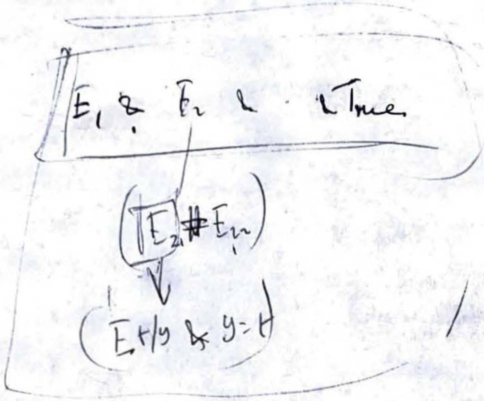
```
  AAAAAA    BBBBBBBB    EEEEEEEEEE
  AAAAAA    BBBBBBBB    EEEEEEEEEE
AA      AA  BB      BB  EE
AA      AA  BB      BB  EE
AA      AA  BB      BB  EE
AA      AA  BB      BB  EE
AA      AA  BBBBBBBB    EEEEEEEE
AA      AA  BBBBBBBB    EEEEEEEE
AAAAAAAAAA  BB      BB  EE
AAAAAAAAAA  BB      BB  EE
AA      AA  BB      BB  EE              ....
AA      AA  BB      BB  EE              ....
AA      AA  BBBBBBBB    EEEEEEEEEE      ....
AA      AA  BBBBBBBB    EEEEEEEEEE      ....


44    44      000000      000000                44    44      000000    5555555555
44    44      000000      000000                44    44      000000    5555555555
44    44    00      00  00      00              44    44    00      00  55
44    44    00      00  00      00              44    44    00      00  55
44    44    00    0000  00    0000              44    44    00    0000  555555
44    44    00    0000  00    0000              44    44    00    0000  555555
4444444444  00  00  00  00  00  00              4444444444  00  00  00        55
4444444444  00  00  00  00  00  00              4444444444  00  00  00        55
      44    0000    00  0000    00                    44    0000    00          55
      44    0000    00  0000    00                    44    0000    00          55
      44    00      00  00      00      ,,,,          44    00      00  55      55
      44    00      00  00      00      ,,,,          44    00      00  55      55
      44      000000      000000          ,,          44      000000      555555
      44      000000      000000          ,,          44      000000      555555


BBBB  U   U N   N DDDD  Y   Y        AAA
B   B U   U N   N D   D Y   Y       A   A
B   B U   U NN  N D   D  Y Y        A   A
BBBB  U   U N N N D   D   Y         A   A
B   B U   U N  NN D   D   Y         AAAAA
B   B U   U N   N D   D   Y         A   A
BBBB  UUUUU N   N DDDD    Y         A   A


LPTSPL VERSION 6(344)  RUNNING ON LPT500
 *START* USER BUNDY A [400,405] JOB  ABE SEQ. 3138 DATE 14-NOV-75 14:08:24 MONITOR NETMON 5.07B V3 (AUG 12 T *START*
REQUEST CREATED: 14-NOV-75  14:09:26
FILE: DSKA0:ABE[400,405] CREATED: 14-NOV-75 14:07:00 <155>  PRINTED: 14-NOV-75 14:08:32
QUEUE SWITCHES:  /PRINT:ARROW /FILE:ASCII /COPIES:1 /SPACING:1 /LIMIT:45 /FORMS:NORMAL
FILE WILL BE RENAMED TO <055> PROTECTION
```

```
* PROLOG EQUATION SOLVING PROGRAM.
* BOB WELHAM                    1975.



*****************************************.
* SOLVE ONE EQUATION IN ONE UNKNOWN.
*****************************************.

* SYNTACTIC SUGAR FOR USER.

+SOLVE(*EQN,*U)-SOLVE11(*EQN,*U,*ANS).

+SOLVE11(*EQN,*U,*ANS)-SORTER(SOLVING-*EQN-FOR-*U)-LIGNE-LIGNE
    -SOL11(*EQN,*U,*ANS)-ANSWER(*U=*ANS).


* LOOK FOR SPECIAL CASES FIRST.
               *U=
+SOL11(*LHS=Ø,*U,*ANS)-LINEAR(*U,*LHS,*A,*B)-/
    -SIMPLIFY(%1.*B.(*A$%1),*ANS).
                *U=   *U=
+SOL11(*LHS=Ø,*U,*ANS1#*ANS2)-QUAD(*U,*LHS,*A,*B,*C)-/
    -TRACE(QUADRATIC-EQUATION-IN-*U)-TRACE(COEFFICIENTS-*A-*B-*C)
    -SIMPLIFY((*B$2+%1.4.*A.*C)$(2$%1),*SQRT)
    -SIMPLIFY((%1.*B+*SQRT).(2.*A)$%1,*ANS1)
    -SIMPLIFY((%1.*B+%1.*SQRT).(2.*A)$%1,*ANS2).


* THEN TRY BASIC METHOD OF ISOLATION, COLLECTION AND ATTRACTION.

+SOL11(*EQN,*U,*ANS)-ISOLATE(*U,*EQN,*ANS)-/.

+SOL11(*EQN,*U,*ANS)-COLLECT(*U,*EQN,*NEW)-SOL11(*NEW,*U,*ANS).

+SOL11(*EQN,*U,*ANS)-ATTRACT(*U,*EQN,*NEW)-SOL11(*NEW,*U,*ANS).





*****************************************.
* ISOLATION ROUTINES.
*****************************************.

+ISOLATE(*X,*EQN1#*EQN2,*ANS1#*ANS2)-/
    -ISOLATE(*X,*EQN1,*ANS1)-ISOLATE(*X,*EQN2,*ANS2).
                        *X=

+ISOLATE(*X,*X=*RHS,*ANS)-FREEOF(*RHS,*X)-/-SIMPLIFY(*RHS,*ANS).


+ISOLATE(*X,*LHS=*RHS,*ANS)
    -PERM2(*LHS,*RHS,*L,*R)-FREEOF(*R,*X)-SINGLEOCC(*L,*X)
    -TRACE(ISOLATION-ON-*LHS=*RHS-FOR-*X)
    -SETUP(*X,*L,*LM)-USEFUL(ISOLATION,*AXIOM)
    -APPLY(LTR,*AXIOM,*LM=*R,*NEW)
    -ISOLATE(*X,*NEW,*ANS).


+SETUP(*X,*U+*V,*P+*Q)-/-PERM2(*U,*V,*P,*Q)-SINGLEOCC(*P,*X).
+SETUP(*X,*U.*V,*P.*Q)-/-PERM2(*U,*V,*P,*Q)-SINGLEOCC(*P,*X).
+SETUP(*X,*E,*E)-SINGLEOCC(*E,*X).




*****************************************.
* COLLECTION ROUTINES.
*****************************************.

+COLLECT(*X,*OLD,*NEW)-OCC(*OLD,*X,*N)-INF(*N,2)-/-FAIL.

+COLLECT(*X,*OLD,*NEW)-TRACE(COLLECTING-*X-IN-*OLD)
    -OCC(*OLD,*X,*N)
    -USEFUL(COLLECTION,*AXIOM$*HOW)
    -APPLY(*HOW,*AXIOM,*OLD,*NEW)
    -OCC(*NEW,*X,*M)-INF(*M,*N)
    -TRACE(COLLECTION-SUCCESSFUL).


* TRY TO COLLECT WITHIN A SUB-TERM.

+COLLECT(*X,*OLD,*NEW)-UNIV(*OLD,*F.*A.NIL)
    -COLLECT(*X,*A,*B)-UNIV(*NEW,*F.*B.NIL).

+COLLECT(*X,*OLD,*NEW)-UNIV(*OLD,*OP.*ARG1.*ARG2.NIL)
    -COLLECT(*X,*ARG1,*ARG3)-UNIV(*NEW,*OP.*ARG3.*ARG2.NIL).

+COLLECT(*X,*OLD,*NEW)-UNIV(*OLD,*OP.*ARG1.*ARG2.NIL)
    -COLLECT(*X,*ARG2,*ARG3)-UNIV(*NEW,*OP.*ARG1.*ARG3.NIL).

+COLLECT(*X,*OLD,*NEW)-SHUFFLE(*OLD,*OLDS)-COLLECT(*X,*OLDS,*NEW).




*****************************************.
* ATTRACTION ROUTINES.
*****************************************.

+ATTRACT(*X,*OLD,*NEW)-OCC(*OLD,*X,*N)-INF(*N,2)-/-FAIL.

+ATTRACT(*X,*OLD,*NEW)-TRACE(ATTRACTING-*X-IN-*OLD)
```

```
     -USEFUL(ATTRACTION,*AXIOMS*HOW)
     -APPLY(*HOW,*AXIOM,*OLD,*NEW)
     -TRACE(ATTRACTION-SUCCESSFUL).


*TRY TO ATTRACT WITHIN SUB-TERM.

+ATTRACT(*X,*OLD,*NEW)-UNIV(*OLD,*F.*A.NIL)
     -ATTRACT(*X,*A,*B)-UNIV(*NEW,*F.*B.NIL).

+ATTRACT(*X,*OLD,*NEW)-UNIV(*OLD,*OP.*ARG1.*ARG2.NIL)
     -ATTRACT(*X,*ARG1,*ARG3)-UNIV(*NEW,*OP.*ARG3.*ARG2.NIL).

+ATTRACT(*X,*OLD,*NEW)-UNIV(*OLD,*OP.*ARG1.*ARG2.NIL)
     -ATTRACT(*X,*ARG2,*ARG3)-UNIV(*NEW,*OP.*ARG1.*ARG3.NIL).

+ATTRACT(*X,*OLD,*NEW)-SHUFFLE(*OLD,*OLDS)-ATTRACT(*X,*OLDS,*NEW).








****************************************.
* SIMPLIFICATION ROUTINES.
****************************************.

* QUICK KILLS.

+SIMPLIFY(*E,*E)-UNIV(*E,*CONSTANT.NIL)-/.
+SIMPLIFY(%1,%1)-/.
+SIMPLIFY(*E,*E) -WONTSIMP(*E) -/.



+SIMPLIFY(*E,*R)-TRACE(SIMPLIFYING-*E)-FAIL.

+SIMPLIFY(*E,*R)-USEFUL(SIMPLIFICATION,*AX)
     -APPLY(LTR,*AX,*E,*S)-/-SIMPLIFY(*S,*R).

+SIMPLIFY(*E,*R)-EVAL(*E,*R)-/-TRACE(*E-EVALUATED-TO-*R).

+SIMPLIFY(*E,*R)-UNIV(*E,*OP.*E1.*E2.NIL)
     -SIMPLIFY(*E1,*R1)-SIMPLIFY(*E2,*R2)-DIFF(*E1.*E2,*R1.*R2)-/
     -UNIV(*F,*OP.*R1.*R2.NIL)-SIMPLIFY(*F,*R).

+SIMPLIFY(*E,*R)-UNIV(*E,*F.*A.NIL)
     -SIMPLIFY(*A,*B)-DIFF(*A,*B)-/
     -UNIV(*D,*F.*B.NIL)-SIMPLIFY(*D,*R).

+SIMPLIFY(*E,*E)-AJOUT((+WONTSIMP(*E)).(-(/)).NIL).
```

```
****************************************.
* DESCRIPTION ROUTINES.
****************************************.

+LINEAR(*U,*E,Ø,*E)-FREEOF(*E,*U)-/.

+LINEAR(*U,*U,1,Ø)-/.

+LINEAR(*U,*E1+*E2,*A,*B)
     -LINEAR(*U,*E1,*A1,*B1)-LINEAR(*U,*E2,*A2,*B2)-/
     -SIMPLIFY(*A1+*A2,*A)-SIMPLIFY(*B1+*B2,*B).

+LINEAR(*U,*E1.*E2,*A,*B)-PERM2(*E1,*E2,*E3,*E4)
     -FREEOF(*E3,*U)-LINEAR(*U,*E4,*A4,*B4)
     -SIMPLIFY(*E3.*A4,*A)-SIMPLIFY(*E3.*B4,*B).



+QUAD(*U,*E,Ø,*B,*C)-LINEAR(*U,*E,*B,*C)-/.

+QUAD(*U,*U.*U,1,Ø,Ø)-/.

+QUAD(*U,*U$2,1,Ø,Ø)-/.

+QUAD(*U,*E1+*E2,*A,*B,*C)
     -QUAD(*U,*E1,*A1,*B1,*C1)-QUAD(*U,*E2,*A2,*B2,*C2)-/
     -SIMPLIFY(*A1+*A2,*A)
     -SIMPLIFY(*B1+*B2,*B)
     -SIMPLIFY(*C1+*C2,*C).

+QUAD(*U,*E1.*E2,*A,*B,*C)
     -PERM2(*E1,*E2,*E3,*E4)-FREEOF(*E3,*U)-/
     -QUAD(*U,*E4,*A4,*B4,*C4)
     -SIMPLIFY(*E3.*A4,*A)
     -SIMPLIFY(*E3.*B4,*B)
     -SIMPLIFY(*E3.*C4,*C).

+QUAD(*U,*E1.*E2,*A,*B,*C)
     -LINEAR(*U,*E1,*A1,*B1)-LINEAR(*U,*E2,*A2,*B2)
     -SIMPLIFY(*A1.*A2,*A)
     -SIMPLIFY(*A1.*B2+*A2.*B1,*B)
     -SIMPLIFY(*B1.*B2,*C).




****************************************.
* SIMULTANEOUS EQUATIONS ROUTINES.
****************************************.

+SSOLVE(TRUE,NIL,TRUE)-/.
```

```
+SSOLVE(*ES1#*ES2,*US,*ANS1#*ANS2)
     -TRACE(DISJUNCTION-*ES1-OR-*ES2)
     -SSOLVE(*ES1,*US,*ANS1)-SSOLVE(*ES2,*US,*ANS2).

+SSOLVE(*E&*ER,*U.*UR,*ANS&*ANSR)
     -TRACE(SIMULTANEOUSLY-SOLVING-*E&*ER-FOR-*U.*UR)
     -CONTAINS(*E,*U)-SOLVE11(*E,*U,*ANS)-/
     -SUBSTITUTE(*U=*ANS,*ER,*NEWEQNS)
     -SSOLVE(*NEWEQNS,*UR,*ANSR).


+FIN.
```



```
  AAAAAA    BBBBBBBB    LL          MM      MM
  AAAAAA    BBBBBBBB    LL          MM      MM
AA      AA  BB      BB  LL          MMMM  MMMM
AA      AA  BB      BB  LL          MMMM  MMMM
AA      AA  BB      BB  LL          MM  MM  MM
AA      AA  BB      BB  LL          MM  MM  MM
AA      AA  BBBBBBBB    LL          MM      MM
AA      AA  BBBBBBBB    LL          MM      MM
AAAAAAAAAA  BB      BB  LL          MM      MM
AAAAAAAAAA  BB      BB  LL          MM      MM
AA      AA  BB      BB  LL          MM      MM      ....
AA      AA  BB      BB  LL          MM      MM      ....
AA      AA  BBBBBBBB    LLLLLLLLLL  MM      MM      ....
AA      AA  BBBBBBBB    LLLLLLLLLL  MM      MM      ....


44    44      ØØØØØØ      ØØØØØØ                44    44      ØØØØØØ    5555555555
44    44      ØØØØØØ      ØØØØØØ                44    44      ØØØØØØ    5555555555
44    44    ØØ      ØØ  ØØ      ØØ              44    44    ØØ      ØØ  55
44    44    ØØ      ØØ  ØØ      ØØ              44    44    ØØ      ØØ  55
44    44    ØØ    ØØØØ  ØØ    ØØØØ              44    44    ØØ    ØØØØ  555555
44    44    ØØ    ØØØØ  ØØ    ØØØØ              44    44    ØØ    ØØØØ  555555
4444444444  ØØ  ØØ  ØØ  ØØ  ØØ  ØØ              4444444444  ØØ  ØØ  ØØ        55
4444444444  ØØ  ØØ  ØØ  ØØ  ØØ  ØØ              4444444444  ØØ  ØØ  ØØ        55
      44    ØØØØ    ØØ  ØØØØ    ØØ                    44    ØØØØ    ØØ          55
      44    ØØØØ    ØØ  ØØØØ    ØØ                    44    ØØØØ    ØØ          55
      44    ØØ      ØØ  ØØ      ØØ      ,,,,          44    ØØ      ØØ  55      55
      44    ØØ      ØØ  ØØ      ØØ      ,,,,          44    ØØ      ØØ  55      55
      44      ØØØØØØ      ØØØØØØ          ,,          44      ØØØØØØ      555555
      44      ØØØØØØ      ØØØØØØ          ,,          44      ØØØØØØ      555555


BBBB  U   U N   N DDDD  Y   Y        AAA
B   B U   U N   N D   D Y   Y       A   A
B   B U   U NN  N D   D  Y Y        A   A
BBBB  U   U N N N D   D   Y         A   A
B   B U   U N  NN D   D   Y         AAAAA
B   B U   U N   N D   D   Y         A   A
BBBB  UUUUU N   N DDDD    Y         A   A


LPTSPL VERSION 6(344)  RUNNING ON LPT5ØØ
 *START* USER BUNDY A [4ØØ,4Ø5] JOB  MECH1 SEQ. 3Ø63 DATE 13-NOV-75 13:59:48 MONITOR NETMON 5,Ø7B V3 (AUG 12 T *START*
REQUEST CREATED: 13-NOV-75  14:ØØ:47
FILE: DSKA1:ABLM[4ØØ,4Ø5] CREATED: 13-NOV-75 13:39:ØØ <155>  PRINTED: 13-NOV-75 14:Ø2:13
QUEUE SWITCHES:  /PRINT:ARROW /FILE:ASCII /COPIES:1 /SPACING:1 /LIMIT:46 /FORMS:NORMAL
FILE WILL BE RENAMED TO <Ø55> PROTECTION
```

```
* LEGAL MOVES FOR PROLOG EQUATION SOLVING PROGRAM.
* BOB WELHAM                 1975.
* ALAN BUNDYS VERSION      NOV 1975.


*****************************************.
* LEGAL MOVES.
*****************************************.

* LEGAL MOVES FOR SIMPLIFICATION.

+AX1( *U+Ø , *U ).

+AX1Ø( *U.Ø , Ø ).

+AX2Ø( *U↑Ø , 1 ).

+AX3Ø( Ø↑*U , Ø )-NONZERO(*U).

+AX4Ø( LOG(*U,1) , Ø ).

+AX5Ø( LOG(*U,*U) , 1 ).

+AX6Ø( *U.1 , *U ).

+AX8Ø( *U↑1 , *U ).

+AX85( 1↑*U , 1 ).

+AX9Ø( *U+-1.*U , Ø ).

+AX91( 1+-1 , Ø).

+AX1ØØ( -1.-1 , 1 ).

+AX1Ø1( -1↑-1 , -1 ).

+AX2ØØ( LOG(*U,*U↑*V) , *V ).

+AX2Ø1( *U↑LOG(*U,*V) , *V ).
```

+ Ax300 (*u/*u , 1) - Nonzero (*u) .

301 $\frac{*u . *V}{*u}$, *V

302 ($\frac{*u}{*u . *w}$, 1/*w)

303 ($\frac{*u . *v}{*u . *w}$, *v/*w)

$\frac{1760}{60}$

```
* LEGAL MOVES FOR ISOLATION.

+AX1ØØØ( *U+*V=*W , *U=*W+-1.*V ).

+AX1Ø2Ø( *U.*V=*W , *U=*W.*V↑-1 )-NONZERO(*V).

+AX1Ø4Ø( LOG(*U,*V)=*W , *V=*U↑*W ).

+AX1Ø5Ø( *U↑*N=*V , *U=*V↑(*N↑-1) #
                    *U=-1.*V↑(*N↑-1) )-EVEN(*N).

+AX1Ø6Ø( *U↑*N=*V , *U=*V↑(*N↑-1) )-ODD(*N).
```

```
+AX1Ø7Ø( *U↑*V=*W , *V=LOG(*U,*W) ).

+AX15ØØ( SIN(*U)=*V , *U=*N.PI+-1↑*N.ARCSIN(*V) )-ARBINT(*N).

+AX151Ø( COS(*U)=*V , *U=2.*N.PI+ARCCOS(*V) #
                      *U=2.*N.PI+-1.ARCCOS(*V) )-ARBINT(*N).

+AX152Ø( TAN(*U)=*V , *U=*N.PI+ARCTAN(*V) )-ARBINT(*N).

+AX153Ø( COSEC(*U)=*V , *U=*N.PI+-1↑*N.ARCCOSEC(*V) )-ARBINT(*N).

+AX154Ø( SEC(*U)=*V , *U=2.*N.PI+ARCSEC(*V) #
                      *U=2.*N.PI+-1.ARCSEC(*V) )-ARBINT(*N).

+AX155Ø( COT(*U)=*V , *U=*N.PI+ARCCOT(*V) )-ARBINT(*N).

+AX156Ø( ARCSIN(*U)=*V , *U=SIN(*V) ).

+AX157Ø( ARCCOS(*U)=*V , *U=COS(*V) ).

+AX158Ø( ARCTAN(*U)=*V , *U=TAN(*V) ).

+AX159Ø( ARCCOSEC(*U)=*V , *U=COSEC(*V) ).

+AX16ØØ( ARCSEC(*U)=*V , *U=SEC(*V) ).

+AX161Ø( ARCCOT(*U)=*V , *U=COT(*V) ).



* LEGAL MOVES FOR COLLECTION.

+AX2ØØØ( (*U+*V).*W , *U.*W+*V.*W ).

+AX2ØØ1( (*V+1).*W , *W+*V.*W ).

+AX2ØØ2( 2.*W , *W+*W ).

+AX2Ø1Ø( (*U+*V).(*U+-1.*V) , *U↑2+-1.*V↑2 ).

+AX2Ø11( (*U+1).(*U+-1) , *U↑2+-1 ).

+AX2Ø2Ø( *W↑(*U+*V) , *W↑*U.*W↑*V ).

+AX2Ø21( *W↑(*V+1) , *W.*W↑*V ).

+AX2Ø22( *W↑2 , *W.*W ).

+AX25ØØ( SIN(2.*U).2↑-1 , SIN(*U).COS(*U) ).

+AX251Ø( COS(2.*U) , COS(*U)↑2+-1.SIN(*U)↑2 ).

+AX252Ø( SIN(*U+*V) , SIN(*U).COS(*V)+COS(*U).SIN(*V) ).

+AX253Ø( SIN(*U+-1.*V) , SIN(*U).COS(*V)+-1.COS(*U).SIN(*V) ).

+AX254Ø( COS(*U+*V) , COS(*U).COS(*V)+-1.SIN(*U).SIN(*V) ).
```

```
+AX255Ø( COS(*U+-1.*V) , COS(*U).COS(*V)+SIN(*U).SIN(*V) ).



* LEGAL MOVES FOR ATTRACTION.

+AX3ØØØ( LOG(*W,*U)+LOG(*W,*V) , LOG(*W,*U.*V) ).

+AX3ØØ1( LOG(*W,*U)+*A.LOG(*W,*V) , LOG(*W,*U.*V↑*A) ).

+AX3Ø1Ø( (*U↑*V)↑*W , *U↑(*V.*W) ).



*****************************************.
* RECOMMENDATION LISTS.
*****************************************.

* ALL AXIOMS APPLIED LEFT TO RIGHT FOR ISOLATION
  AND SIMPLIFICATION.

+USE(ISOLATION, 1ØØØ.1Ø2Ø.1Ø4Ø.1Ø5Ø.1Ø6Ø.1Ø7Ø.
                15ØØ.151Ø.152Ø.153Ø.154Ø.155Ø.156Ø.157Ø.
                158Ø.159Ø.16ØØ.161Ø.NIL).

+USE(SIMPLIFICATION, 1.1Ø.2Ø.3Ø.4Ø.5Ø.6Ø.7Ø.8Ø.85.9Ø.91.
                     65.1ØØ.1Ø1.11Ø.2ØØ.2Ø1.NIL).

+USE(COLLECTION, 2ØØØ↑RTL . 2ØØ1↑RTL . 2ØØ2↑RTL .
                 2Ø2Ø↑RTL . 2Ø21↑RTL . 2Ø22↑RTL .
                 2Ø1Ø↑LTR . 2Ø11↑LTR . 25ØØ↑RTL . 251Ø↑RTL .
                 252Ø↑RTL . 253Ø↑RTL . 254Ø↑RTL . 255Ø↑RTL . NIL).

+USE(ATTRACTION, 2ØØØ↑RTL . 2Ø2Ø↑RTL . 3ØØØ↑LTR .
                 3ØØ1↑LTR . 3Ø1Ø↑LTR . NIL).



*****************************************.
* ARITHMETIC.
*****************************************.

+INTEGER(-1).
```

Change INTEGER ~~integer~~ INT

```
+INTEGER(-1.*N)-/-INT(*N).
+INTEGER(*N)-INT(*N).

+INT(*N)-UNIV(*N,*M.NIL)-DIGITS(*M).
+DIGITS(NIL)-/.
+DIGITS(*D.*L)-CHIFFRE(*D)-DIGITS(*L).

+ODD(*N)-INT(*N)-RESTE(*N,2,*R)-IDEN(*R,1).
+EVEN(*N)-INT(*N)-RESTE(*N,2,*R)-IDEN(*R,Ø).

+NONZERO(*N)-INT(*N)-DIFF(*N,Ø).
+NONZERO(*X)-SIMPLIFY(*X,*Y)-IDEN(*Y,Ø)-/-FAIL.
+NONZERO(*X)-SORCHA("ASSUMING NON-ZERO ")-SORTER(*X)-LIGNE.



* EVALUATE AN ARITHMETIC EXPRESSION.

+EVAL(-1,-1.*N,*R)-/-EVAL(*N,*R).
+EVAL(-1,-1.1)-/.
+EVAL(*L+*M,*N)-/-EVAL(*L,*P)-EVAL(*M,*Q)-ADD(*P,*Q,*N).
+EVAL(*L.*M,*N)-/-EVAL(*L,*P)-EVAL(*M,*Q)-TIMES(*P,*Q,*N).
+EVAL(*L↑*M,*N)-/-EVAL(*L,*P)-EVAL(*M,*Q)-POWER(*P,*Q,*N).
+EVAL(*N,*N)-INTEGER(*N)-/.
+EVAL(*E,*R)-FACT(*E=*R).



* ADD,TIMES AND POWER WORK FOR PLAIN INTEGERS OR FOR INTEGERS
* PRECEDED BY ONE -1 ONLY.

+ADD(-1.*L,-1.*M,-1.*N)-/-PLUS(*L,*M,*N).
+ADD(-1.*L,*M,-1.*N)-INF(*M,*L)-/-MOINS(*L,*M,*N).
+ADD(-1.*L,*M,*N)-/-MOINS(*M,*L,*N).
+ADD(*L,-1.*M,*N)-/-ADD(-1.*M,*L,*N).
+ADD(*L,*M,*N)-PLUS(*L,*M,*N).

+TIMES(-1.*L,-1.*M,*N)-/-MULT(*L,*M,*N).
+TIMES(-1.*L,*M,-1.*N)-/-MULT(*L,*M,*N).
+TIMES(*L,-1.*M,-1.*N)-/-MULT(*L,*M,*N).
+TIMES(*L,*M,*N)-MULT(*L,*M,*N).

+POWER(-1.*L,*M,*N)-EVEN(*M)-/-POWER(*L,*M,*N).
+POWER(-1.*L,*M,-1.*N)-ODD(*M)-/-POWER(*L,*M,*N).
+POWER(*L,1,*L)-/.
+POWER(*L,*M,*N)-INT(*M)-MOINS(*M,1,*P)
    -POWER(*L,*P,*Q)-MULT(*L,*Q,*N).



**********************************************,
* UTILITY ROUTINES.
**********************************************,

* COUNT NUMBER OF OCCURENCES OF GIVEN CONSTANT IN GIVEN EXPRESSION.
```

88
1760
60
)

Division ?

EVAL(*L /*M ,

```
+OCC(*X,*X,1)-/.
+OCC(NIL,*X,Ø)-/.
+OCC(*E,*X,*N)-UNIV(*E,*F,*E1,*E2,NIL)-/
     -OCC(*E1,*X,*N1)-OCC(*E2,*X,*N2)-PLUS(*N1,*N2,*N).
+OCC(*E,*X,*N)-UNIV(*E,*F,*A)-OCC(*A,*X,*N).


+FREEOF(*E,*X)-OCC(*E,*X,*N)-IDEN(*N,Ø).
+SINGLEOCC(*E,*X)-OCC(*E,*X,*N)-IDEN(*N,1).
+CONTAINS(*E,*X)-OCC(*E,*X,*N)-DIFF(*N,Ø).
```

funny syntax

```
+SUBSTITUTE(*U=(*T1#*T2),*OLD,*NEW1#*NEW2)
     -SUBSTITUTE(*U=*T1,*OLD,*NEW1)
     -SUBSTITUTE(*U=*T2,*OLD,*NEW2).

+SUBSTITUTE(*U=*TERM,*OLD,*NEW)
     -TRACE(SUBSTITUTING-*TERM-FOR-*U-IN-*OLD)
     -SUB(*U=*TERM,*OLD,*NEW)-TRACE(GIVES-*NEW).


+SUB(*U=*T,*U,*T)-/.

+SUB(*U=*T,*E,*E)-FREEOF(*E,*U)-/.

+SUB(*U=*T,*E,*R)-UNIV(*E,*F,*A.*L)
     -SUB(*U=*T,*A,*B)-SUB(*U=*T,*L,*M)-UNIV(*R,*F.*B,*L).
```

[illegible] L2 = L

```
+SELECT(*U,*L,*R)-APPEND(*L1,*U.*L2,*L)-APPEND(*L1,*L2,*R)
     -TRACE(*U-SELECTED-FROM-*L).


+APPEND(NIL,*L,*L).
+APPEND(*X.*L1,*L2,*X.*L)-APPEND(*L1,*L2,*L).


* GENERATE IDENTIFIERS DENOTING ARBITRARY INTEGERS.

+ARBINT(*N)-AINO(*X)-UNIV(*X,*Y.NIL)-UNIV(*N,(N.*Y).NIL)
     -SUPP((+AINO(*X)).NIL)-PLUS(*X,1,*Z)
     -AJOUT((+INTEGER(*N)).NIL)-AJOUT((+AINO(*Z)).NIL)
     -SORTER(*N)-SORCHA(" DENOTES AN ARBITRARY INTEGER")-LIGNE.

+AINO(Ø).




+PERM2(*X,*Y,*X,*Y).
```

```
+PERM2(*X,*Y,*Y,*X).

+ANSWER(*X=(*ANS1#*ANS2))-/-ANSWER(*X=*ANS1)
    -LIGNE-SORCHA("OR")-LIGNE-ANSWER(*X=*ANS2).
```

change

```
+ANSWER(*X=*ANS)-LIGNE-LIGNE
    -SORCHA("ANSWER IS ")-SORTER(*X=*ANS)-LIGNE-LIGNE,


+TRACE(*X)-TFLAG-/-SORTER(*X)-LIGNE.
+TRACE(*X),

+T-AJOUT((+TFLAG),NIL).        * TRACE ON.
+NT-SUPP((+TFLAG),NIL).        * TRACE OFF.
```

duplicated

```
+MEM(*X,*X.*Y).
+MEM(*X,*Y.*Z)-MEM(*X,*Z),
```

duplicate

```
+IDEN(*X,*X),

+DIFF(*X,*X)-/-FAIL.
+DIFF(*X,*Y),
```

better

```
* ROUTINES TO APPLY THE LEGAL MOVE AXIOMS,

+USEFUL(*STRAT,*AXIOM)-USE(*STRAT,*AXLIST)-MEM(*AXIOM,*AXLIST),


+APPLY(LTR,*AXIOM,*OLD,*NEW)
    -UNIV(*AXIOM,*N.NIL)-MATCH(*OLD,*OLDM)
    -UNIV(*GOAL,(A.X,*N),*OLDM,*NEW.NIL)-*GOAL
    -TRACE(AXIOM-*AXIOM-LEFT-TO-RIGHT-ON-*OLD-GIVES-*NEW),

+APPLY(RTL,*AXIOM,*OLD,*NEW)
    -UNIV(*AXIOM,*N.NIL)-MATCH(*OLD,*OLDM)
    -UNIV(*GOAL,(A.X,*N),*NEW,*OLDM.NIL)-*GOAL
    -TRACE(AXIOM-*AXIOM-RIGHT-TO-LEFT-ON-*OLD-GIVES-*NEW),


* PATTERN MATCHER,

+MATCH(*X,*X),

+MATCH(*X+*Y,*U+*V)-PERM2(*X,*Y,*P,*Q)
    -MATCH(*P,*U)-MATCH(*Q,*V)-DIFF(*X+*Y,*U+*V),

+MATCH(*X.*Y,*U.*V)-PERM2(*X,*Y,*P,*Q)
    -MATCH(*P,*U)-MATCH(*Q,*V)-DIFF(*X.*Y,*U.*V),

+SHUFFLE(*P+*Q+*R,*R+*P+*Q).
+SHUFFLE(*P+*Q+*R,*Q+*R+*P),
+SHUFFLE(*P.*Q.*R,*R.*P.*Q).
+SHUFFLE(*P.*Q.*R,*Q.*R.*P).
```

```
+FIN.
```

```
  AAAAAA    BBBBBBBB    EEEEEEEEEE  XX      XX    11
  AAAAAA    BBBBBBBB    EEEEEEEEEE  XX      XX    11
AA      AA  BB      BB  EE          XX      XX  1111
AA      AA  BB      BB  EE          XX      XX  1111
AA      AA  BB      BB  EE            XX  XX      11
AA      AA  BB      BB  EE            XX  XX      11
AA      AA  BBBBBBBB    EEEEEEEE        XX        11
AA      AA  BBBBBBBB    EEEEEEEE        XX        11
AAAAAAAAAA  BB      BB  EE            XX  XX      11
AAAAAAAAAA  BB      BB  EE            XX  XX      11
AA      AA  BB      BB  EE          XX      XX    11          ....
AA      AA  BB      BB  EE          XX      XX    11          ....
AA      AA  BBBBBBBB    EEEEEEEEEE  XX      XX  111111        ....
AA      AA  BBBBBBBB    EEEEEEEEEE  XX      XX  111111        ....


44    44      000000      000000                44    44      000000    5555555555
44    44      000000      000000                44    44      000000    5555555555
44    44    00      00  00      00              44    44    00      00  55
44    44    00      00  00      00              44    44    00      00  55
44    44    00    0000  00    0000              44    44    00    0000  555555
44    44    00    0000  00    0000              44    44    00    0000  555555
4444444444  00  00  00  00  00  00              4444444444  00  00  00        55
4444444444  00  00  00  00  00  00              4444444444  00  00  00        55
      44    0000    00  0000    00                    44    0000    00          55
      44    0000    00  0000    00                    44    0000    00          55
      44    00      00  00      00      ,,,,          44    00      00  55      55
      44    00      00  00      00      ,,,,          44    00      00  55      55
      44      000000      000000          ,,            44      000000      555555
      44      000000      000000          ,,            44      000000      555555


BBBB  U   U N   N DDDD  Y   Y        AAA
B   B U   U N   N D   D Y   Y       A   A
B   B U   U NN  N D   D  Y Y        A   A
BBBB  U   U N N N D   D   Y         A   A
B   B U   U N  NN D   D   Y         AAAAA
B   B U   U N   N D   D   Y         A   A
BBBB  UUUUU N   N DDDD    Y         A   A


LPTSPL VERSION 6(344)  RUNNING ON LPT500
 *START* USER BUNDY A [400,405] JOB  MECH1 SEQ. 3063 DATE 13-NOV-75 13:59:48 MONITOR NETMON 5,07B V3 (AUG 12 T *START*
REQUEST CREATED: 13-NOV-75  14:00:47
FILE: DSKA0:ABEX1[400,405] CREATED: 13-NOV-75 13:34:00 <155>  PRINTED: 13-NOV-75 14:03:13
QUEUE SWITCHES:  /PRINT:ARROW /FILE:ASCII /COPIES:1 /SPACING:1 /LIMIT:39 /FORMS:NORMAL
FILE WILL BE RENAMED TO <055> PROTECTION
```

```
-SOLVE(A.X+B=Ø,X).

-SOLVE(A.X↑2+B.X+C=Ø,X).

-SOLVE(LOG(E,X+1)+LOG(E,X+-1)=3,X).

-SOLVE(SIN(X).COS(A)+COS(X).SIN(A)=1,X).

-SOLVE((E↑X)↑(2.X)=5,X).

-TTY.
```

```
  AAAAAA    BBBBBBBB    EEEEEEEEEE  XX      XX    222222
  AAAAAA    BBBBBBBB    EEEEEEEEEE  XX      XX    222222
AA      AA  BB      BB  EE          XX      XX  22      22
AA      AA  BB      BB  EE          XX      XX  22      22
AA      AA  BB      BB  EE            XX  XX            22
AA      AA  BB      BB  EE            XX  XX            22
AA      AA  BBBBBBBB    EEEEEEEE        XX            22
AA      AA  BBBBBBBB    EEEEEEEE        XX            22
AAAAAAAAAA  BB      BB  EE            XX  XX        22
AAAAAAAAAA  BB      BB  EE            XX  XX        22
AA      AA  BB      BB  EE          XX      XX    22            ....
AA      AA  BB      BB  EE          XX      XX    22            ....
AA      AA  BBBBBBBB    EEEEEEEEEE  XX      XX  2222222222      ....
AA      AA  BBBBBBBB    EEEEEEEEEE  XX      XX  2222222222      ....


44    44      000000      000000                  44    44      000000    5555555555
44    44      000000      000000                  44    44      000000    5555555555
44    44    00      00  00      00                44    44    00      00  55
44    44    00      00  00      00                44    44    00      00  55
44    44    00    0000  00    0000                44    44    00    0000  555555
44    44    00    0000  00    0000                44    44    00    0000  555555
4444444444  00  00  00  00  00  00                4444444444  00  00  00        55
4444444444  00  00  00  00  00  00                4444444444  00  00  00        55
      44    0000    00  0000    00                      44    0000    00          55
      44    0000    00  0000    00                      44    0000    00          55
      44    00      00  00      00      ,,,,            44    00      00  55      55
      44    00      00  00      00      ,,,,            44    00      00  55      55
      44      000000      000000          ,,            44      000000      555555
      44      000000      000000          ,,            44      000000      555555


BBBB  U   U N   N DDDD  Y   Y        AAA
B   B U   U N   N D   D Y   Y       A   A
B   B U   U NN  N D   D  Y Y        A   A
BBBB  U   U N N N D   D   Y         A   A
B   B U   U N  NN D   D   Y         AAAAA
B   B U   U N   N D   D   Y         A   A
BBBB  UUUUU N   N DDDD    Y         A   A


LPTSPL VERSION 6(344)  RUNNING ON LPT500
 *START* USER BUNDY A [400,405] JOB  MECH1 SEQ. 3063 DATE 13-NOV-75 13:59:48 MONITOR NETMON 5,07B V3 (AUG 12 T *START*
REQUEST CREATED: 13-NOV-75  14:00:47
FILE: DSKA1:ABEX2[400,405] CREATED: 13-NOV-75 13:58:00 <155>  PRINTED: 13-NOV-75 14:03:23
QUEUE SWITCHES:  /PRINT:ARROW /FILE:ASCII /COPIES:1 /SPACING:1 /LIMIT:38 /FORMS:NORMAL
FILE WILL BE RENAMED TO <055> PROTECTION
```

```
-SSOLVE((X+Y=A)&(X+-1,Y=B)&TRUE,X.Y.NIL,*ANS) -TRACE(*ANS).

-TTY.
```

```
  AAAAAA    BBBBBBBB    EEEEEEEEEE  XX      XX    333333
  AAAAAA    BBBBBBBB    EEEEEEEEEE  XX      XX    333333
AA      AA  BB      BB  EE          XX      XX  33      33
AA      AA  BB      BB  EE          XX      XX  33      33
AA      AA  BB      BB  EE            XX  XX            33
AA      AA  BB      BB  EE            XX  XX            33
AA      AA  BBBBBBBB    EEEEEEEE        XX            33
AA      AA  BBBBBBBB    EEEEEEEE        XX            33
AAAAAAAAAA  BB      BB  EE            XX  XX            33
AAAAAAAAAA  BB      BB  EE            XX  XX            33
AA      AA  BB      BB  EE          XX      XX  33      33      ::::
AA      AA  BB      BB  EE          XX      XX  33      33      ::::
AA      AA  BBBBBBBB    EEEEEEEEEE  XX      XX    333333        ::::
AA      AA  BBBBBBBB    EEEEEEEEEE  XX      XX    333333        ::::


44    44      ØØØØØØ      ØØØØØØ                44    44      ØØØØØØ    5555555555
44    44      ØØØØØØ      ØØØØØØ                44    44      ØØØØØØ    5555555555
44    44    ØØ      ØØ  ØØ      ØØ              44    44    ØØ      ØØ  55
44    44    ØØ      ØØ  ØØ      ØØ              44    44    ØØ      ØØ  55
44    44    ØØ    ØØØØ  ØØ    ØØØØ              44    44    ØØ    ØØØØ  555555
44    44    ØØ    ØØØØ  ØØ    ØØØØ              44    44    ØØ    ØØØØ  555555
4444444444  ØØ  ØØ  ØØ  ØØ  ØØ  ØØ              4444444444  ØØ  ØØ  ØØ        55
4444444444  ØØ  ØØ  ØØ  ØØ  ØØ  ØØ              4444444444  ØØ  ØØ  ØØ        55
      44    ØØØØ    ØØ  ØØØØ    ØØ                    44    ØØØØ    ØØ          55
      44    ØØØØ    ØØ  ØØØØ    ØØ                    44    ØØØØ    ØØ          55
      44    ØØ      ØØ  ØØ      ØØ      ::::          44    ØØ      ØØ  55      55
      44    ØØ      ØØ  ØØ      ØØ      ::::          44    ØØ      ØØ  55      55
      44      ØØØØØØ      ØØØØØØ          ,,          44      ØØØØØØ      555555
      44      ØØØØØØ      ØØØØØØ          ,,          44      ØØØØØØ      555555


BBBB  U   U N   N DDDD  Y   Y        AAA
B   B U   U N   N D   D Y   Y       A   A
B   B U   U NN  N D   D  Y Y        A   A
BBBB  U   U N N N D   D   Y         A   A
B   B U   U N  NN D   D   Y         AAAAA
B   B U   U N   N D   D   Y         A   A
BBBB  UUUUU N   N DDDD    Y         A   A


LPTSPL VERSION 6(344)  RUNNING ON LPT5Ø0
 *START* USER BUNDY A [4ØØ,4Ø5] JOB  MECH1 SEQ. 3Ø63 DATE 13-NOV-75 13:59:48 MONITOR NETMON 5,Ø7B V3 (AUG 12 T *START*
REQUEST CREATED: 13-NOV-75  14:00:47
FILE: DSKA1:ABEX3[4ØØ,4Ø5] CREATED: 13-NOV-75 13:57:ØØ <155>  PRINTED: 13-NOV-75 14:Ø3:33
QUEUE SWITCHES:  /PRINT:ARROW /FILE:ASCII /COPIES:1 /SPACING:1 /LIMIT:37 /FORMS:NORMAL
FILE WILL BE RENAMED TO <Ø55> PROTECTION
```

```
-SSOLVE(

    (X+A.Y+B.Ƶ=C)&
    (Y↑2+-1.D.Ƶ=Ø)&
    (X+Y=E)&             TRUE
,X.Y.Ƶ.NIL,   *ANS) -TRACE(*ANS).
.

-TTY.
```