another generalization of the head-line concept, based on an analysis that is both topological and functional. In FAST, a line \( l \) is a backtrace-stop for value \( v \), if the assignment \( l = v \) can be justified without conflicts. For example, in Figure 6.39, \( L \) is a backtrace-stop for 0, because \( L = 0 \) can be justified without assigning any line with reconvergent fanout (by \( F = 0 \) and \( A = B = 1 \)). Note that \( L \) is fed by reconvergent fanout, and it is not a total-reconvergence line. The identification of backtrace-stop lines will be explained in the next section.

### 6.2.1.3 Selection Criteria

The search process of any of the TG algorithms analyzed in this chapter involves decisions. A first type of decision is to select one of the several unsolved problems existing at a certain stage in the execution of the algorithm. A second type is to select one possible way to solve the selected problem. In this section we discuss selection criteria that are helpful in speeding up the search process. These selection criteria are based on the following principles:
$M_{backtrace}$ (Current_objectives)
begin
repeat
begin
remove one entry $(k,v_k)$ from Current_objectives
if $k$ is a head line
then add $(k,v_k)$ to Head_objectives
else if $k$ is a fanout branch then
begin
\[
j = \text{stem}(k) \]
increment number of requests at $j$ for $v_k$
add $j$ to Stem_objectives
end
else /* continue tracing */
begin
\[
i = \text{inversion of } k \]
c = \text{controlling value of } k
if $(v_k \oplus i = c)$ then
begin
select an input $(j)$ of $k$ with value $x$
add $(j,c)$ to Current_objectives
end
else
for every input $(j)$ of $k$ with value $x$
add $(j,c)$ to Current_objectives
end
end
until Current_objectives = $\emptyset$
if Stem_objectives $\neq \emptyset$ then
begin
remove the highest-level stem $(k)$ from Stem_objectives
$v_k = \text{most requested value of } k$
if $(k$ has contradictory requirements and $k$ is not reachable from target fault)
then return $(k,v_k)$
add $(k,v_k)$ to Current_objectives
return $M_{backtrace}$ (Current_objectives)
end
remove one objective $(k,v_k)$ from Head_objectives
return $(k,v_k)$
end

Figure 6.34  Multiple backtrace
2. Consider the circuit in Fig. 2. (a) Use COP to generate the controllability-1, controllability-0, and observability of each line. (b) Use PODEM to generate a test pattern for line I stuck-at 1 under the guidance of con/obser values in each line. Note that you must follow the PODEM example shown in Problem 1 to present your ATPG process. (c) Repeat (b) using FAN. Note that you must follow the same steps in Problem 1 to show the ATPG process. (d) If your answer in (c) does not create a decision tree, try to generate a test pattern for line I stuck-at 1 without the guidance of con/obser such that a decision tree will be generated. (this enables you to choose a way of multiple backtracing with decision tree created). (e) Try to find a case in which the ATPG process involves decision tree backtracking by FAN? Note that, if yes, you have to show the fault and the entire ATPG process. (60%)