,"G+F:X=3ELSEIFJ=251PRINT"EI"
1080 IFJ=252PRINT"CALL","M,"G+F:X=3ELSEIFJ=254PRINT"CP",""F"H":X=2ELSEIFJ=255PRI
NT"RST","38H"
1090 GOTO1720
1100 X=2:IFK=9PRINT"ADD","IX,BC"ELSEIFK=25PRINT"ADD","IX,DE"ELSEIFK=33PRINT"LD",
"IX,"H+G"H":X=4ELSEIFK=34PRINT"LD","("H+G"H),IX":X=4ELSEIFK=35PRINT"INC","IX"ELS
EIFK=41PRINT"ADD","IX,IX"ELSEIFK=42PRINT"LD","IX,("H+G"H)":X=4

1110 IFK=43PRINT"DEC","IX"ELSEIFK=52PRINT"INC",;:X=3:GOTO790ELSEIFK=53PRINT"DEC"
,;:X=3:GOTO790ELSEIFK=54PRINT"LD",;:X=4:GOSUB810
1120 IFK=54PRINT""H"H"ELSEIFK=57PRINT"ADD","IX,SP"
1130 GOTO1720
1140 IFK=126PRINT"LD","A,";ELSEIFK=134PRINT"ADD","A,";ELSEIFK=142PRINT"ADC","A,"
;ELSEIFK=150PRINT"SUB",;ELSEIFK=158PRINT"SBC","A,";ELSEIFK=166PRINT"AND",;ELSEIF
K=174PRINT"XOR",;ELSEIFK=182PRINT"OR",;ELSEIFK=190PRINT"CP",;
1150 IFK<=190GOTO790
1160 X=2:IFK=225PRINT"POP","IX"ELSEIFK=227PRINT"EX","(SP),IX"ELSEIFK=229PRINT"PU
SH","IX"ELSEIFK=233PRINT"JP","(IX)"ELSEIFK=249PRINT"LD","SP,IX"
1170 GOTO1720
1180 IFM=6PRINT"RLC",;ELSEIFM=14PRINT"RRC",;ELSEIFM=22PRINT"RL",;ELSEIFM=30PRINT
"RR",;ELSEIFM=38PRINT"SLA",;ELSEIFM=46PRINT"SRA",;ELSEIFM=62PRINT"SRL",;
1190 GOTO790
1200 IFK=64PRINT"IN","B,(C)"ELSEIFK=65PRINT"OUT","(C),B"ELSEIFK=66PRINT"SBC","HL
,BC"ELSEIFK=67PRINT"LD","("H+G"H),BC":X=4ELSEIFK=68PRINT"NEG"ELSEIFK=69PRINT"RET
N"ELSEIFK=70PRINT"IM","0"ELSEIFK=71PRINT"LD","I,A"ELSEIFK=72PRINT"IN","C,(C)"
1210 IFK=73PRINT"OUT","(C),C"ELSEIFK=74PRINT"ADC","HL,BC"ELSEIFK=75PRINT"LD","BC
,("H+G"H)":X=4ELSEIFK=77PRINT"RETI"ELSEIFK=80PRINT"IN","D,(C)"ELSEIFK=81PRINT"OU
T","(C),D"ELSEIFK=82PRINT"SBC","HL,DE"ELSEIFK=83PRINT"LD","("H+G"H),DE":X=4
1220 IFK=86PRINT"I+","1"ELSEIFK=87PRINT"LD","A,I"ELSEIFK=88PRINT"IN","E,(C)"ELSE
IFK=89PRINT"OUT","(C),E"ELSEIFK=90PRINT"ADC","HL,DE"ELSEIFK=91PRINT"LD","DE,("H+
G"H)":X=4ELSEIFK=94PRINT"IM","2"ELSEIFK=96PRINT"IN","H,(C)"
1230 IFK=97PRINT"OUT","(C),H"ELSEIFK=98PRINT"SBC","HL,HL"ELSEIFK=103PRINT"RRD"EL
SEIFK=104PRINT"IN","L,(C)"ELSEIFK=105PRINT"OUT","(C),L"ELSEIFK=106PRINT"ADC","HL
,HL"ELSEIFK=111PRINT"RLD"ELSEIFK=114PRINT"SBC","HL,SP"
1240 IFK=115PRINT"LD","("H+G"H),SP":X=4ELSEIFK=120PRINT"IN","A,(C)"ELSEIFK=121PR
INT"OUT","(C),A"ELSEIFK=122PRINT"ADC","HL,SP"ELSEIFK=123PRINT"LD","SP,("H+G"H":X=
4ELSEIFK=160PRINT"LDI"ELSEIFK=161PRINT"CPI"ELSEIFK=162PRINT"INI"
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1250 IFK=163PRINT"OUTI"ELSEIFK=168PRINT"LDD"ELSEIFK=169PRINT"CPD"ELSEIFK=170PRIN
T"IND"
1260 IFK=171PRINT"OUTD"ELSEIFK=176PRINT"LDIR"ELSEIFK=177PRINT"CPIR"ELSEIFK=178PR
INT"INIR"ELSEIFK=179PRINT"OTIR"ELSEIFK=184PRINT"LDDR"ELSEIFK=185PRINT"CPDR"ELSEI
FK=186PRINT"INDR"ELSEIFK=187PRINT"OTDR"
1270 GOTO1720
1280 IFK=9PRINT"ADD","IY,BC"ELSEIFK=25PRINT"ADD","IY,DE"ELSEIFK=33PRINT"LD","IY,
"H+G"H":X=4ELSEIFK=34PRINT"LD","("H+G"H),IY":X=4ELSEIFK=35PRINT"INC","IY"ELSEIFK
=41PRINT"ADD","IY,IY"ELSEIFK=42PRINT"LD","IY,("H+G"H)":X=4
1290 IFK=43PRINT"DEC","IY"ELSEIFK=52PRINT"INC",;:X=3:GOTO770ELSEIFK=53PRINT"DEC"
,;:X=3:GOTO770ELSEIFK=54PRINT"LD",;:GOSUB750
1300 IFK=54PRINT""H"H":X=4ELSEIFK=57PRINT"ADD","IY,SP"
1310 GOTO1720
1320 IFK=126PRINT"LD","A,";ELSEIFK=134PRINT"ADD","A,";ELSEIFK=142PRINT"ADC","A,"
;ELSEIFK=150PRINT"SUB",;ELSEIFK=158PRINT"SBC","A,";ELSEIFK=166PRINT"AND",;ELSEIF
K=174PRINT"XOR",;ELSEIFK=182PRINT"OR",;ELSEIFK=190PRINT"CP",;
1330 IFK<=190THEN770ELSEX=2:IFK=225PRINT"POP","IY"ELSEIFK=227PRINT"EX","(SP),IY"
ELSEIFK=229PRINT"PUSH","IY"ELSEIFK=233PRINT"JP","(IY)"ELSEIFK=249PRINT"LD","SP,I
Y"
1340 GOTO1720
1350 IFM=6PRINT"RLC",;ELSEIFM=14PRINT"RRC",;ELSEIFM=22PRINT"RL",;ELSEIFM=30PRINT
"RR",;ELSEIFM=38PRINT"SLA",;ELSEIFM=46PRINT"SRA",;ELSEIFM=62PRINT"SRL",;
1360 GOTO770
1370 X=1:IFJ=118PRINT"HALT":GOTO1720ELSEPRINT"LD",;:N=(J-56)/8:GOSUB570
1380 N=(J-((INT(N)*8)+56))+1:GOTO580
1390 GOTO1720
1400 PRINT"ADD","A,";:N=J-127:GOTO580
1410 PRINT"ADC","A,";:N=J-135:GOTO580
1420 PRINT"SUB",;:N=J-143:GOTO580
1430 PRINT"SBC","A,";:N=J-151:GOTO580
1440 PRINT"AND",;:N=J-159:GOTO580
1450 PRINT"XOR",;:N=J-167:GOTO580
1460 PRINT"OR",;:N=J-175:GOTO580
1470 PRINT"CP",;:N=J-183:GOTO580
1480 PRINT"RLC",;:N=K+1:GOTO580
1490 PRINT"RRC",;:N=K-7:GOTO580
1500 PRINT"RL",;:N=K-15:GOTO580
1510 PRINT"RR",;:N=K-23:GOTO580
1520 PRINT"SLA",;:N=K-31:GOTO580
1530 PRINT"SRA",;:N=K-39:GOTO580
1540 PRINT"SRL",;:N=K-55:GOTO580
1550 PRINT"BIT",;INT((K-64)/8);",";:N=(K-((INT((K-56)/8)*8)+56))+1:GOTO580
1560 PRINT"RES",;INT((K-128)/8);",";:N=(K-((INT((K-120)/8)*8)+120))+1:GOTO580
1570 PRINT"SET",;INT((K-192)/8);",";:N=(K-((INT((K-184)/8)*8)+184))+1:GOTO580
1580 PRINT"LD",;:N=((K-69.9)/8)+1:GOSUB570
1590 GOTO790
1600 PRINT"LD",;:GOSUB810
1610 N=K-111:GOTO580
1620 PRINT"BIT",;(M-70)/8;",";:GOTO790
1630 PRINT"RES",;(M-134)/8;",";:GOTO790
1640 PRINT"SET",;(M-198)/8;",";:GOTO790
1650 PRINT"LD",;:N=((K-69)/8)+1:GOSUB570
1660 GOTO770
1670 PRINT"LD",;:GOSUB750
1680 N=K-111:GOTO580
1690 PRINT"BIT",;(M-70)/8;",";:GOTO770
1700 PRINT"RES",;(M-134)/8;",";:GOTO770
1710 PRINT"SET",;(M-198)/8;",";:GOTO770
1720 IFPOS(0)>0PRINTTAB(32)"NOT FOUND":X=1
1730 W=W+1:IFW=12GOSUB130
1740 IFX=>2THENW=W+1:PRINTY+1,F"  ";:IFK<=191ANDK=>32PRINT"("CHR$(K)")"ELSEPRINT
1750 IFW=>12GOSUB130
1760 IFX=>3THENW=W+1:PRINTY+2,G"  ";:IFL<=191ANDL=>32PRINT"("CHR$(L)")"ELSEPRINT
1770 IFW=>12GOSUB130
1780 IFX=>4THENW=W+1:PRINTY+3,H"  ";:IFM<=191ANDM=>32PRINT"("CHR$(M)")"ELSEPRINT
1790 IFW=12GOSUB130
1800 GOTO180
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