Rule M: Effectively dead places and transitions

The Rule M finds and removes effectively dead places and transitions. We define an effectively dead place to be a place that will never gain nor lose tokens. Effectively dead transitions are transitions that are initially disabled (and/or inhibited) by a place that cannot gain (and/or lose) tokens. These places and transitions are found using fixed-point iteration as defined in Algorithm 1.

Algorithm 1: Rule M: Effectively dead places and transitions

Input: A net $N = \langle P, T, W_{\cdot}, W_{\cdot}, I \rangle$, initial marking M_0 and CTL* formula φ

Output: A reduced net N' and its initial marking M'_0

1 $S_{\leq} := P$ `/* Places that cannot gain tokens */`
2 $S_{\geq} := P$ `/* Places that cannot lose tokens */`
3 $F := T$ `/* Transitions that cannot fire */`
4 **do**
  `/* Find transitions that may fire and update sets accordingly */`
5 **foreach** $t \in F$ *where* $\forall p \in P.(W_(p,t) \leq M_0(p) \vee p \notin S_{\leq}) \wedge (I(p,t) > M_0(p) \vee p \notin S_{\geq})$ **do**
6 $F := F \setminus \{t\}$
7 $S_{\leq} := S_{\leq} \setminus t$
8 $S_{\geq} := S_{\geq} \setminus {}^{t}$
9 **until** $S_{\leq}$, $S_{\geq}$, *and* F *do not change*
10 $P' := P \setminus (S_{\leq} \cap S_{\geq} \setminus places(\varphi))$
11 $T' := T \setminus F$
12 **return** $N' = \langle P', T', W_{\cdot}, W_{\cdot}, I \rangle$ *and* M_0

Theorem 1 *Rule M in Algorithm 1 is correct for CTL*.*