ALGORITHM 69
CHAIN TRACING
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procedure CHAIN tracing (iteration counter, number of
identifiers, number of identifier links, final linkage
matrix, couples);

Boolean array final linkage matrix;
integer array couples;
integer iteration counter, number of identifiers, number of
identifier links;

begin comment This procedure is given a list of pairs of inte-
gers, the second being related to the first in some way. It finds
those pairs of integers which are related to each other if the
relation is transitive. It is supplied with,
couples a matrix whose bound pair list is [1:2, 1:number of
identifier links] where couples [2, i] is related to couples
[1, i] in some way.

final linkage matrix a matrix whose bound pair list is
[1:number of identifiers, 1:number of identifiers] and into
which the procedure puts true if the second subscript
expression is an integer which is related to the integer
corresponding to the first subscript expression, if the
relation is irreflexive then the diagonal entries of this
matrix are false.

iteration counter a place for the procedure to put the
length of the longest chain it finds. CHAIN tracing can be
applied to any system which can be represented by a Turing
machine by letting the integers in couples correspond to
the Turing machine states. Two integers j, k are related if
there is an input symbol which causes state j to change to
state k. If the Turing machine always stops whatever the
sequence of input symbols, then its final linkage matrix
will have false for all leading diagonal entries;

integer i, j;
Boolean array working linkage matrix [1:number of identifi-
ers, 1:number of identifiers];

Boolean procedure PROGRESS;
begin PROGRESS := false;
for i := 1 step 1 until number of identifiers
  for j := 1 step 1 until number of identifiers
    do for j := 1 step 1 until number of identifiers
      do begin if Working linkage matrix [i, j] = \-
Final
linkage matrix [i, j] then PROGRESS := true;
Final linkage matrix [i, j] := Working linkage
matrix [i, j]
end of comparison
end of PROGRESS;
BEGIN OF PROGRAM:
for iteration counter := -1, 0, iteration counter + 1 while
PROGRESS
do for i := 1 step 1 until number of identifier links
do for j := 1 step 1 until number of identifiers
  do begin if iteration number = -1
then Final linkage Matrix [couples [1, i], j]
  := Working linkage Matrix [couples [1, i], j]
  := couples [2, i] = j
else Working linkage Matrix [couples [1, i], j]
  := Working linkage Matrix [couples [1, i], j]
  \∨ Working linkage Matrix [couples [2, i], j];

end of setting one linkage
end of CHAIN tracing;