

## GandALF — Exercise Sheet 6

**Exercise 1.** Prove that NPT are closed under intersection.

**Exercise 2.** Is the language of  $\{0,1\}$ -labelled trees that have exactly one node labelled by 1 recognizable by a NPT?

**Exercise 3.** Is the language of  $\{0,1\}$ -labelled trees that have exactly one path starting from the root labelled by only 1s recognizable by a NPT?

**Exercise 4.** Is the language of  $\{0,1\}$ -labelled trees such that every subtree contains a node labelled by 0 recognizable by a NPT?

**Exercise 5.** Is the following statement true? For every LTL formula  $\varphi$  there is an NPT  $A$  such that  $A$  recognizes a tree  $t$  iff every path of this tree satisfies  $\varphi$ .

We defined tree automata on ordered binary trees. The following open-ended exercises are to encourage you to think about possible solutions to the cases of different kind of trees.

In each case, discuss whether the basic properties of the automata: closure under union and intersection, determination etc.

**Exercise 6.** Propose an automaton type for unordered (full) binary trees.

**Exercise 7.** Propose an automaton type for ordered binary trees that are not necessary full, i.e., where a node can have 0, 1 or 2 children.

**Exercise 8.** Propose an automaton type for ordered unranked (i.e., every node can have arbitrary many children) trees.

**Exercise 9.** Propose an automaton type for unordered unranked trees.