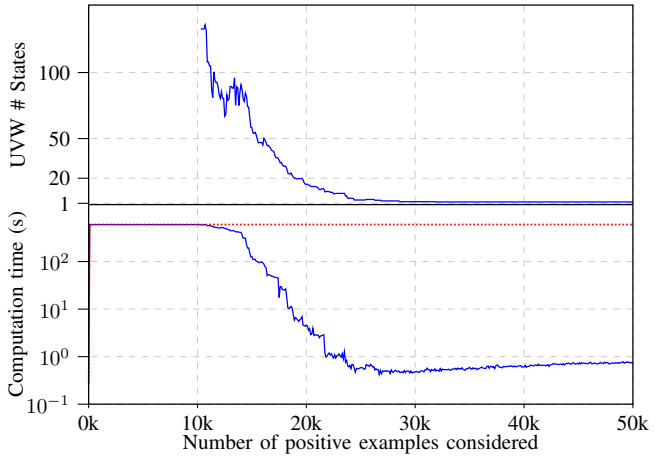
Supplement to the main paper

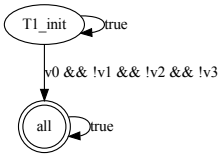
Full benchmark results for all 10 properties

For the sake of completeness, we give the full experimental results for all 10 properties considered in the FMCAD 2020 paper (available from the authors' personal web pages) below. All main observations that we made from the results have been discussed in Section IV of the paper.

Figures 6 to 15 contain the results. Every figure contains (a) the computation time and UVW size evolution (over the number of positive examples) in the style of Figure 4, and (b) the learned UVWs for chain lengths of 2 (on the left) and 3 (on the right) for all 50000 positive examples. For property 8, the 10 runs performed per property yielded different UVWs for the chain of length 3. The corresponding Figure 13 shows one arbitrarily selected UVW.

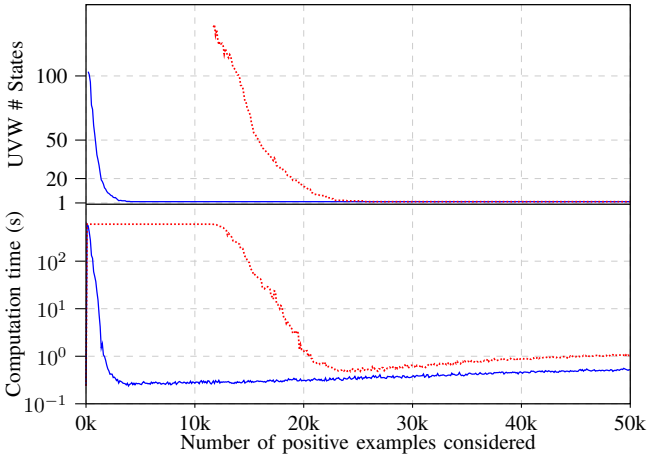
The UVWs are drawn automatically using `graphviz`. For technical reasons, the atomic propositions have been renamed to `v0`, `v1`, `v2`, and `v3`. The UVW library used for minimization has as an invariant that the state rejecting every (suffix) word (labeled as `all`) is always present in the UVW. Hence, it shows up as unreachable state in liveness properties.





N/A

Fig. 6. Full experimental results for the LTL property 1) $\mathsf{G}[a \rightarrow (b \vee c \vee d)]$



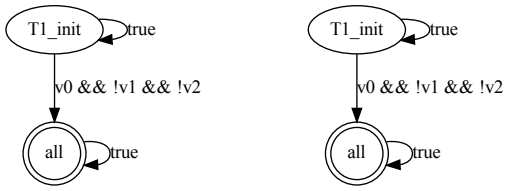
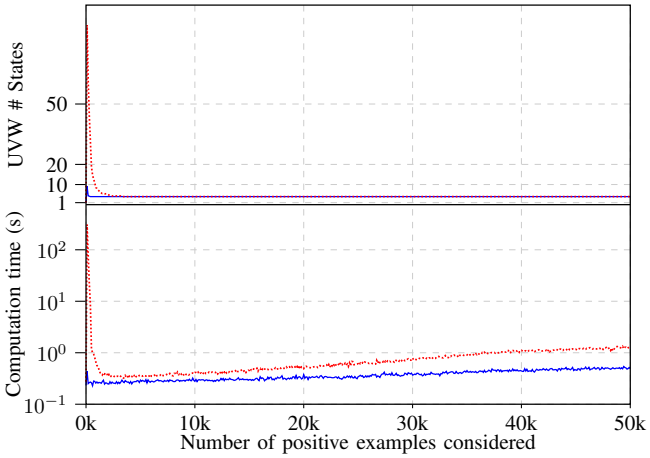


Fig. 7. Full experimental results for the LTL property 2) $\mathsf{G}[a \rightarrow (b \vee c)]$



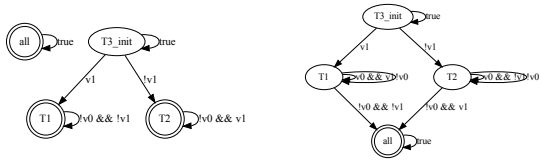
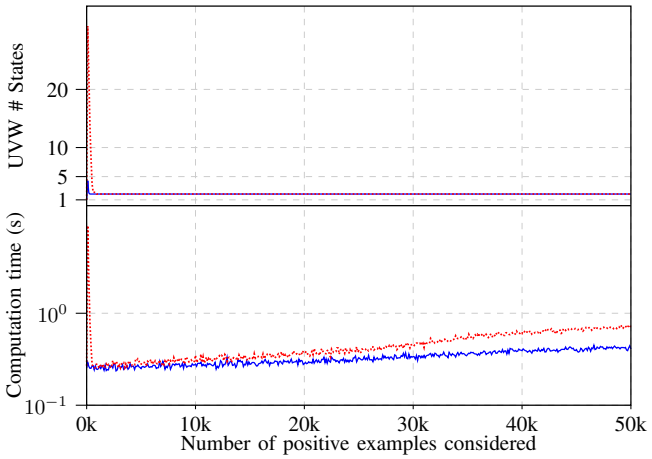


Fig. 8. Full experimental results for the LTL property 3) $\mathsf{G}[\mathsf{X}\neg a \rightarrow (\neg b \leftrightarrow \mathsf{X}(\neg b))]$



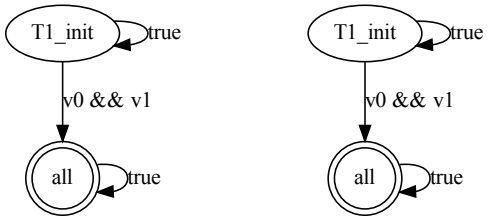
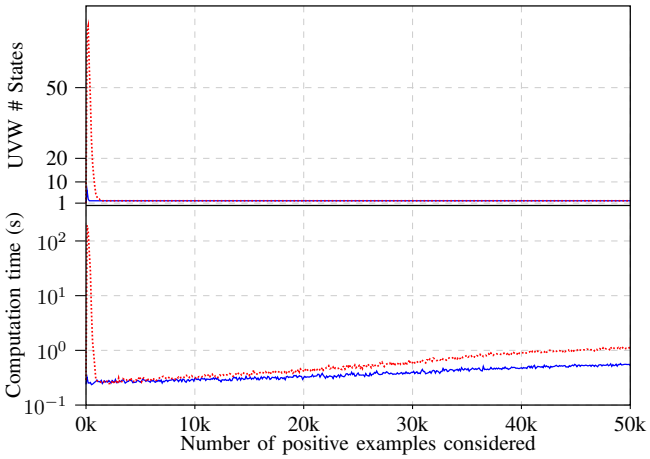


Fig. 9. Full experimental results for the LTL property 4) $\mathsf{G}[a \rightarrow \neg b]$



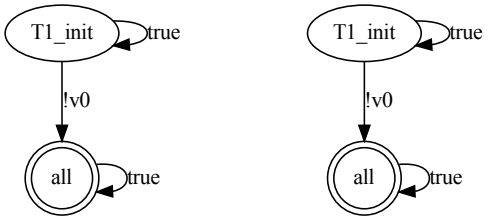
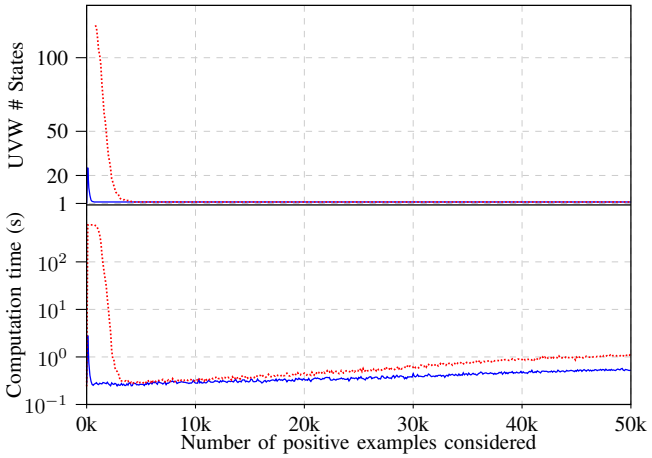


Fig. 11. Full experimental results for the LTL property 6) $\mathsf{G}\, a$



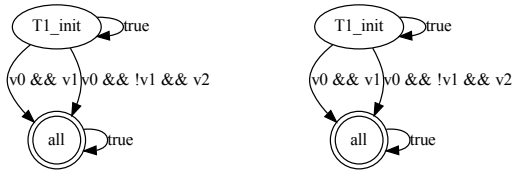
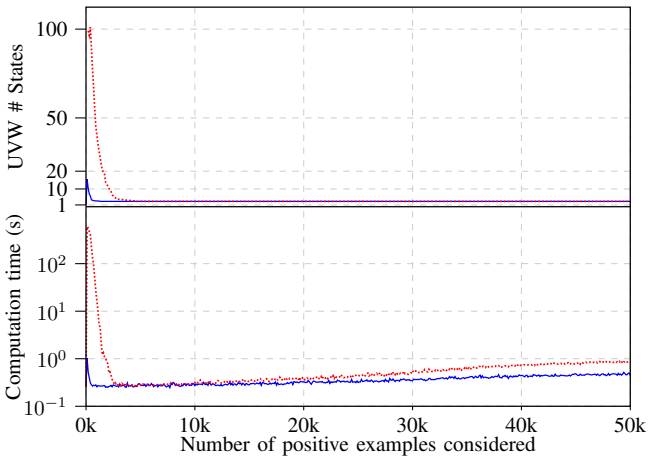


Fig. 10. Full experimental results for the LTL property 5) $\mathsf{G}[a \rightarrow (\neg b \wedge \neg c)]$



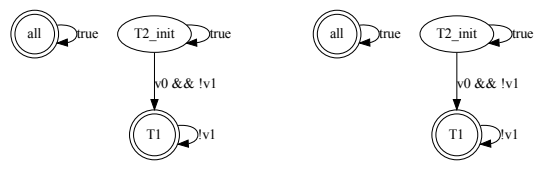


Fig. 12. Full experimental results for the LTL property 7) $\mathsf{G}[a \rightarrow \mathsf{F}\, b]$

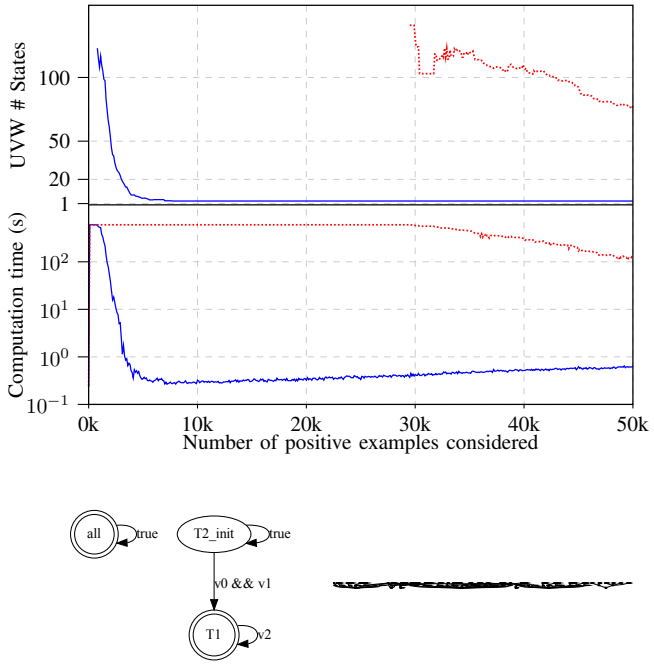


Fig. 13. Full experimental results for the LTL property 8) $\mathsf{G}[(a \wedge b) \rightarrow \mathsf{X}\,\mathsf{F}(\neg c)]$

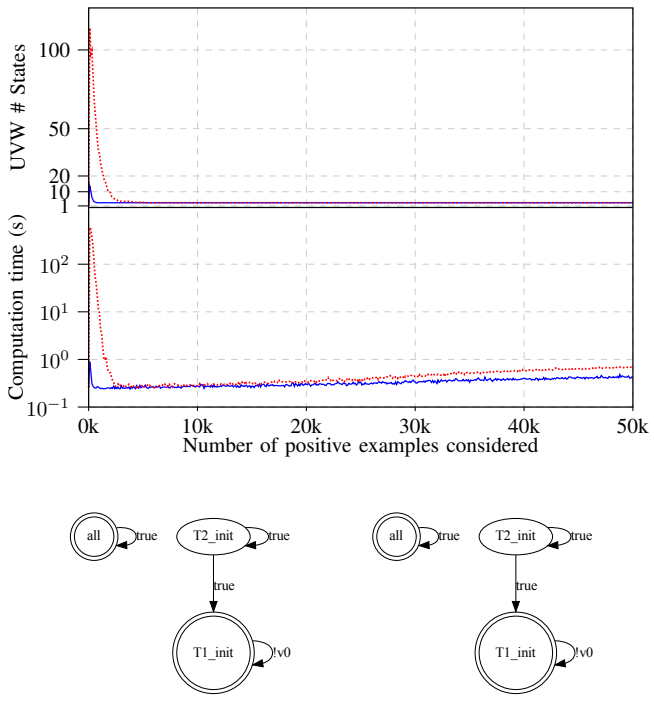


Fig. 14. Full experimental results for the LTL property 9) $\mathsf{G}\,\mathsf{F}\,a$

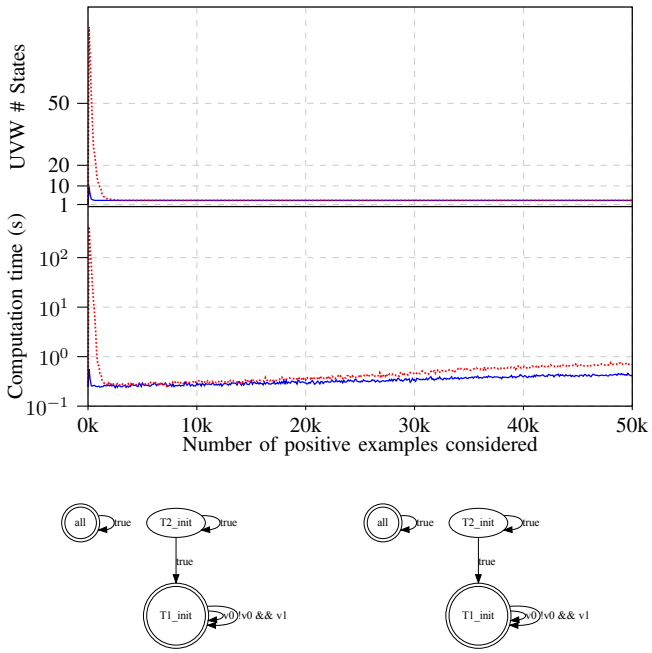


Fig. 15. Full experimental results for the LTL property 10) $\mathsf{G}\,\mathsf{F}(\neg a \wedge \neg b)$