Erratum for "Randomization in Automata on Infinite Trees"

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In the article "Randomization in Automata on Infinite Trees" [Carayol et al. 2014; http://dl.acm.org/citation.cfm?doid=2648783.2629336] that appeared in the July 2014 issue, on page 22 we state the following proposition.

PROPOSITION 38. *For all probabilistic tree automata $\mathcal{A}$ with a ω-regular acceptance condition, the sets* AccRuns($\mathcal{A}$) *and* QualAccRuns($\mathcal{A}$) *are measurable.*

Whereas the second part of the statement concerning the measurability of the set QualAccRuns($\mathcal{A}$) is correct in full generality, the first part of the statement concerning the measurability of the set QualAccRuns($\mathcal{A}$) only holds if the automaton $\mathcal{A}$ is equipped with a Büchi acceptance condition. This was pointed out to us by Weidner [2014], and we offer warm thanks for this observation.

The proof of Proposition 38 given in Carayol et al. [2014] mainly deals with Büchi condition (and this part is correct) and argues that this case is enough to handle the general case of ω-regular conditions as they can be expressed as a Boolean combination of Büchi conditions. We indicated that one could simply follow the same lines as in the proof of a previous statement, namely Proposition 6. However, in Proposition 6, we were considering measurability of sets of accepting *branches* (and in this case, we can rely on the fact that parity conditions are Boolean combination of Büchi conditions to conclude from the measurability of the set of branches for the latter), whereas Proposition 38 is about sets of *runs* (and in general, one cannot express the set of accepting runs as a Boolean combination of sets of accepting runs for Büchi conditions).

Hence, for this reason, one should correct Proposition 38 to be as follows.

PROPOSITION 39. *For all probabilistic tree automata $\mathcal{A}$ with a Büchi acceptance condition, the set* AccRuns($\mathcal{A}$) *is measurable.*

For all probabilistic tree automata $\mathcal{A}$ with a ω-regular acceptance condition, the set QualAccRuns($\mathcal{A}$) *is measurable.*

In fact, as noted by Weidner [2014], the set AccRuns($\mathcal{A}$) may not be measurable when $\mathcal{A}$ is equipped with a co-Büchi acceptance condition. His argument is the following. In Niwinski and Walukiewicz [2003], it was proven that there are languages of infinite trees (e.g., all trees over an alphabet {a,b} with finitely many *b* on every branch) that are not Borel while recognised by a co-Büchi automaton (in the classical sense of regular tree languages). This result implies that the co-Buchi automaton, with two states q_a and q_b (where q_b is the only forbidden state) and all possible transitions, has a non-Borel set of accepting runs, as the accepting runs are exactly those that contain finitely many q_b on every branch.

The following list presents the consequences that the weakening of Proposition 38 has on the rest of the paper. Note that it is quite minor, because the focus was mainly on the qualitative acceptance criterion (for which one has several positive results), which somehow appears even more legitimate now as a robust definition for probabilistic tree automata (because it makes sense for *any* ω-regular condition).

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—The definition of language $L^{=1}(\mathcal{A}) = \{t \mid \mu_t(\text{AccRuns}(\mathcal{A})) = 1\}$ (in Carayol et al. [2014], p. 22, Section 4.1.3, first paragraph) is robust only when $\mathcal{A}$ is equipped with a Büchi condition (it might be correct, however, for some co-Büchi automata, but not for all of them, as explained earlier).

—In Theorem 48 (in Carayol et al. [2014], p. 26), we state in item (1) that the following problem is undecidable: given a probabilistic co-Büchi tree automaton $\mathcal{A}$, decide if $L^{=1}(\mathcal{A}) = \emptyset$. As one can object that in general $L^{=1}(\mathcal{A})$ is not well defined, one may wonder whether the co-Büchi automaton used to prove undecidability in Theorem 48 is such that AccRuns($\mathcal{A}$) is measurable (hence, $L^{=1}(\mathcal{A})$ is well defined in that case). One can easily check that it is the case (the automaton $\mathcal{A}$ that is used essentially simulates an automaton on infinite words on the left-most branch of its input tree while accepting trivially all other branches), and therefore the statement is still valid (one should simply understand that undecidability is meant here when the object $L^{=1}(\mathcal{A})$ is well defined). The same holds for Table I, which recaps on page 31 the decidability status of the emptiness problem for the different types of probabilistic semantics.

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REFERENCES

A. Carayol, A. Haddad, and O. Serre. 2014. Randomization in automata on infinite trees. *ACM Transactions on Computational Logic* 15, 3.

D. Niwinski and I. Walukiewicz. 2003. A gap property of deterministic tree languages. *Theoretical Computer Science* 1, 303, 215–231.

T. Weidner. 2014. Private communication.

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