7 Chapter 7 The APL Program “BOOL”

This chapter consists of the listings of the APL functions which comprise the program BOOL.

This concludes the APL program Listings for the set of computer-assisted design programs developed by Dr. Svoboda.

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     ∇ BULL
[1]    'NUMBER OF CONSTANTS IS:'
[2]    NX←⍞
[3]    'SYMBOLS FOR CONSTANTS: ';ABCD[⍳NX]
[4]    'NUMBER OF UNKNOWNS IS:'
[5]    NY←⍞
[6]    'SYMBOLS FOR UNKNOWNS: ';ABCD[NX+⍳NY]
[7]    DUO←NX,NY
[8]    XXX←2*NX
[9]    YYY←2*NY
[10]   NN←2*N←NX+NY
[11]   TRFT←N⍴3
[12]   DSCR←(YYY,XXX)⍴1
[13]   'CALL FORMULA.'
     ∇
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     ∇ COMB;BMB;P;U
[1]    BMB←AMB←2*(¯1+(⍳N))
[2]    P←1
[3]   H1:CMB←⍳0
[4]    U←P
[5]   H2:CMB←CMB,((2*U)+(((2*U)>BMB)/BMB))
[6]    →(N>U←U+1)/H2
[7]    AMB←AMB,CMB
[8]    BMB←CMB
[9]    →(N>P←P+1)/H1
[10]   AMB←0,AMB
     ∇
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     ∇ COMMENTS
[1]    'ENTER THE PROGRAM BY CALLING  BULL'
[2]    'NOT MORE THAN  12  VARIABLES'
[3]    'NEGATION BY UNDERLINING: A̲ , B̲ ,...'
[4]    '= STANDS FOR EQUALITY, → STANDS FOR IMPLICATION'
[5]    'VALUES:  0, 1  ARE PERMITTED ON THE RIGHT'
[6]    'SIDE OF THE FORMULA ONLY.'
[7]    'EXAMPLE OF AN EQUATION:  C̲DA̲+BA̲=B̲A+AC̲'
[8]    'THE SAME WITH SPACING: C̲ D A̲ + BA̲ =... '
[9]    'EXAMPLE OF AN IMPLICATION: AB̲C+D̲→AD̲+C̲B'
[10]   'SOLUTION VECTOR = SET OF SOLUTION NUMBERS'
[11]   '⍳SOL  WILL PRODUCE ALL SOLUTIONS'
[12]   'INTERPRETATION OF THE SOLUTION PRINTOUT:'
[13]   'EXAMPLE:  D = [1 4 5] ∪ (3 7)'
[14]   'MEANS: D  MUST BE TRUE FOR MINTERMS  1,4,5'
[15]   '       D  IS UNSPECIFIED FOR  3,7'
[16]   'CALL BULL' ⍎CONST
     ∇
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     ∇ CONST
[1]    ABCD←'ABCDEFGHJKLMABCDEFGHJKLM01→+ '
[2]    FABC←(3*(¯1+⍳12)),(2×3*(¯1+⍳12)),5⍴0
     ∇



     ∇ DISCRIMINANT
[1]    'THE DISCRIMINANT VALUE BEFORE CONSTRAINTS IS:  ';
       DSCR
[2]    'AFTER ::EXECUTE:: HAS BEEN CALLED, CALL MTY TO GET
       THE CONSTRAINT RECTIFIED DISCRIMINANT.'
[3]    'CALL EXECUTE AFTER ALL CONDITIONS HAVE BEEN PUT IN.'
[4]    'IF NOT, CALL FORMULA AGAIN.'
[5]    →0
     ∇



     ∇ EXECUTE;MTX;FIX;SET;COL;MMR;VEC;LIM;T;V;RES;MES;
       MAX;LIN;N;BMB;SEQ;SIG
[1]    MTX←⍉(XXX,YYY)⍴⍳YYY
[2]    SET←+⌿DSCR
[3]    DON←(YYY=SET)/¯1+⍳XXX
[4]    NIC←(0=SET)/¯1+⍳XXX
[5]    →(0=⍴DON)/S5
[6]    'EACH SOLUTION HAS THE FOLLOWING DONT CARES:  ';
       DON
[7]   S5:→(0=⍴NIC)/S6
[8]    'THE NUMBER OF SOLUTIONS IS ZERO, UNLESS
       THE FOLLOWING INPUT IDENTIFIERS ARE FORBIDDEN:  ';
       NIC
[9]   S6:MTY←(YYY,XXX)⍴((SET≠YYY)∧(SET≠0))
[10]   MTY←MTY×DSCR
[11]   MTY[1;]←(SET=0)∨(SET=YYY)∨MTY[1;]
[12]   MAX←⌈/SET←+⌿MTY
[13]   SOL←×/SET
[14]   MTX←MTX×MTY
[15]   'NUMBER OF SOLUTIONS UNDER ALL CONSTRAINTS:  SOL =  ';
       SOL
[16]   →(SOL=0)/0
[17]   'SOLUTION VECTOR OR TYPE  0  FOR CIRCUIT DESIGN.'
[18]   VEC←,□
[19]   →(0∈VEC)/L1
[20]  L3:LIM←⍴VEC
[21]   →L9
[22]  L1:→(SOL≥LIM←2×1+NY)/L2
[23]   VEC←⍳SOL
[24]   →L3
[25]  L2:VEC←(⍳(1+NY)),1+SOL-⍳(1+NY)
[26]  L9:MES←(MAX,XXX)⍴0
[27]   V←1
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[28]   N←NY
[29]   COMB
[30]  L4:COL←(MTX[;V]>0)/MTX[;V]
[31]   BMB←1+AMB
[32]   SIG←ρSEQ←BMB⍳COL
[33]   SEQ←BMB[SEQ[⍋SEQ]]
[34]   LIN←MAXρ0
[35]   LIN[⍳SIG]←SEQ
[36]   MES[;V]←LIN
[37]   →(XXX≥V←V+1)/L4
[38]   T←1
[39]  L5:FIX←1+SET⊤(VEC[T]-1)
[40]   RES←⍳0
[41]   V←1
[42]  L6:COL←MES[;V]
[43]   RES←RES,COL[FIX[V]]
[44]   →(XXX≥V←V+1)/L6
[45]   MMR←(NY,XXX)ρ0
[46]   RES←RES-1
[47]   V←1
[48]  L7:MMR[;V]←V×(NYρ2)⊤RES[V]
[49]   →(XXX≥V←V+1)/L7
[50]   MMR←⊖MMR
[51]   'SOLUTION NUMBER: ';VEC[T]
[52]   V←1
[53]  L8:ABCD[NX+V];' = [';¯1+((0<MMR[V;])/MMR[V;]);
       '] ∪ (';DON,NIC;')'
[54]   →(NY≥V←V+1)/L8
[55]   →(LIM≥T←T+1)/L5
     ∇
```

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     ∇ FORMULA;FCT;RES;SETL;SETR;LEF;RIG;PUL;FORM;ALL
[1]    'WRITE DOWN THE FORMULA:'
[2]    ALL←ρFORM←⍞
[3]    PUL←⌊/(FORM⍳'='),(FORM⍳'→')
[4]    →(0=ρLEF←FORM[⍳(PUL-1)])/0
[5]    →(0=ρRIG←FORM[PUL+⍳(ALL-PUL)])/0
[6]    SETL←REFORM LEF
[7]    SETR←REFORM RIG
[8]    →('→'∈FORM)/F1
[9]    RES←((¯1+⍳NN)∈SETL)=((¯1+⍳NN)∈SETR)
[10]   →F2
[11]  F1:RES←((¯1+⍳NN)∈SETL)≤((¯1+⍳NN)∈SETR)
[12]  F2:FCT←(YYY,XXX)ρRES
[13]   DSCR←DSCR×FCT
[14]   'MAY CALL EITHER (NEXT) FORMULA OR DISCRIMINANT
       OR EXECUTE.'
[15]   →0
     ∇
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     ∇ REF←REFORM FRM;PUT;ORG;U;TRI;TRFD;TRM;MEZ;RES;S
[1]    REF←⍳0
[2]    →('0'∈FRM)/0
[3]    →('1'∈FRM)/R2
[4]    PUT←(FRM='+')/⍳⍴FRM
[5]    ORG←0,PUT,⍴FRM
[6]    U← 1 2
[7]   R1:TRI←+/FABC[ABCD⍳(FRM[ORG[U[1]]+⍳(ORG[U[2]]-
       ORG[U[1]])])]
[8]    TRM←TRFT⊤TRI
[9]    TRFD←1+(TRM=0)
[10]   MEZ←2*+/TRM=0
[11]   S←0
[12]  R4:RES←2|TRM+TRFD⊤S
[13]   REF←REF,2⊥RES
[14]   →(MEZ>S←S+1)/R4
[15]   →((⍴ORG)≥⌈/U←U+1)/R1
[16]   →0
[17]  R2:REF←¯1+⍳NN
     ∇
```